SPEECH, PHONOLOGICAL AWARENESS AND LITERACY IN NEW ZEALAND CHILDREN WITH DOWN SYNDROME

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The material presented in this thesis is the original work of the candidate except as acknowledged in the text, and has not been previously submitted, either in part or in whole, for a degree at this or any other University.

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ABSTRACT

Children with Down syndrome (DS) are reported to experience difficulty with spoken and written language which can persist through the lifespan. However, little is known about the spoken and written language profiles of children with DS in the New Zealand social and education environment, and a thorough investigation of these profiles has yet to be conducted. The few controlled interventions to remediate language deficits in children with DS that are reported in the literature typically focus on remediation of a single language domain, with the effectiveness of interventions which integrate spoken and written language goals yet to be explored for this population. The experiments reported in this thesis aim to address these areas of need. The following questions are asked 1) What are the phonological awareness, speech, language and literacy skills of New Zealand children with DS? 2) What are the home and school literacy environments of New Zealand children with DS and how do they support written language development? and 3) What are the immediate and longer term effects of an integrated phonological awareness intervention on enhancing aspects of spoken and written language development in young children with DS? These questions will be addressed through the following chapters.

The first experiment (presented in Chapter 2) was conducted in two parts. Part 1 consisted of the screening of the early developing phonological awareness, letter knowledge, and decoding skills of 77 primary school children with DS and revealed considerable variability between participants on all measures. Although some children were able to demonstrate mastery of the phoneme identity and letter knowledge skills, floor effects were also apparent. Data were analysed by age group (5 - 8 years and 9 - 14 years) which revealed increased performance with maturation, with older children

outperforming their younger peers on all measures. Approximately one quarter of all children were unable to decode any words, 6.6% demonstrated decoding skills at a level expected for 7 - 8 year old children and one child demonstrated decoding skills at an age equivalent level. Significant relationships between decoding skills and letter knowledge were found to exist. In Part 2 of the experiment, 27 children with DS who participated in the screening study took part in an in-depth investigation into their speech, phonological awareness, reading accuracy and comprehension and narrative language skills. Results of the speech assessments revealed the participants' speech was qualitatively and quantitatively similar to the speech of younger children with typical development, but that elements of disorder were also evident. Results of the phonological awareness measures indicated participants were more successful with blending than with segmentation at both sentence and syllable level. Rhyme generation scores were particularly low. Reading accuracy scores were in advance of reading comprehension, with strong relationships demonstrated between reading accuracy and phonological awareness and letter knowledge. Those children who were better readers also had better language skills, producing longer sentences and using a greater number of different words in their narratives. The production of more advanced narrative structures was restricted to better readers.

In the second experiment (presented in Chapter 3), the home literacy environment of 85 primary school aged children with DS was investigated. Parents of participants completed a questionnaire which explored the frequency and duration of literacy interactions, other ways parents support and facilitate literacy, parents' priorities for their children at school, and the child's literacy skills. Results revealed that the homes of participants were generally rich in literacy resources, and that parents and children read together regularly, although many children were reported to take a passive role duding joint story reading. Many parents also reported actively teaching their child letter names and sounds and encouraging literacy development in other ways such as language games, computer use, television viewing and library access. Writing at home was much less frequent than reading, and the allocation of written homework was much less common than reading homework.

In the third experiment (presented in Chapter 4), the school literacy environment of 87 primary school aged children with DS (identified in the second experiment) was explored. In a parallel survey to the one described in Chapter 3, the teachers of participants completed a questionnaire which explored the frequency and duration of literacy interactions, the role of the child during literacy interactions, the child's literacy skills, and other ways literacy is supported. The results of the questionnaire revealed nearly all children took part in regular reading instruction in the classroom although the amount of time reportedly dedicated to reading instruction was extremely variable amongst respondents. The average amount of time spent on reading instruction was consistent with that reported nationally and in advance of the international average for Year 5 children. Reading instruction was typically given in small groups or in a one on one setting and included both 'top-down' and bottom up' strategies. Children were more likely to be assigned reading homework compared to written homework, with writing activities and instruction reported to be particularly challenging.

In the fourth experiment (reported in Chapter 5), the effectiveness of an experimental integrated phonological awareness intervention was evaluated for ten children with DS, who ranged in age from 4;04 to 5;05 (M = 4;11, SD = 4.08 months). The study employed a multiple single-subject design to evaluate the effect of the intervention on participants' trained and untrained speech measures, and examined the development of letter knowledge and phonological awareness skills. The 18 week intervention included the following three components; 1. parent implemented print referencing during joint story reading, 2. speech goals integrated with letter knowledge and phoneme awareness activities conducted by the speech-language therapist (SLT) in a play based format, and 3. letter knowledge and phoneme awareness activities conducted by the computer specialist (CS) adapted for presentation on a computer. The intervention was implemented by the SLT and CS at an early intervention centre during two 20 minute sessions per week, in two 6 week therapy blocks separated by a 6 week break (i.e. 8 hours total). The parents implemented the print referencing component in four 10 minute sessions per week across the 18 week intervention period (approximately 12 hours total). Results of the intervention revealed all ten children made statistically significant gains on their trained and untrained speech targets with some children demonstrating transfer to other phonemes in the same sound class. Six children demonstrated gains in letter knowledge and nine children achieved higher scores on phonological awareness measures at post-intervention, however all phonological awareness scores were below chance. The findings demonstrated that dedicating some intervention time to facilitating the participants' letter knowledge and phonological awareness was not at the expense of speech gains.

The fifth experiment (presented in Chapter 6) comprises a re-evaluation of the speech, phonological awareness, and letter knowledge, and an evaluation of the decoding and spelling development in children with DS who had previously participated in an integrated phonological awareness intervention (see Chapter 5), after they had subsequently received two terms (approximately 20 weeks) of formal schooling. Speech accuracy was higher at follow-up than at post-intervention on standardised speech measures and individual speech targets for the group as a whole, with eight of the ten participants demonstrating increased scores on their individual speech targets. Group scores on both letter knowledge measures were higher at follow-up than at post-intervention, with nine participants maintaining or improving on post-intervention performance. The majority of participants exhibited higher phonological awareness scores at follow-up on both the phoneme level assessments, with above chance scores achieved by five participants on one of the tasks, however, scores on the rhyme matching task demonstrated no evidence of growth. Some transfer of phonological awareness and letter knowledge was evident, with five children able to decode some words on the single word reading test and three children able to represent phonemes correctly in the experimental spelling task. The emergence of these early literacy skills highlighted the need for ongoing monitoring of children's ability to transfer their improved phonological awareness and letter knowledge to decoding and spelling performance.

In the sixth experiment (presented in Chapter 7) the long term effects of the integrated phonological awareness intervention was evaluated for one boy with DS aged 5;2 at the start of the intervention. The study monitored Ben's speech and literacy development up to the age of 8;0 (34 months post pre-school intervention) which included two years of formal schooling. Ben demonstrated sustained growth on all measures with evidence of a growing ability to transfer letter-sound knowledge and phoneme-grapheme correspondences to the reading and spelling process. The results indicated an intervention which is provided early and which simultaneously targets speech, letter knowledge and phonological awareness goals provides a promising alternative to conventional therapy, and that integrating spoken and written therapy goals for children with DS can be effective in facilitating development in both domains.

This thesis provides evidence that the spoken and written language abilities of New Zealand children with DS exhibit a pattern of delay and disorder that is largely consistent with those of children with DS from other countries reported in the literature. The home and school literacy environments of children in New Zealand with DS are rich in literacy resources and are, for the most part, supportive of their literacy development. The immediate and longer term results of the integrated phonological awareness intervention suggest that it is possible to achieve significant and sustained gains in speech, letter knowledge and phonological awareness which may contribute to the remediation of the persistent and compromised spoken and written language profile characteristic of individuals with DS.

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CHAPTER 1

LITERATURE REVIEW

1.1 Introduction

Individuals with Down syndrome (DS) experience difficulty with both spoken and written language acquisition. They demonstrate poorer verbal skills compared to non-verbal skills and perform more poorly on language measures and speech production measures than mental age-matched peers with other cognitive impairments (e.g. Abbeduto et al., 2001; Dodd, 1976; Roberts et al., 2007), leading to the conclusion that individuals with DS present with speech and language impairment in addition to cognitive impairment. Children with concurrent speech and language impairment are known to be at high risk for reading difficulties (e.g. Catts, Fey, Zhang, & Tomblin, 2001) which suggests that written language development in children with DS may be particularly comprised. Controlled intervention studies to improve spoken or written language development in children with DS are rare and have typically focused on improving only one language domain such as improving speech intelligibility, or improving visual word recognition or phonological awareness.

This thesis reports the spoken and written language profiles of New Zealand children with DS and the influences of the home and school environment on these profiles. The thesis also examines the speech and early literacy development of 10 children with DS and investigates their responsiveness to an intervention designed to simultaneously enhance speech, phonological awareness and early literacy development.

1.2 Spoken and written language profiles of children with Down syndrome

Down syndrome is the most common genetic cause of cognitive impairment and is reported to occur in between 1 in 600 and 1 in 1000 live births (Crane & Morris, 2006; Roizen & Patterson, 2003; Sherman, Allen, Bean, & Freeman, 2007; Stone, 2005; Weijerman et al., 2008). Although there are no New Zealand national prevalence data for DS births, Stone (2005) reported a stable yearly prevalence data of 1.17 per 1000 births between 1997 and 2003. From these data it can be estimated that 65-70 children with DS are born in New Zealand annually.

Cognitive impairment is a feature of DS, but a particular level of intelligence quotient (IQ) can not be uniquely associated with this population and IQs ranging from 30 and 90 have been reported (Chapman, 2003). However, the presence of the syndrome has been described by Pennington and colleagues as exerting "a powerful downward main effect on the IQ distribution" (Pennington, Moon, Edgin, Stedron, & Nadel, 2003, p. 77). Additionally, the trajectory of IQ change is one of decline (Hodapp & Zigler, 1990) which is apparent from a young age, and a greater and earlier decline is associated with aging in this population than is observed in individuals with typical development. Negative changes are also apparent on measures of language and short term memory with declines in these already impaired systems (Abbeduto et al., 2001; Dodd, 1976; Roberts et al., 2007) further contributing to the observed decline in IQ (Pennington et al., 2003).

Individuals with DS experience difficulty with written language acquisition. As well as considerable variability in reading levels in individuals with DS (Groen, Laws, Nation, & Bishop, 2006; Sloper, Cunningham, Turner, & Knussen, 1990), researchers report atypical and uneven reading profiles including better reading accuracy than reading comprehension (A. Byrne, MacDonald, & Buckley, 2002; Fletcher & Buckley, 2002; Groen et al., 2006). Individuals with DS also demonstrate poorer verbal skills compared to non-verbal skills with expressive language typically more affected than receptive, and vocabulary and morphology reported to be particularly compromised (Eadie, Fey, Douglas, & Parsons, 2002; Laws & Bishop, 2003; Miller, 1995). Additionally, individuals with DS perform more poorly on speech and language measures than peers with typical development and those with other cognitive impairments matched for mental age (Abbeduto et al., 2001; Dodd, 1976; Dodd, McCormack, & Woodyatt, 1994; Laws & Bishop, 2003; Parsons & Iacono, 1992; Roberts et al., 2007), with early word production and phonological development substantially delayed and highly variable.

Poor speech intelligibility is common amongst individuals with DS. Difficulties with intelligibility are apparent from early speech production and remain unresolved for many individuals with DS, presenting as a persistent difficulty through adolescence and adulthood. Additionally, speech intelligibility is poorer in individuals with DS than mental age-matched peers (Dodd, 1972; Kumin, 1994). These findings lead to the conclusion that individuals with DS present with speech and language impairment in addition to cognitive impairment.

The following section describes the speech and language profile of individuals with DS. A discussion on interventions to remediate spoken language deficits characteristic of this population is presented in section 1.6.

1.3 Speech profiles

1.3.1 Phonological development - speech sound acquisition

Although early vocalisations and babble appear similar to those produced by their peers with typical development (Dodd, 1972; Smith & Stoel-Gammon, 1996), phonological development and early word production are substantially delayed in children with DS (Miller & Leddy, 1998; Smith & Stoel-Gammon, 1983). Dodd (1972) compared the babbling patterns of infants with DS and age-matched infants with typical development and reported no significant differences on measures of utterance type, frequency or length. Based on the similarity of babbling patterns between the two groups, irrespective of differences in measures of intellectual and psychomotor development, Dodd (1972) proposed a lack of connection between babble and intelligence at this age and hypothesised a minimal role for babble in the development of the articulatory movements required for speech.

Smith and Stoel-Gammon (1996) reported that the patterns of babble demonstrated by the nine infants in their study were qualitatively similar to those reported for typically developing children. Babble and early speech are phonetically and syllabically similar, and greater and more variable canonical babble is associated with superior early language skills (Stoel-Gammon, 1998a). Stoel-Gammon (1998a) suggested this advantage may result from the increased linguistic opportunities a wider phonetic repertoire provides. In a longitudinal study investigating phoneme acquisition and emergence, Kumin, Councill, and Goodman (1994) examined speech samples from 60 children with DS aged from 9 months to 9 years and reported that for most of the children the majority of phonemes emerged in their speech between the ages of 12 and 59 months. However, the authors also reported considerable variability amongst children, with the emergence of specific phonemes spanning a seven year age range and not consistent with the typical order of emergence. Variability between children was also a feature of the phonetic inventories of children in Bleile and Schwarz's (1984) study. The authors described the phonologies of three children with DS aged between 3;04 and 4;06 and reported no unusual phonemes present. Smith and Stoel-Gammon (1983) compared the development of stop consonants in children with DS and younger children with typical development. The results of the longitudinal study showed the children with DS evidenced an increasing delay in their phonological development, with speech that was qualitatively similar to that of the younger children. As in typical development (Schwartz & Leonard, 1982), researchers report phonological preferences in the vocalisations of young children with DS (Iacono, 1998; Stoel-Gammon, 1998b).

<u>Phonological development-phonological patterns and processes</u>

The speech of children with DS is reported to contain the same type of error patterns and to be qualitatively similar to that of younger children with typical development (Bleile & Schwarz, 1984; Parsons & Iacono, 1992; Smith & Stoel-Gammon, 1983; Van Borsel, 1988, 1996). However, the slower development of speech in individuals with DS, results in a widening gap between their speech and the speech of children with typical development across time. Bleile and Schwarz (1984) reported the syllable errors of final consonant deletion and cluster reduction and the substitution process of stopping were predominant in the speech of all three children in their study. Iacono (1998) analysed the phonological skills of five children with DS aged 5;0 to 6;07 and reported similar results, with the error patterns of final consonant deletion, cluster reduction, liquid/glide simplification and devoicing errors present in the single word speech samples of all the children. These speech error patterns include both earlier and later resolving processes (Grunwell, 1982) and are amongst those reported by Hodson and Paden (1991) as evident in the speech of children with typical phonological development aged less than 2;06 and in the speech of highly unintelligible 4 year old children.

Parsons and Iacono (1992) investigated phonological abilities of 30 children with DS who ranged in age from 6;09 to 18;08. While the type of phonological error patterns they used were similar to those seen in the speech of younger children with typical development, many of the children with DS used multiple phonological processes which would drastically reduce their intelligibility. The authors suggested differences in error patterns reported across studies of children with DS may reflect the different sample sizes and ages of the participants and the different criteria by which the phonological errors were described.

As well as delay, researchers report characteristics of disorder, including non-developmental errors (Dodd et al., 1994), inconsistency (Dodd & Thompson, 2001), and high rates of dysfluency (Devenny, Silverman, Balgley, Wall, & Sidtis, 1990; Devenny & Silverman, 1990; Van Borsel & Tetnowski, 2007) in the speech of individuals with DS. In a comparative analysis of phonological error patterns in the speech of children with DS and mental aged-matched peers with typical development and with cognitive impairment, Dodd (1976) found that not only did the children with DS make more errors than their mental aged-matched peers, these were more inconsistent and included significantly more error types and more random errors. However, Parsons and Iacono (1992) argued the atypical error patterns or phonetic errors (such as distortions) produced by some children in their study should not be considered characteristic of the speech of individuals with DS as these are also seen in the speech of individuals with phonological impairment (Hodson & Paden, 1991).

In describing speech errors and error patterns the terms inconsistency and variability are often used synonymously. However, Holm, Crosbie, and Dodd (2007) make an important distinction between the two. The authors defined variability as differences in repetitions accountable for by natural contexts such as maturation or linguistic demands, and defined inconsistent speech on the other hand, as being characterised by unpredictable multiple error types across repetitions which may affect both sounds and structure of the target word. Williams and Stackhouse (2000) investigated a number of speech parameters in young children and reported increasing consistency with age across children aged 3 to 5, with the youngest children still on average 84.5% consistent. These findings are in line with those of Holm et al. (2007) who investigated the consistency of speech production of children with typical development aged between 3 and 7. Holm et al. reported that although younger children were slightly more inconsistent, their speech was still less than 13% inconsistent, with much of the variation demonstrative of a shift towards a more mature production. The findings confirmed that inconsistency is not a feature of typically developing speech but rather is a sign of speech disorder (Dodd, Holm, Crosbie, & McCormack, 2005; Grunwell, 1982).

Inconsistent speech production including that evident in DS speech may result from impaired ability to plan and execute the required articulatory movements (Dodd et al., 2005; Dodd & McCormack, 1995; Dodd et al., 1994). Although not all investigations into speech sound development and phonology in DS have distinguished between the two elicitation methods (Iacono, 1998; Parsons & Iacono, 1992), superior word imitation skills compared to spontaneous word production skills in individuals with DS provides evidence to support this explanation for inconsistent speech production in DS (Dodd, 1976). Griffiths and Stackhouse (2002) suggested poorly specified phonological representations may influence the accuracy of phonological assembly. Recent evidence suggests achieving a precise phonological representation of a word is particularly demanding for children with DS (Jarrold, Thorn, & Stephens, 2009).

Improving explicit awareness of the underlying representation of a spoken word and a child's ability to consciously access this representation through phoneme awareness tasks (such as identifying the initial sound in a word or segmenting a word into phonemes), may improve the child's speech production of the target word (Gillon, 2004). Intervention to improve phonological awareness in children with DS has been the focus of a number of recent studies. Reported findings included improvement in reading skills, alphabet knowledge, and phonological awareness (Cupples & Iacono, 2002; Goetz et al., 2008; van Bysterveldt, Gillon, & Moran, 2006) however the effects of the interventions on speech production were not examined. (For a discussion on phonological awareness intervention in individuals with DS, see section 1.6).

Intelligibility

Speech intelligibility is a frequent problem for children with DS that is apparent from early speech production (Dodd, 1972; Smith & Stoel-Gammon, 1996) and can persist into adolescence and adulthood (Kumin, 1994; Miller & Leddy, 1999; Roberts, Stoel-Gammon, & Barnes, 2008). Speech intelligibility is poorer in individuals with DS than would be predicted by mental age (Roberts et al., 2005) and difficulty being understood is reported to affect the majority of individuals with DS (Kumin, 1994).

Intelligibility refers to the degree to which a person's speech can be understood and is typically calculated as a percentage of words (or utterances) understood by the listener (Gordon-Brannan & Hodson, 2000). Measures of an individual's phonology may be analysed to yield a percentage consonants correct score (PCC) (Shriberg & Kwiatkowski, 1982) either manually or using a computer programme such as Computerised Profiling (PROPH, Long & Fey, 2005). Intelligibility and phonology are linked, with measures of phonological deviation and subjective intelligibility ratings reported to be highly correlated (r = -0.75) (Gordon-Brannan & Hodson, 2000). Hodson and Paden (1981) reported the speech of children with speech disorder described as "essentially unintelligible" (p 369) contained a significantly higher percentage of phonological processes than that of children with typically developing intelligible speech. Additionally, qualitative analysis revealed group differences in the types of phonological processes used, with greater numbers of processes including idiosyncratic and unusual processes evident in the speech of the children who were unintelligible. Shriberg, Kwiatkowski, Best, Hengst, and Terselic-Weber (1986) investigated the speech production abilities of children with speech disorders and reported 18% percent of intelligibility was predicted by children's PCC scores.

Klein and Flint (2006) sought to quantify the relative impact on connected speech intelligibility of the three early resolving phonological processes (Grunwell, 1982) of final consonant deletion, stopping of fricatives and affricates and fronting of velars. Listeners were read live a series of passages in which one of the error patterns was present for every opportunity of that pattern. The researchers reported final consonant deletion had the most impact on intelligibility and fronting of velars the least impact even when frequency of occurrence was controlled for. Fewer differences were apparent at low level of occurrence, however when the error pattern occurred at high frequency levels (50% of syllables) no differences were apparent, possibly because intelligibility was maximally affected. It is important to note that only one error pattern was presented at a time. However, a number of error patterns are typically present in the speech of young children (Bernthal & Bankson, 2004; Hodson & Paden, 1991). Intelligibility is also severely impacted by the presence of non-developmental patterns and the use of multiple error patterns (Hodson, 2007b; Parsons & Iacono, 1992).

Factors other than phonological accuracy are also known to influence how well a speaker is understood including but not limited to the lexical and phonological neighbourhood, supra-segmental influences, voice quality, linguistic including semantic and syntactic demands, and the familiarity of the listener (Bernthal & Bankson, 2004; Connolly, 1986; Shriberg & Kwiatkowski, 1982; Weston & Shriberg, 1992). Thus although many factors contribute to the intelligibility of an individual's speech both at the single word level and in connected speech, remediating phonological error patterns is likely to have a positive affect on an individual's ability to be understood.

Other factors impacting speech development

The potential impact of other factors on speech has also been investigated in individuals with DS, including hearing impairment, short term memory deficits, poorly specified phonological representations, low muscle tone and motor planning deficits (Dodd & Crosbie, 2005; Jarrold, Baddeley, & Hewes, 1999, 2000; Kumin, 2006; Leddy, 1999; McPherson, Lai, Leung, & Ng, 2007; Miller & Leddy, 1999). An examination of the physical and physiological deficits on speech in DS is beyond the scope of this study.

Hearing impairment in individuals with DS is widely documented, with loss reported to affect up to 96% of individuals (Driscoll, Kei, Bates, & McPherson, 2003; Hassmann, Skotnicka, Midro, & Musiatowicz, 1998; Roizen, Wolters, Nicol, & Blondis, 1993) and researchers recommend an aggressive approach to treatment of otitis media in this population (Shott, Joseph, & Heithaus, 2001).

1.3.2 Section Summary

The speech of individuals with DS has been reported to include elements of both delay and disorder including slower, more variable development, the presence of more random errors and idiosyncratic error patterns and multiple error pattern usage (Bleile & Schwarz, 1984; Hodson, 2007b; Miller & Leddy, 1998; Parsons & Iacono, 1992; Smith & Stoel-Gammon, 1983; Van Borsel, 1988, 1996). Additionally individuals with DS experience difficulty with speech intelligibility which can persist throughout the lifespan (Kumin, 1994; Miller & Leddy, 1999; Roberts, Stoel-Gammon et al., 2008).

1.3.3 Spoken Language profiles

Individuals with DS have been shown to have poorer language than non-verbal and other cognitive abilities and perform more poorly on language measures than do mental age-matched peers with typical development and with other cognitive impairments (Abbeduto et al., 2001; Keller-Bell & Abbeduto, 2007; Laws & Bishop, 2003; Roberts et al., 2007). Expressive language is typically more affected than receptive language with expressive vocabulary and morphology reported to be particularly compromised (Eadie et al., 2002; Laws & Bishop, 2003; Miller, 1995).

Expressive language

Chapman, Seung, Schwartz, and Kay-Raining Bird (1998) investigated the expressive language of 47 children and adolescents with DS and compared their language to the language of a control group of 47 children with typical development matched for non-verbal mental age. They concluded that compared to the control children, the children with DS presented with a specific language impairment. Chapman et al. grouped their participants with DS into four age groups to investigate change in expressive language associated with age. The younger two groups in the study are of a comparable age to the children in the current study described in Chapter 2. Using language samples elicited using a narrative task, the researchers reported an increase in the mean Mean Length of Utterance (MLU) in morphemes of children with DS with an increase in age. Mean MLU for children aged 5;7 – 8;5 was 2.00 (SD = 0.68, range 1.20-3.3) and for children aged 8.6 – 12.1 was 2.4 (SD = 0.83, range 1.5- 4).

Complex language use by the older participants in the Chapman et al. (1998) study was further explored by Thordadottir, Chapman, and Wagner (2002), who reported both continued growth in MLU and in syntactic complexity in the narratives produced by individuals with DS. Additionally their syntactic complexity was in keeping with their MLU and was not significantly different qualitatively or quantitatively from that produced by children with typical development matched for MLU.

These findings are in contrast to those of Fowler (1990), who hypothesised the apparent plateau she observed in the MLU in the speech of adolescent children with DS in her study was evidence of either a critical period for learning language, or the existence of a syntactic ceiling. Differences between Fowler's (1990) findings and those of Chapman et al. (1998) and Thordadottir et al. (2002) may be partially explained by the different elicitation tasks, with narrative language reported to be more complex than conversational language (Chapman et al., 1998).

Comparison between expressive language in Down syndrome and Specific Language Impairment

Researchers comparing language profiles of children with DS with those of children with specific language impairment (SLI) who also present with poorer language than non-verbal abilities (Chapman et al., 1998; Chapman, Schwartz, & Kay-Raining Bird, 1991; Laws & Bishop, 2004), report a number of similarities. In a study of 16 Italian speaking children with DS (aged 6;07 -14;02), 16 with SLI (aged 3;05 – 5;07), and 32 with typical development (aged 3;08-5;07) who were matched for mental age, Caselli, Monaco, Transciani, and Vicari (2008) reported no significant differences between the DS and SLI group on vocabulary and morphosyntactic comprehension measures.

Laws and Bishop (2003) investigated the language profiles of 19 children with DS (aged 10-19), 19 children with SLI (aged 4-7) and 19 children with typical development (aged 4-7). The groups were matched for mental age and their language profiles were compared. Both the DS and SLI groups exhibited difficulties with both receptive and expressive morphosyntax, expressive language was poorer than receptive and both groups performed poorly on real and non-word repetition tasks.

Narrative

Narrative language skills are related to literacy skills, with competency in narrative production supportive of early literacy (Cain & Oakhill, 1996; Griffin, Hemphill, Camp, & Palmer Wolf, 2004). Moreover, children with poor reading comprehension produce less well structured quality narratives than their chronological or comprehension age-matched peers with typical development (Cain, 2003) (Westerveld & Gillon, 2008; Westerveld, Gillon, & Moran, 2008). Narrative can be analysed at both macrostructure and microstructure levels (Hughes, MacGillivray, & Schmidek, 1997). Macrostructure refers to the organisational aspects of the narrative including its structure and content (e.g. high point analysis (McCabe & Rollins, 1994)). Microstructure analysis includes measures of grammatical and semantic complexity typically expressed by Mean Length of Utterance (MLU), number of different words, total number of words, and measures of grammatical accuracy.

Narrative skills in children with DS have typically been elicited using a fictional story-retell task following a book reading, a story-tell using a wordless picture book or via a story description task (Kay-Raining Bird, Cleave, White, Pike, & Helmkay, 2008; Keller-Bell & Abbeduto, 2007; Miles & Chapman, 2002) with picture support associated with increased MLU in narratives produced by individuals with DS (Miles, Chapman, & Sindberg, 2006). Chapman and colleagues (Chapman et al., 1998; Chapman, Seung, Schwartz, & Kay-Raining Bird, 2000) assessed children's narrative by analysing a narrative free speech sample gathered using a variety of methods with and without visual prompts including recall of events, and personal photos (in addition to picture description and story completion tasks).

Personal narrative is a recount of a past experience or event and has been described as one of the earliest developing forms of narrative in children with typical development (Preece, 1987). Children as young as 2 are able to produce some sequential retell of events (Engel, 1995) with the ability to tell classic narratives as determined by high point analysis evident in children aged 6 (Peterson & McCabe, 1983), however personal narrative development in children with DS has yet to be explored. The Achievement Objectives for Levels 1 and 2 of the New Zealand English Curriculum oral language strand state "children should be able to converse, ask questions, and talk about events and personal experiences in a group" (Ministry of Education, 1994 p 60). Thus these skills are deemed appropriate for children to acquire from school entry. Milosky (1987) discussed the important role of narratives in the classroom for social interaction, for the demonstration of skills and as contributors to the acquisition of literacy.

Narrative Production

Kay-Raining Bird et al. (2008) investigated oral and written narrative abilities of 20 children and adolescents with DS aged between 8;6 and 19;10. The researchers compared the narratives of participants with DS on measures of macro and microstructure as well as spelling and punctuation, with those from 17 children with typical development aged 4;9 to 10;9 matched for decoding abilities. The children and adolescents with DS exhibited higher decoding scores relative to mental age than the children with typical development, who thus presented with higher mental age and with higher receptive vocabulary. Both groups produced significantly longer and more complex oral compared to written narratives, however the researchers reported few between-group differences on either macro or microstructure analysis. These findings suggest that overall, oral narrative skill development is in step with decoding skills in children with DS. Despite variability within the DS group, narrative abilities were best predicted by vocabulary comprehension, in contrast to the children with typical development for whom chronological age was the best predictor of narrative abilities. Boudreau and Chapman (2000) hypothesised that the difficulties with producing oral narratives experienced by children with DS may be attributable to their expressive language difficulties rather than their inability to mentally represent the event.

Miles and Chapman (2002) compared the narratives produced by participants with DS aged 12- 26 years to those produced by three groups of typically developing children matched for mental age, syntactic comprehension and MLU respectively. These three control groups exemplified the divergent language profiles associated with DS compared to the language profiles of children with typical development. Macrostructure analysis revealed narratives produced by participants with DS were most comparable to those produced by the group matched for syntactic comprehension. At a microstructure level, although individuals with DS produced more utterances than the MLU-matched control group, the groups did not differ on measures of total number of words, or number of different words. Thus the authors concluded, consistent with the findings of Boudreau and Chapman (2000), the narratives of individuals with DS were more advanced in content than in form, and demonstrative of additional expressive language difficulties.

Other researchers confirm the finding of additional expressive language difficulties including the omission of grammatical words (Fabbretti, Pizzuto, Vicari, & Volterra, 1997), incorrect pronoun use (Lorusso et al., 2007), and lower grammatical accuracy (Keller-Bell & Abbeduto, 2007), in narratives produced by individuals with DS.

Receptive Language

Receptive vocabulary is reported to be a relative strength in individuals with DS. Some research findings suggest vocabulary comprehension is commensurate with or in advance of mental age in children and adolescents with DS (Chapman et al., 1991; Kay Raining-Bird, Cleave, White, Pike, & Helmkay, 2008; Miller, 1995), however discrepancies between vocabulary comprehension and mental age are also reported for this population (Hick, Botting, & Conti-Ramsden, 2005; Roberts et al., 2007). Roberts, Chapman, Martin, and Moskowitz (2008) suggested the different findings in the reported similarities between vocabulary comprehension and mental age measures may be attributed to differences in individual's age and in the assessment measures used. Better vocabulary comprehension has been associated with better narrative skills (Kay Raining-Bird et al., 2008) and better receptive vocabulary and non-word and sentence repetition have also been associated with lower hearing thresholds (Laws & Gunn, 2002).

An exception to the receptive language advantage in the language profile of individuals with DS is the comprehension of grammar, which has been shown to be an area of relative weakness (A. Byrne, Buckley, MacDonald, & Bird, 1995; Chapman et al., 2000; Laws & Bishop, 2003; Price, Roberts, Vendergrift, & Martin, 2007; Ypsilanti, Grouios, Alevriadou, & Tsapkini, 2005), and has been associated with variation on measures of expressive language.

Narrative comprehension

Kim, Kendeou, van den Broek, White, and Kremer (2008) investigated narrative comprehension in children with DS aged 6 and 7 years. The participants' ability to recall events from two narratives (one presented as a TV excerpt and one via audiotape) was assessed. Additionally the relationships between participants' narrative comprehension abilities and other language abilities were investigated. Kim et al., reported participants were able to recall more of the events which were highly connected than those with fewer connections under both media conditions. Weak to moderate non-significant relationships between participants' comprehension ability and measures of receptive vocabulary, phonological awareness and decoding were also reported, leading the researchers to the hypothesis that narrative comprehension skills were relatively independent of participants' receptive vocabulary, or of literacy measures of phonological awareness or decoding.

1.3.4 Section Summary

In addition to cognitive impairment, individuals with DS are reported to have a specific language impairment (Chapman et al., 1998), producing language that is similar in profile to the language of children with SLI (Caselli et al., 2008; Chapman et al., 1998; Chapman et al., 1991; Laws & Bishop, 2004). The language profile of individuals with DS is characterised by poorer verbal than non-verbal abilities (Abbeduto et al., 2001; Keller-Bell & Abbeduto, 2007; Laws & Bishop, 2003; Roberts et al., 2007) and poorer expressive than receptive language (Eadie et al., 2002; Laws & Bishop, 2003; Miller, 1995), however both expressive and receptive syntax are relatively more affected than other language domains (A. Byrne et al., 1995; Chapman et al., 2000; Laws & Bishop, 2003; Price et al., 2007; Ypsilanti et al., 2005). The narratives produced by individuals are more impaired in form than content (Boudreau & Chapman, 2000), and are characterised by grammatical errors and omissions (Fabbretti et al., 1997; Keller-Bell & Abbeduto, 2007; Lorusso et al., 2007).

1.3.5 Written Language Profiles

Literacy is an essential skill that is critical for academic and social success for individuals in the 21st century. The literature around literacy development in DS has emerged over the last forty years in conjunction with a growing understanding of the etiology of DS. These advances, as well as a move away from institutionalisation to home-rearing and the implementation of early intervention programmes, have resulted in the recognition that reading acquisition is a valid goal for individuals with DS. There is a growing body of research reporting reading achievement and reading instruction methodologies for this population, however the contributions of other factors to reading acquisition and development in individuals with DS remain less well investigated and understood. Contributing to this under-investigation is the relatively low numbers of individuals with DS in a population and the wide variation in its presentation, hence research findings are limited by small and heterogeneous population samples.

Reading achievement

Groen et al. (2006) reviewed ten studies that reported reading ages in individuals with DS as determined by standardised tests of word recognition, and included their case study data. Reading ages from the ten studies ranged from 80 to 99 months with a reading age of 102 months reported from the Groen et al. (2006) case study. Other research findings also demonstrate considerable variability in reading levels in individuals with DS (Cardoso-Martins, Peterson, Olson, & Pennington, 2008; Groen et al., 2006; Sloper et al., 1990).

Supporting Buckley's (1985) position that reading may be an "island of ability" (p324) for children with DS, Carr (1995) reported children with DS may display a reading age in advance of what would be predicted based on their mental age. Carr reported reading scores for 31 individuals with DS assessed at age 21 years, which showed over 80% of the sample demonstrated higher scores on reading measures than mental age would predict. In a study which included 24 children with DS aged between 4;11 and 12;07 (years; months), A. Byrne, et al. (1995) reported reading abilities in advance of other cognitive abilities in individuals with DS, with participants demonstrating reading ages approximately 2 years ahead of their grammar, vocabulary and numeracy ages.

Cardoso-Martins, Peterson, Olson, and Pennington's (2008) results however, are in contrast to findings that the reading abilities of children with DS are in advance of their mental age. Using PPVT-III (Dunn & Dunn, 1997) scores as estimates of IQ, they calculated correlations between IQ and reading scores and found the correlation was not dissimilar to that found in the general population. Taking into account individual's difference from the IQ mean, Cardoso-Martins et al. (2008) calculated expected reading scores using two IQ-reading correlation values. From these results they concluded the reading performance of the individuals with DS in their study was much poorer than would be predicted from their mental age. As with different findings in the relationship between mental age and vocabulary comprehension (Roberts, Chapman et al., 2008), different relationships reported between mental age and reading may also be attributable to differences in individual's age and in the assessment measures used.

Although findings of early research suggested little relationship between reading (and number skills) and IQ (Buckley, 1985), findings from more recent studies investigating non-verbal cognitive ability and reading in DS report a significant relationship between the two. Laws and Gunn's (2002) results indicated that the most important difference between the "readers" and "non readers" in their study was non-verbal ability. Although readers also demonstrated higher scores than their non-reading peers on a number of other measures including non-word repetition and receptive language, no group differences were still apparent after hearing thresholds were taken into account. Participants were assessed on two occasions five years apart with no interaction found between group and time, suggesting that the individuals in the study who were able to read may have been those with better cognitive abilities to start with. This suggestion is consistent with the findings of other studies (Carr, 1995; Lemons, 2008; Sloper et al., 1990; Turner, Alborz, & Gayle, 2008) that indicated that cognitive measures are an important factor influencing reading and other academic successes in individuals with DS.

An exception to the finding that cognitive measures and reading are related is reported by Roch and Leverato (2008) who found no significant correlations (all $r < 0.35$) between the reading measures assessed in their study and measures of chronological aged, IQ and years of schooling for the 23 participants with DS aged 11 to 18 years. The reason for these contradictory findings is unclear. One possibility is that any relationships may have been masked by the composition of the group on the demographic measures which may include some extreme scores. As individual's scores on these measures were not reported this possibility can not be verified or discounted.

Not only do researchers report considerable variability in reading levels in individuals with DS (Groen et al., 2006; Sloper et al., 1990), there is evidence to suggest that children with DS have atypical and uneven reading profiles including better reading accuracy than reading comprehension (A. Byrne et al., 1995; A. Byrne et al., 2002; Carr, 1988; Fletcher & Buckley, 2002; Groen et al., 2006).

With reference to the applicability of the Simple View of Reading (Hoover & Gough, 1990) for children with DS, Roch and Leverato (2008) investigated the reading profile of 23 children with DS and a comparison group of children with typical development matched for reading comprehension. The Simple View of Reading describes reading ability as a product of word identification and listening comprehension. Some children with DS evidenced superior word reading accuracy, but as a group the children with DS demonstrated poorer listening comprehension than the comparison group. Interpretation of the results was consistent with the Simple View of Reading, with the reading profile of children with DS similar to the atypical profile of poor comprehenders (Cain & Oakhill, 2006) and in line with the profile of an exceptional reader with DS reported by Groen et al. (2006).

Reading development

Early research into reading for individuals with DS supported a sight word or "look say" approach, drawing on a phenotypic relative strength in visual memory (Kay-Raining Bird & Chapman, 1994; Laws, 2002) and weaknesses in auditory working memory (Jarrold, Baddeley, & Hewes, 1999; 2000; Kay-Raining Bird & Chapman, 1994) to support the appropriateness of this approach. More than 20 years ago, and in line with the research of the time, it was suggested that due to their restricted expressive language, and therefore a restricted vocabulary to draw on, learning to read “is a completely different process” (Buckley, 1985, p326) for children with DS. However, within the discussion put forward to support this view, two considerations appeared contradictory to this position; firstly the suggestion that readers can indeed access a word’s meaning directly from the orthographic form which would therefore bypass a restricted expressive vocabulary, and secondly Buckley’s recommendation that sight word vocabulary be selected from words the children can already say. At the time, the need for learning print-to-sound relationships was not seen as important for children with DS and was described as “a useful trick” (Buckley, 1985, p327) but not essential for normal reading.

Writing and spelling

The literature investigating writing and spelling ability in individuals with DS is extremely limited. A few studies have reported spelling skills commensurate with word reading skills in individuals with DS (A. Byrne et al., 2002; Cardoso-Martins et al., 2008). However, significant spelling development was only evident in the latter part of A. Byrne et al.’s (2002) three year investigation, leading the researchers to the hypothesis that spelling development was contingent on a certain level of reading skill. Cardoso-Martins et al. (2008) found that participants’ phonological recoding ability contributed to performance on both reading and spelling measures.

Kay-Raining Bird et al. (2008) analysed words glossed from the handwritten and word-processed narratives of individuals with DS and a reading age-matched control group and reported spelling accuracy was similar between the two groups. However, a decline in accuracy with increasing word length was apparent in the DS group and fine-motor skills and handwriting legibility were poorer.

1.3.6 Section Summary

Although research findings demonstrate considerable variability in reading levels in individuals with DS (Cardoso-Martins et al., 2008; Groen et al., 2006; Sloper et al., 1990), there is evidence to suggest reading age in this population is commensurate with or in advance of non-verbal ability (Buckley, 1985; Byrne et al., 1995; Carr, 1995), and that reading and non-verbal abilities are related (Carr, 1995; Laws & Gunn, 2002; Lemons, 2008; Sloper et al., 1990; Turner et al., 2008). Researchers also report relationships between reading and spelling abilities in individuals with DS (A. Byrne et al., 2002; Cardoso-Martins et al., 2008). Reading accuracy is a relative strength and is characteristically in advance of reading comprehension (A. Byrne et al., 1995; A. Byrne et al., 2002; Carr, 1988; Fletcher & Buckley, 2002; Groen et al., 2006).

1.4 Word recognition, reading and spelling models

A better understanding of the written language profile of individuals with DS can be gained by an examination of models of reading and spelling development. The following section presents a summary of word recognition, reading and spelling models, and implications for reading in DS within the presented models are discussed.

1.4.1 Dual-Route Models of word recognition

According to a dual-route model of word recognition (Coltheart, 1978), readers access the meaning of a word using one of two independent routes: phonological or visual. The phonological route requires the word must first be broken down (segmented) into its component phonemes. These phonemes must then be mapped to their corresponding grapheme(s). These are then assembled or blended and the resulting phonological representation may be accessed, allowing the reader to connect this phonological representation with the meaning of the word. In order to utilise the phonological route, a reader must have an understanding of phoneme-grapheme correspondences and the phoneme level skills of segmentation and blending, skills which have historically not been part of the reading instruction of children with DS.

As the phonological route does not allow for reading phonetically irregular words i.e. those words with irregular phoneme-grapheme correspondences, an alternative route, the visual route is proposed, whereby the reader makes an association between the word's shape and orthographic representation and the meaning of the word. Word recognition via this route therefore, is dependent on previous and frequent exposure to the printed word such as a sight word reading approach, but not on phonological awareness or letter knowledge. The model also proposes that once words accessed via the phonological route become familiar, the reader subsequently uses the more direct visual route to access their meaning, and that use of the phonological route is restricted to unfamiliar words.

1.4.2 Modified Dual-Route Model

Although earlier models (e.g. dual-route) may have supported a sight word reading approach, more recent models acknowledge the integration of information from additional sources. Ehri (1992) proposed a modified dual-route model to address the lack of emphasis on phonological skills evident in the dual-route model, both in a reader's initial ability to read words and the proposed shift from a phonological to a visual route once a word has become familiar. This model contains a phonological route (see above) and a visual-phonological route. The visual-phonological route proposes that the phoneme-grapheme connections and orthographic knowledge of the reader form the visual cues which are then paired with the phonological recoding of the word to establish a visual-phonological access to the words pronunciation and subsequently to its meaning. The visual-phonological route allows the reader to access a word from its spelling, thus reducing the memory demands presented by a purely visual method of word recognition and bypassing the phonological recoding required by the phonological route.

Interpretation of the modified dual-route model of word recognition with respect to reading in individuals with DS suggests the relative strength in visual word recognition associated with this population could be further enhanced by the teaching of phoneme-grapheme correspondences and orthographic knowledge. The combination of these skills would provide both a strategy for the recoding of new words and reduce the memory demands of visual word recognition. Cardoso-Martins et al. (2008) reported that although the children with DS in their study showed less regularity advantage than their control children with typical development, they were still more successful at reading regular than irregular words, suggesting they were using at least some phonological recoding.

1.4.3 Connectionists Model of word recognition

As well as using their phonological knowledge, a connectionist or parallel distributed processing model proposes readers also integrate orthographic and semantic knowledge (Seidenberg, 1992; Seidenberg & McClelland, 1989). The researchers utilised a computer-model which represented phonological, semantic and orthographic knowledge to simulate reading development and explore the inhibitory or facilitatory effects of the various components on word identification, thus providing a mechanism for the manipulation (or impairment) of one of the components to determine the impact on reading (e.g. Harm & Seidenberg, 1999).

The finding that children with DS make semantic errors when reading, supports the hypothesis that these readers are able to access the meaning of a known word directly from its orthography (Buckley, 1985, 1993). However, without the application of phonological knowledge to the word recognition process, readers are reliant on stored orthographic representations to access a words meaning, which does not allow for the reading of unfamiliar words, nor provide a mechanism for facilitating reading accuracy. A connectionist interpretation of word recognition by individuals with DS has implications for reading instruction in this population. This model acknowledges the integration of information sources by readers with DS historically not recognised. Further, it lends support to the recent recommendations that children with DS should be taught to read in the same way children with typical development are taught (Conners, 1992; Cupples & Iacono, 2002; Goetz et al., 2008), and that reading instruction should include letter-sound correspondences (Buckley, 2003; Buckley & Johnson-Glenberg, 2008), although according to this model the teaching of these latter skills need not be predicated on sight word knowledge.

1.4.4 Stage models of word recognition and spelling development

According to a stage model of reading (Ehri, 1991; Frith, 1985), readers use different strategies in their acquisition and development of reading skills depending on their stage in the developmental process. It has been suggested that the stage should be interpreted as the predominate strategy used by the child at the time, as opposed to a more restricted and exclusive interpretation (Treiman & Bourassa, 2000).

Word recognition

The stage models of reading described by Ehri (1991) and Frith (1985) comprise three stages: logographic, alphabetic, and orthographic. Children initially read using a logographic approach where whole words are recognised akin to a picture, with a growing ability to attend to the alphabetic and orthographic structure of the words developing in response to increasing reading experience and phonological awareness (Frith, 1985). Children reading at an alphabet stage demonstrate an increasing ability to use phoneme-grapheme knowledge to decode some sounds in words, whereas children reading at an orthographic stage use larger segments of orthographic information in their reading attempts.

Spelling

Reading and spelling are closely associated, both drawing on the same underlying understanding of the alphabetic principle (Ehri, 2000), consequently stage models describing their development show significant commonalities. Ehri (2000) described four stages in the development of spelling skills. At the pre-alphabetic or pre-communicative stage, children's spelling attempts reflect their lack of alphabetic knowledge and may consist of scribbles or random letters. At the partial alphabetic or semi-phonetic stage, children's spelling begins to show some connections between their emergent letter knowledge and the salient sounds they hear in words. Alphabetic spellers utilise their complete phonographic knowledge to spell words and begin to use analogies based on words they know in their attempts to spell novel words. In the final stage described as the consolidated alphabetic stage, spellers are able to utilise their knowledge of larger segments of orthographic information in their spelling attempts.

The commonalities present in the underlying skills necessary for reading and spelling and the reported association between the two skills (A. Byrne et al., 2002; Cardoso-Martins et al., 2008), reinforce the importance of monitoring the development of spelling and writing as well as reading in children with DS. However this is not currently the case, with research to date predominantly focusing on reading development only, and their separate treatment in the research suggesting an integrated approach to reading and spelling instruction (Treiman, 1998) is not yet widespread.

1.4.5 Self-teaching hypothesis of word recognition

In contrast to a stage based model of word recognition, Share's (1995) self-teaching hypothesis proposes that children's successful phonological decoding experiences result in the establishment of an orthographic representation of a word and the build up of knowledge about the relationships between the phonological and orthographic representations of the language. This accrued knowledge is then available for self-teaching. The principal tenet of the hypothesis is the fundamental importance of repeated successful phonological decoding experiences, experiences which are contingent on knowledge about phoneme-grapheme relationships. The subsequent ability to store and access orthographic (visual) information efficiently is predicated on these successful decoding experiences. The self-teaching hypothesis of word recognition has important implications for reading in individuals with DS. Children with DS who have strong phoneme-grapheme knowledge are equipped with the knowledge to achieve successful phonological decoding and thus to "self-teach" and become independent readers. In contrast, children without this phoneme-grapheme knowledge may be described as dependent readers as they are reliant on repeated exposure to sight word teaching in order to store and access orthographic information.

1.4.6 Section Summary

A common theme of the reading models and theories discussed in this section is the vital contribution of phonological decoding to the process of reading and spelling. The use of a phonological strategy to decode (recode) and encode requires readers to use phoneme-grapheme correspondences, and as such has implications for readers with DS, who have traditionally been taught to read using a visual approach and may lack the prerequisite knowledge to utilise this strategy.

1.5 Letter Knowledge and Phonological Awareness

The reading models and theories described in section 1.4 emphasised the use of a phonological (alphabetic) strategy as critical to successful reading and spelling. Letter knowledge, and more specifically the ability to use print-to-sound relationships (phoneme-grapheme correspondences), is a necessary component in acquiring the alphabetic principle and is key to beginning reading (Adams, 1990; B. Byrne & Fielding-Barnsley, 1989; Ehri, 1998). Phonological awareness is described as the ability to consciously attend to and manipulate sounds in words (Gillon, 2004) and is conceptualised at three levels of awareness: syllable, onset-rime and phoneme level. A developmental progression from awareness of larger to smaller units is generally accepted (Anthony et al., 2002; Carroll, Snowling, Hulme, & Stevenson, 2003), with strong correlations demonstrated between various phonological awareness skills (Muter, Hulme, Snowling, & Stevenson, 2004).

Letter knowledge and phonological awareness are also positively associated. Studies have demonstrated greater gains when letter knowledge and phonological awareness activities have been integrated than when presented in isolation (Murray, Stahl, & Ivey, 1996; Oudeans, 2003).The importance of phonological awareness and letter knowledge in early reading and spelling acquisition is now well established for children with typical development and those at risk for literacy difficulties (e.g. Anthony & Lonigan, 2004; Bradley & Bryant, 1983; Carroll & Snowling, 2004), with both phonological awareness and letter knowledge strongly predictive of later reading outcomes (Hogan, Catts, & Little, 2005; Muter, Hulme, Snowling, & Taylor, 1997; Muter et al., 2004; Share, Jorm, Maclean, & Matthews, 1984; Torgesen, Wagner, & Rashotte, 1994). Treiman and Bourassa (2000) highlighted the relationship between reading and spelling acquisition, and Treiman (1998) recommended the integration of reading and spelling instruction and the inclusion of phoneme awareness and letter knowledge teaching into this instruction.

The importance of different levels of phonological awareness and their relative predictive strength of later literacy outcomes has been the subject of ongoing investigation (Bryant, Bradley, Maclean, & Crossland, 1989; Muter et al., 1997; Wood & Terrell, 1998). While the contribution of syllable and rhyme awareness has been considered, a now widely accepted view is that phoneme level skills are the phonological awareness skills most predictive of later literacy (Hulme et al., 2002; MacMillan, 2002; Muter et al., 1997). A number of researchers describe a reciprocal relationship between phoneme awareness and reading development (Burgess & Lonigan, 1998; Castles & Coltheart, 2004; Perfetti, Beck, Ball, & Hughes, 1987).

Although some researchers have suggested letter knowledge is a prerequisite for phoneme awareness (Carroll, 2004; Castles & Coltheart, 2004; Johnston, Anderson, & Holligan, 1996), others have reported children were able to demonstrate phoneme awareness without letter-sound knowledge (Hulme, Caravolas, Malkova, &

Brigstocke, 2005; Muter et al., 2004; van Bysterveldt et al., 2006). In a study investigating the development of letter knowledge in young children, McBride-Change (1999) found letter-sound knowledge was more predictive of later reading skills than was letter-name knowledge, and suggested the reason for this might be that the former "involves access to the sound structure of the language" (p 302) and is in that respect similar to a phonological awareness skill.

1.5.1 Letter Knowledge and Phonological Awareness in individuals with Down syndrome

The relationship between letter knowledge and reading in children with DS is not well established. Although letter-sound knowledge was found to be predictive of reading skills in their control groups of children with typical development, both Boudreau (2002) and Snowling, Hulme, and Mercer (2002) reported it did not predict reading in the children with DS. However, Lemons (2008) reported relationships between letter-sound knowledge and the ability to read both real (decodable) and nonsense words in a group of 24 children with DS aged 7-16 with emergent literacy skills.

There is increasing research into the role of phonological awareness in reading for children with DS, however the existence of a relationship between phonological awareness and reading in this population has not always been accepted. A claim for the absence of a relationship between phonological awareness and reading was provided by Cossu, Rossini and Marshall (1993a) who argued against the need for phonological awareness skills as prerequisite for reading and against the hypothesis that the relationship is causal and facilitatory (Burgess & Lonigan, 1998; Perfetti et al., 1987). Their study reported the phonological awareness skills in 10 Italian children with DS who were able to read, compared to reading aged-matched peers.

The participants with DS performed significantly more poorly on all the phonological awareness measures. These results were interpreted by Cossu et al. as “gross failure” (p 134) and used to support their claim that the participants had acquired reading in the absence of phonological awareness. Despite this claim, Cossu et al. also reported the ability to read real words and non-words was the same for both the individuals with DS and the typically developing controls. Morais (2003) stated that the participants with DS were unable to complete the phoneme deleting and counting task may simply have shown that “counting and deleting are not crucial for phonological reading” (p126) but did not necessarily preclude the involvement of phonological awareness in reading for this population.

Other concerns raised in response to Cossu et al.’s (1993a) study included the interpretation of the non-zero scores (B. Byrne, 1993), and of the participant’s ability to read non-words (Cardoso-Martins & Frith, 2001), as well as with the phonological memory demands of the phonological awareness tasks (Bertelson, 1993), which exceeded the digit span of the participants. Using test items of two to four phonemes, Cupples and Iacono (2000) examined the relationship between phonological awareness and reading skills in young children with DS aged between 6;07 and 10;03 and found better phonological awareness skills were associated with better reading of both real and non-words. Such reading demonstrates the use of a phonological recoding strategy as this is the only manner in which non-words or pseudo words can be read.

Conners, Atwell, Rosenquist, and Sligh (2001) compared two groups of children with intellectual disability who were grouped on non-word decoding ability. While the group of stronger decoders demonstrated an advantage in verbal phonological memory over their peers with weaker decoding, the groups did not differ significantly on measures of general intelligence or phonemic awareness when age was factored out. Contrastively, relationships have been reported between the ability to read non-words and various phonological awareness skills in children with DS (Cupples & Iacono, 2002; Hatcher, Snowling, & Griffiths, 2002; Kay-Raining Bird, Cleave, & McConnell, 2000). Boudreau (2002) reported a relationship between non-verbal cognitive ability and the ability to read nonsense words in individuals with DS. Groen et al. (2006) reported instances of non-word decoding skills in advance of real word reading in children with DS.

Roch and Jarrold (2008) compared real word and non-word reading ability in individuals with DS and children with typical development. They found that compared to children with typical development, the non-word reading skills of participants with DS were poorer than would be predicted from their real word reading ability. Roch and Jarrold also investigated the relationship between participant's non-word reading and composite phonological awareness scores, with reported correlation coefficients equivalent between the two groups. Thus, while real and non-word reading appeared differently related, non-word reading and phonological awareness skills were similarly related in both the DS and control group.

The findings from other recent studies also indicate a relationship between phonological awareness and reading for individuals with DS (Cupples & Iacono, 2000, 2002; Goetz et al., 2008; Gombert, 2002; Snowling et al., 2002), particularly at the phoneme level. Phoneme segmentation ability was the best predictor of growth in non-word reading ability by children in Lemon's (2008) study. Cardoso-Martins and Frith (2001) compared phonological awareness in readers and non-readers with DS and found group differences in favour of readers on a phoneme detection task. Thus, the research suggests that while individuals with DS do exhibit strengths in visual reading strategies relative to other reading skills, phonological awareness skills also play a role in supporting reading in this population.

The developmental trajectory of phonological awareness from larger to smaller units seen in typical development and the relationships between these phonological awareness skills have lead researchers to conclude they may be tapping the same underlying abilities (Lonigan, Burgess, Anthony, & Barker, 1998; Stahl & Murray, 1994). Others have suggested rhyming and phoneme level skills actually draw on two different abilities (Muter et al., 1997). Phonological awareness appears to be an area of particular difficulty for individuals DS, however rhyme awareness poses even greater challenges (Gombert, 2002; Snowling et al., 2002). Children with DS have been shown to develop phoneme level skills before rhyme (Gombert, 2002; Snowling et al., 2002) and as such phonological awareness development does not appear to follow a typical path, suggesting a dissociation between the different levels of phonological awareness in individuals with DS.

1.5.2 Section summary

Phonological awareness, particularly phoneme level awareness, and letter knowledge have been identified as critical for successful reading and spelling acquisition (e.g. Anthony & Lonigan, 2004; Bradley & Bryant, 1983; Carroll & Snowling, 2004; Hogan et al., 2005; Muter et al., 1997; Muter et al., 2004; Share et al., 1984; Torgesen et al., 1994). Phonological awareness is also positively associated with reading of both real and nonwords in individuals with DS (Cupples & Iacono, 2000, 2002; Goetz et al., 2008; Gombert, 2002; Roch & Jarrold, 2008; Snowling et al., 2002). Phonological awareness typically develops from awareness of larger to smaller units (Lonigan et al., 1998; Stahl & Murray, 1994), however phonological awareness development in individuals with DS appears both delayed and atypical

(Gombert, 2002; Roch & Jarrold, 2008; Snowling et al., 2002), with researchers reporting poorer phonological awareness than would be predicted by real word reading skills and evidence of a specific rhyme deficit in this population.

1.6 Interventions for children with Down syndrome

The following section describes interventions to remediate spoken and written language deficits in individuals with DS.

1.6.1 Speech Interventions

Despite widespread difficulty with intelligibility, effective empirically-based interventions to improve speech intelligibility in this population are scarce in the literature.

Physical and Motor Based Interventions

A number of interventions have focused on physical and motor based activities to improve the speech production of children with DS. In a radical approach to try to improve speech intelligibility, children with DS may undergo tongue-reduction surgery. Parsons, Iacono, and Rozner (1987) compared the articulation errors of 18 children with DS pre-, post- and six months after tongue-reduction surgery and found no significant difference across the three measures, nor between the surgery group and a non-surgery contrast group. Other researchers report similar findings (Margar-Bacal, Witzel, & Munro, 1987).

Non-speech oral motor exercises and treatments have been recommended for children with DS to increase awareness and strength of the oral and facial muscles used during speech (Kumin, 2006; Rosin & Swift, 1999; Swift & Rosin, 1990). However, Barnes, Roberts, Mirrett, Sideris, and Misenheimer (2006) reported a disassociation between oral motor structure and function, with children with DS demonstrating better oral function skills than speech function skills, supporting the hypothesis that remediating oral-motor deficits will not improve speech production. Reviews of the literature investigating the use of non-speech oral motor exercises and treatments showed evidence does not support their effectiveness in the treatment of speech disorders (Lass & Pannbacker, 2008; Lof, 2003; Lof & Watson, 2008; Powell, 2008; Ruscello, 2008). Nonetheless, in a survey of 537 American speech language pathologists undertaken by Lof and Watson (2008), 85% of respondents reported using non-speech oral motor exercises in their clinical practice when working with children with speech sound disorders, including children with DS. Such a high rate of reported usage of an intervention approach that research indicates is ineffective is contrary to the Evidence-Based Practice in Communication Disorders position statement (American Speech-Language-Hearing Association, 2005) defining evidence-based practice in the profession of speech-language therapy, and suggests the examination of other treatments to improve speech production in children with DS is urgently needed.

Phonological Interventions

An alternative to oral motor approaches to improving speech production is a phonological approach. This linguistic approach focuses on the phonological system and targets phonological error patterns apparent in the child's speech (Holm, Crosbie, & Dodd, 2005; Strattman, 2007).

Minimal pairs

The minimal pairs approach focuses on contrastive versus homonymous production using pairs of words that contrast the sound which is in error with the correct production of that sound (e.g. Gierut, 1991; Weiner, 1981). Pairs of words which differ on one sound only (i.e. minimally) are used to illustrate the targeted contrast. The approach highlights to the child the semantic confusion caused by the homonymous production of the different words (Holm et al., 2005).

Maximal oppositions

Similarly, the maximal oppositions approach described by Gierut (1990) focuses on reducing homonymy by contrasting targets sounds within error patterns with a sound the child can produce correctly, and which differs maximally from the target sound. Maximal differences between the target and contrast sound include differences in voice, place and manner (Holm et al., 2005).

Multiple oppositions

This approach focuses on establishing contrasts missing from a child's phonological system which result in the use of overgeneralised phonemes. Multiple maximally contrastive pairs are used to contrast the sound the child overuses, with the multiple phonemes it is substituted for, within the child's "phoneme collapse" (Holm et al., 2005, p. 174).

Metaphon

Metaphon, described as a metalinguistic approach (Dean, Howell, Waters, & Reid, 1995), aims to increase the child's awareness of the features of voice, place and manner that occur in speech sounds. Children are first taught to classify environmental nonspeech sounds according to these features, and then to apply this knowledge to the speech domain by attending to the features presented in minimal pairs. Attention is also drawn to the breakdown in communication that results from the homonymous production of different words.

Cycles Phonological Remediation Approach (The cycles approach)

In common with many of the methods discussed above, the cycles approach (Hodson & Paden, 1991; Hodson, 2007a) also targets phonological error patterns present in a child's speech. The cycles approach is so named because of the cyclic way in which the child's error patterns are targeted and if necessary retargeted. The selection and sequential targeting of error patterns in this approach reflect the tenets which underlie the approach, including the gradual acquisition of phonology primarily acquired through listening, the active role of the child and the role of their learning on generalisation and self monitoring of new speech skills, and the importance of the phonetic and learning environment in this process (Hodson & Paden, 1991; Hodson, 2007a).

<u>Phonological interventions for children with Down syndrome</u>

Although researchers report the use of phonological approaches to remediate speech errors in children with expressive phonological disorders (Dean et al., 1995; Gierut, 1990, 1991; Hodson & Paden, 1991; Hodson, 2007a; Holm et al., 2005; Weiner, 1981), only two phonological intervention approaches aimed at improving speech intelligibility for children with DS have been documented (Cholmain, 1994; Dodd et al., 1994). Cholmain's (1994) study included six children with DS aged 4;01-5;06 who had language ages of 1;03 – 2;08. The children attended an early intervention centre where they had previously participated in an early intervention programme with an emphasis on communication, and were able to communicate effectively using augmentative and alternative communication systems (AAC), however speech intelligibility was not a current focus of their therapy.

The intervention was implemented by both a clinician and the children's parents via a modified cycles approach (Hodson & Paden, 1991) to remediate phonological error patterns, and was delivered using amplification with a focus on contrastive versus homophonic production of the targeted patterns in words (Weiner, 1981). Pre-intervention Percentage Consonant Correct (PCC) scores ranged from 3% - 37% with assessment showing minimal change in the 3-12 months prior to the intervention. Despite this previous stability, response to the intervention was rapid with all the children demonstrating positive change in the first two weeks. Post-intervention PCC scores ranged from 19% - 88%. Children also demonstrated increases in syntax development which Cholmain (1994) hypothesised may have been potentiated by their increased intelligibility.

Nine children with DS aged between 2 and 6 years took part in the Dodd et al. (1994) study which used a core vocabulary approach to reduce variability and non-developmental errors in the children's speech. The approach required the child to produce a consistent pronunciation of each target word, with no non-developmental errors present. As with the Cholmain (1994) study, parents played an active role in the delivery of the intervention. Fewer errors and inconsistencies were reported post-intervention. These two studies demonstrate a phonological intervention approach can be effective for young children with DS, and that parents can play a key role in modelling target production and providing corrective feedback to improve their child's speech.

Phonological Awareness Intervention

Phonological awareness intervention is effective in facilitating reading and spelling development (see Ehri et al., 2001 for a review). Interventions which make explicit links between phonemes and graphemes (Hatcher, Hulme, & Ellis, 1994), and provides explicit instruction in phoneme level awareness appear to demonstrate the most benefit for enhancing reading development (Gillon, 2004).

Phonological intervention approaches have been extensively used with young children with spoken language impairment (Denne, Langdown, Pring, & Roy, 2005; Gillon, 2000; 2002; 2005; Hesketh, Adams, Nightingale, & Hall, 2000; van Kleeck, Gillam, & McFadden, 1998). Van Kleeck et al. (1998) provided phonological awareness training for 16 young children aged 4 and 5 who had speech and/or language impairments. Children demonstrated significant gains in phoneme awareness at post-intervention, with children who had little or no PA skills pre-intervention demonstrating particularly strong gains. The 4 and 5 year old children performed equally well, supporting the early instruction of phonological awareness skills for young children with speech and language disorder who are known to be at risk of later reading difficulties, as these are underlying skills critical for early reading development (Catts et al., 2001; Leitão & Fletcher, 2004).

Integrated phonological Awareness interventions

Integrated phonological awareness intervention which incorporates phonological awareness, letter knowledge and speech goals have been shown to be effective for young children with speech disorders and normal cognitive ability, including children with spoken language impairment and children with childhood apraxia of speech (CAS), by simultaneously improving speech production, phonological awareness and early literacy skills (Gillon, 2005; McNeill, Gillon, & Dodd, in press). Twelve 3 and 4 year old children with moderate to severe speech impairment in the Gillon (2005) study received an intervention which integrated phoneme awareness, letter knowledge and speech targets. Results showed children made simultaneous improvement in phoneme awareness and speech production accuracy, with superior reading and spelling ability at age 6 years compared to the performance of a control group. McNeill et al., (in press) provided intervention which integrated phoneme level skills, phoneme-grapheme connections and speech targets to twelve children with CAS aged 4 to 7 years. Nine of the 12 children made significant gains in speech skills on targeted speech sounds with some transfer evident at the connected speech level. Eight children showed improved phoneme awareness with transfer observed to untrained phoneme awareness tasks. The researchers also reported improved performance on letter knowledge, word decoding and spelling tasks for the group.

1.6.2 Section Summary

Few empirically based interventions to improve speech production in individuals with DS are reported in the literature. Phonological approaches to improving speech production which focus on the child's phonological system by targeting phonological error patterns that are present in their speech, have been used with children with expressive phonological disorder (Dean et al., 1995; 1990, 1991; Hodson & Paden, 1991; Hodson, 2007a; Holm et al., 2005; Weiner, 1981), and with children with DS (Cholmain, 1994; Dodd et al., 1994). Phonological awareness interventions which link letter knowledge and phonological awareness have also been used with children with spoken language impairment (Denne et al., 2005; Gillon, 2000; 2002; 2005; Hesketh et al., 2000; van Kleeck et al., 1998), who are known to be at risk of reading disorder (Catts et al., 2001; Leitão & Fletcher, 2004). Further, integrated phonological awareness intervention which simultaneously targets speech, letter knowledge and phonological awareness goals has been shown to be effective for children with speech disorders (Gillon, 2005; McNeill et al., in press).

1.6.3 Reading interventions for children with Down syndrome

The following section describes reading interventions and instructional methods that have been implemented to teach reading to children with DS.

Recently Buckley (2003) proposed that differences between how school-aged children with DS and typically developing children learn to read may not be qualitative, but quantitative, with research suggesting it may be that children with DS rely on earlier developing strategies i.e. logographic, for longer (Kay-Raining Bird et al., 2000). However some children with DS are able to use alphabetic strategies for reading and spelling (Cupples & Iacono, 2000; Kay-Raining Bird et al., 2000).

Buckley (2003) further advanced a series of principles for consideration by those teaching children with DS to read. These included the recommendation to teach pre-schoolers by first teaching sight words which can be built into sentences, using a "look and say" approach (p148), and introducing phonics when the child can recognise 30 - 40 words. School-aged children should receive phonics instruction with the rest of the class. Proponents of this instruction method draw on phenotypic relative strengths in visual memory and weaknesses in auditory working memory (e.g. Kay-Raining Bird & Chapman, 1994) to support the appropriateness of this approach.

However, both visual and auditory memory skills are important for reading. Recently, Hulme et al. (2007) investigated visual-verbal paired associated learning (PAL) in children aged between 7 and 11 years who were typical readers. Visual-verbal paired associated learning, that is learning the association between a particular shape and a particular sound, was found to be predictive of reading ability even after controlling for phoneme awareness skill. It may also be implicated in the acquisition of a sight word vocabulary as children make associations between the visual representation of the words and their pronunciation.

In addition to the recommendation to teach phonics (i.e. letter-sound correspondence) to children with DS (Buckley, 2003; Buckley & Johnson-Glenberg, 2008), current opinion advocates the same reading instruction for school-aged children with DS as for typically developing children (Conners, 1992; Cupples & Iacono, 2002; Goetz et al., 2008). The results from recent intervention studies provide mounting evidence to support the effectiveness of phonological awareness intervention to facilitate reading development in individuals with DS. These studies are more inline with current evidence-based practice (National Reading Panel, 2000), which emphasises the importance of instruction which makes explicit the connections between spoken and written language including phonological awareness and phoneme-grapheme correspondences.

Cupples and Iacono (2002) compared the single word reading abilities of 7 children with DS aged between 8;06 and 11;01 who had received either whole word or analytic reading instruction. While six of the seven children read more trained words post-intervention, only the three children who had received the analytic approach were able to read significantly more generalisation words post-intervention. Cupples (2008) investigated the response to phonics based reading instruction for 5 children with DS aged 7 to 13 years and reported gains which were not at the expense of reading comprehension.

Goetz et al., (2008) implemented a reading intervention for 15 children with DS aged between 8;03 and 14;06. Participants received an intensive phonics based intervention which included letter knowledge, early word recognition and phoneme segmentation and blending. Compared to a control group, participants made significant gains on the two early reading measures with a trend towards improved alliteration skills. The control group then received the intervention and demonstrated similar results. Gains were maintained five months after completion of the invention.

Lemons (2008) investigated the effectiveness of phonics-based reading instruction for 24 children with DS aged 7 to 16 years and reported, consistent with the findings of Goetz et al. (2008), that children made gains in letter-sound knowledge and real and non-word reading abilities, with strong relationships evident between these skills. Taken together, these studies provide considerable support for reading intervention for children with DS that includes explicit letter knowledge and phonological awareness instruction.

In addition to phonological awareness intervention studies for school-aged children with DS, researchers have also investigated phonological awareness development in pre-school children with DS. Van Bysterveldt, Gillon and Moran (2006) investigated the effectiveness of a phonological awareness intervention for seven 4-year old children with DS. Parents were taught to draw their child's attention to letter names, letter sounds and initial phonemes in words during daily shared book reading. The intervention was delivered in the children's homes for ten minutes a day four times a week for six weeks, i.e. 4 hours total. This reading frequency and duration was compatible with baseline measures of joint reading gathered during the two weeks prior to the intervention, where parents reported they were reading to their child for 10-20 minutes per day (M = 14.4, SD = 4.7). The researchers reported improvement in phonological awareness and letter knowledge at a group level, with the suggestion that letter knowledge may be a prerequisite for phonemic awareness in children with DS. However, individual performance was variable and the relationship between performance and other measures such as children's language, compliance and fidelity of implementation were not explored. The researchers also alluded to the role of the child during the story reading, with the two children who demonstrated the most gains reported to take an active part in the interaction and to engage with the pictures, letters and text in the books during the story reading, but this is an area which requires further investigation. Although the focus of the intervention was on improving phonological awareness and letter knowledge, the researchers reported that some children demonstrated improved speech production on the letter sounds that were targeted. Given the lack of empirically based speech interventions and the potential of phonologically based interventions to remediate speech errors, the current study sought to expand on van Bysterveldt et al.'s (2006) pilot study by simultaneously targeting children's speech production errors in the context of teaching phonological awareness and letter knowledge.

1.6.4 Section summary

Although historically children with DS were taught to read using a sight word approach to word recognition, there is growing support for reading intervention for children with DS that includes explicit letter knowledge and phonological awareness instruction (Buckley, 2003; Buckley & Johnson-Glenberg, 2008; Conners, 1992; Cupples & Iacono, 2002; Goetz et al., 2008). Researchers using phonics-based and phonological awareness reading instruction methods for children with DS report gains in letter knowledge, phonological awareness and reading skills (Cupples, 2008; Goetz et al., 2008; Kennedy & Flynn, 2003b; Lemons, 2008).

1.6.5 Writing and spelling interventions

As discussed in section 1.3.5, investigations into writing and spelling in DS are limited. Although there is some ambiguity in the literature around reading and spelling strategies for individuals with DS, researchers acknowledge the need for phoneme-grapheme knowledge and phonological awareness in development of the alphabetic principle necessary for reading and spelling development (Bird & Buckley, 2002; Buckley, Beadman, & Bird, 2001). However, an emphasis on sight word instruction for spelling, at least initially, (e.g. “look, learn, cover, write, check” (Buckley et al., 2001, p.6)) is still apparent. Recommended strategies include word matching, multi-sensory, mnemonic, and memory games “to develop the rehearsal skills necessary to remember the order of the letters” (Buckley et al., 2001, p.6), with an approach which includes phoneme-grapheme knowledge and phonological awareness recommended for older children (Bird & Buckley, 2002). Nonetheless, consistent with Share’s (1995) self-teaching hypothesis, Buckley and colleagues (Bird & Buckley, 2002; Buckley et al., 2001) acknowledge that as children’s reading develops so too does their understanding of phoneme-grapheme connections and their ability to access orthographic representations.

1.7 Verbal working memory

Investigations into reading abilities and interventions in individuals with DS need also consider the contribution of verbal working memory to reading in this population. Verbal working memory is routinely assessed via word or digit recall tasks and has been found to be consistently lower in individuals with DS than mental age-matched controls (Bower & Hayes, 1994; Jarrold, Baddeley, & Hewes, 1999; 2000; Kay-Raining Bird & Chapman, 1994). Reduced working memory will limit an individual’s ability to store, manipulate and recall sounds in words (and in text) with implications for speech, language and literacy acquisitions.

Verbal working memory deficits

A number of researchers have used non-word repetition tasks (e.g. Gathercole & Baddeley, 1990) to assess phonological short term memory in individuals with DS (Comblain, 1999; Laws, 1998). Individuals with DS demonstrated deficits in this area with stronger non verbal short-term memory associated with better scores on a number of language measures (Laws, 2004; Laws & Gunn, 2004). Seung and Chapman (2004) reported an association between verbal short-term memory deficits and expressive language deficits in this population and confirmed similar levels of performance on the auditory memory tasks when participants with DS and the typically developing control group were matched for language production rather than non-verbal mental age.

Although a verbal short-term (working) memory deficit in most (but not all) individuals with DS is now widely acknowledged, the nature of the deficit remains the subject of debate. The working memory model proposed by Baddeley (1986) is made up of three components: a central executive and the two separate systems it controls, the visuospatial sketch pad and the phonological loop, that hold visual and verbal information. The phonological loop comprises a (passive) phonological store and an (active) articulatory rehearsal process. A phonological loop deficit has been described as a particular area of impairment in individuals with DS (Jarrold & Baddeley, 2001), as a limiting factor in their ability to use phonological information, and as a possible contributing factor in their expressive language delay (Chapman, 1995; Conners, Rosenquist, Arnett, Moore, & Hume, 2008; Laws, 2004; Laws & Gunn, 2004). Research has investigated possible deficits to both phonological loop sub-components.

Researchers have sought to improve memory span in individuals with DS through interventions teaching participants to use rehearsal strategies (e.g. Conners et al., 2008; Laws, MacDonald, & Buckley, 1996). Although participants demonstrated improvements in memory span, the improvements were typically small and short term. However, evidence suggests the presence of rehearsal is influenced by mental age and does not occur in young children with typical development until they have a mental age of about seven years (Gathercole & Hitch, 1993; Jarrold et al., 2000; Vicari, Marotta, & Carlesimo, 2004), and as such most individuals with DS would not be expected to spontaneously use such a strategy. Nevertheless, individuals with DS do more poorly on tests of verbal short-term memory even when mental age is controlled for (Jarrold & Baddeley, 2001). Controlling for mental age may in itself be problematic in explaining this discrepancy. In a study investigating memory span development in typical children, children with DS, and those with other cognitive impairments, Mackenzie and Hulme (1987) found a lower correlation between memory span and mental age in the cognitive impairment groups who also demonstrated a similar, increasingly lag between the two measures as mental age increased.

Results from Jarrold et al.'s (2000) study do not support a sub vocal rehearsal deficit. Instead the researchers cautiously posited impaired phonological storage as a potential explanation for the verbal short-term memory deficits, and recognised this as an area requiring further investigation. Vicari et al., (2004) questioned the impact of a phonological loop deficit and instead hypothesised as to the possible role of the central executive system.

1.7.1 Section Summary

Verbal working memory has been found to be consistently lower in individuals with DS than mental age-matched controls (Bower & Hayes, 1994; Jarrold, Baddeley, & Hewes, 1999; 2000; Kay-Raining Bird & Chapman, 1994), and has been implicated in deficits in the storage, manipulation and recall of sounds in words (and in text) and hence in the development of speech, language and literacy in this population.

1.8 The relationship between language and reading skills

Reading has been associated with stronger language abilities in children with DS, with children who can read demonstrating better language skills than those of their non-reading peers (e.g. Laws, Byrne, & Buckley, 2000; Laws & Gunn, 2002). Laws, Buckley, Bird, MacDonald, and Broadley (1995) reported better vocabulary and grammar skills in readers compared to non-readers in their study. Cardoso-Martins et al. (2008) found reading skills were strongly related to a variety of language measures.

What is not clear is whether children with DS experience an increase in spoken language skills as a result of learning to read or whether the reverse is true (Boudreau, 2002). Whether the relationship is directional, or reciprocal as it may be in typical development (Perfetti et al., 1987), is a question that warrants further investigation. Anecdotal and empirical evidence in favour of the first hypothesis is provided by researchers (Buckley, 2003; Groen et al., 2006) who reported very young children with DS who had received reading interventions which targeted spoken language by teaching children to read words in their receptive vocabulary but not yet in their expressive vocabulary, demonstrated superior speech, language and literacy skills compared to children whose introduction to literacy was later. Additionally, MLU in conversation has been found to be predicted by reading accuracy and comprehension (Boudreau, 2002; Laws & Gunn, 2002). In contrast, A. Byrne et al.'s (2002) longitudinal study reported no significant relationship between reading progress and language development.

Considering the potential confounding factor of school setting (i.e. mainstream versus special school) in interpreting reading results for individuals with DS, Buckley and Johnson-Glenberg (2008) suggested the richness of the spoken language environment and the frequency of reading instruction and experiences may in fact be responsible for the gains in language associated with reading. Research has highlighted the contribution of classroom discourse on reading comprehension for children with typical development (Hansen, 2004; see Nystrand 2006, for a review).

1.8.1 Section Summary

Reading has been associated with improved language abilities in children with DS, (e.g. Cardoso-Martins et al., 2008; Laws et al., 1995; Laws et al., 2000; Laws & Gunn, 2002). However the direction of the relationship and the variables that contribute to this language advantage which readers demonstrate require further investigation. This study sought to investigate these variables by examining the spoken and written language abilities of New Zealand children with DS and the influence of the home and school literacy environment.

1.9 Home literacy environment

1.9.1 Reading readiness and emergent literacy

Adopting a sociocultural approach to the acquisition of literacy has resulted in a shift in thinking from a "reading readiness" model based on maturational level or the acquisition of a prerequisite set of skills (Gates, 1937; Morphett & Washburne, 1931), to an “emergent literacy” model (Teale & Sulzby, 1986) where literacy is seen as emerging from meaningful and functional interactions with print. Using a system whereby children receive instruction or support within their zone of proximal development (Vygotsky, 1978), a child’s current supported achievement becomes their independent achievement in the future. This approach emphasizes the role of daily literacy based experiences and interaction with adults as well as the child’s active role in becoming literate. Thus, while children may not receive formal reading instruction until they start school, the process by which they learn to read can build on a range of earlier literacy experiences (Whitehurst & Lonigan, 1998).

Components of the Home Literacy Environment

There is a considerable body of evidence that suggests that the home literacy environment (HLE) is key to a child’s emergent literacy (Burgess, Hecht, & Lonigan, 2002; DeBaryshe, 1995; Hood, Conlon, & Andrews, 2008; Sénéchal, LeFevre, Thomas, & Daley, 1998), and that the richness of that environment is determined by factors such as frequency of, exposure to, and engagement with, literacy items including joint and independent reading; the importance placed on literacy in the home; socioeconomic status; and maternal education level (Rashid, Morris, & Sevcik, 2005). Emergent literacy skills, the precursors to conventional reading and writing skills, are generally accepted to include alphabet knowledge, concepts of print, phonological awareness, and vocabulary (Whitehurst & Lonigan, 1998). Frijters, Barron, and Brunello (2000) found strong relationships between children’s home literacy and literacy interest measures and their letter knowledge, phonological awareness and vocabulary.

Joint book reading appears to be a key feature of the HLE, positively affecting the development of emergent literacy skills and accounting for approximately 8% of the variance in reading achievement (Bus, van IJzendoorn, & Pellegrini, 1995; Evans & Shaw, 2008; Scarborough & Dobrich, 1994). Additionally, shared story reading which targets the development of specific skills is successful in increasing children's print awareness (Justice & Ezell, 2000; Justice & Ezell, 2002), facilitating emergent phoneme awareness and letter knowledge (van Bysterveldt et al., 2006; Ziolkowski & Goldstein, 2008), and enhancing oral language skills (Scarborough & Dobrich, 1994). These findings are consistent with those of Sénéchal and colleagues (Sénéchal & LeFevre, 2001, 2002; Sénéchal et al., 1998), who investigated the contributions of explicit teaching of reading and print (a formal literacy activity), and joint story reading (an informal literacy activity), to oral and written language development in young children.

In a series of studies, Sénéchal and colleagues (Sénéchal & LeFevre, 2001, 2002; Sénéchal et al., 1998) found children's exposure to story reading was predictive of their oral language development, but not their written language skills. By contrast, parents' reported teaching behaviours were predictive of children's written language skills, but not their oral language development. As no correlation was found between the two measures of story exposure and reported teaching behaviours, participants were grouped across the four possible combinations of the two measures: high teach-high read; high teach-low read; low teach-high read; and low teach-low read, and reading outcomes over time were compared. Children who had the advantage of both high levels of book reading and of parent-teaching outperformed the rest of their peers. The findings suggested that parent-teaching will affect early print decoding and that story exposure will have a continued effect on developing literacy once these early skills are mastered.

In a longitudinal analysis of the effects of HLE on reading development in 124 Australian pre-school children, Hood et al. (2008) reported findings similar to those reported by Sénéchal and colleagues (Sénéchal & LeFevre, 2001, 2002; Sénéchal et al., 1998), and confirmed the independent contribution of both parent-child reading and parent-teaching to children's language and literacy measures.

Many parents report teaching letter knowledge to their child, with such instruction found to be predictive of later reading outcomes (Bus & van IJzendoorn, 1988; Haney & Hill, 2004; Hood et al., 2008; Levy, Gong, Hessels, Evans, & Jared, 2006; Sénéchal & LeFevre, 2002). Children's knowledge of concepts of print is also associated with better reading outcomes (Scarborough, 1998).

In their longitudinal New Zealand based study of reading, Tunmer, Chapman, and Prochnow (2006) found a strong relationship between early literacy skills and later reading outcomes, with nearly 50% of the variance in later reading outcomes attributable to what they termed *literate cultural capital* at school entry. Literate cultural capital covers a range of HLE features including phonological awareness, letter knowledge, grammatical sensitivity and vocabulary. Limited literate cultural capital can prevent children from accessing the literacy instruction practices of the classroom and result in further disadvantage, a phenomenon described as the Matthew effect (Stanovich, 1986). Hindin and Paratore (2007) highlighted the positive outcomes for reading that can result when the school literacy focus is supported at home. A repeated-reading intervention was implemented which involved repeated exposure to school texts at home, and was supplemented by parents correcting children's errors and giving them extra reading support. The researchers reported the struggling readers in their study made significant gains on measures of reading fluency and made fewer reading errors post-intervention.

1.9.2 The Home Literacy Environments of children with Down syndrome

While the literature around the HLE is reasonably robust for children who are typically developing, far less is known about the HLE of children with disabilities. The HLE of children with disabilities may not be as rich and supportive of literacy development as that provided to children with typical development. Fitzgerald, Roberts, Pierce and Schuele (1995) investigated the HLE of three pre-school children with DS. They found that although the homes contained numerous books and literacy based materials, when compared with the results of Teale (1986) for children with typical development, the literacy-based interactions between the parents and children with DS were fewer and were largely made up of story reading events. Moreover, the events that did occur tended to be presented in isolated and defined occasions rather than occurring in everyday contexts.

Other comparisons present a similar picture, with parents in van Bysterveldt et al.'s (2006) study reportedly reading to their pre-school child with DS for approximately 15 minutes per day, compared to parents in a study by Rideout, Vandewater, and Wartella (2003) who reported they spent about 40 minutes per day reading with their pre-school child with typical development.

Marvin and Mirenda (1993) also found the parents of children with disabilities had much lower literacy expectations and priorities, and engaged in significantly fewer literacy related experiences than those of children with typical development, and Marvin (1994) found that children with multiple disabilities had poorer HLEs than those with single disabilities. However, Marvin (1994) cautioned that there is a need for further investigation as to the levels and type of disability and HLE. This sentiment is echoed by Weikle and Hadadian (2004) in their review of the literature pertaining to literacy environments and development for children with disabilities. The reviewers highlighted the need for research into emergent literacy and the role of the home literacy environment for children with disabilities.

Ricci (2004) recently compared parent beliefs about reading and the HLE of 20 pre-school and 17 school-aged children with DS, with 18 children with typical development children, matched for chronological age with the younger children and for mental age with the older children. Findings suggested parents' beliefs about reading and provision of literacy experiences for children with DS were more influenced by the child's mental age than their chronological age, which suggests they may be more aligned with the needs of their children than many educational programmes, which are predicated on chronological age. If children with DS can acquire many of the underlying skills for reading, but on a later schedule than their classmates (as Ricci's (2004) study showed), they may benefit from both earlier and longer exposure to formal literacy experiences than they current appear to receive. Ironically, the younger children with DS in Ricci's study were not assessed on measures of emergent literacy because it was assumed the tasks would be too cognitively demanding. Other studies, however, have demonstrated pre-school children with DS have measurable emergent literacy skills and are capable of acquiring these skills before they begin school (Groen et al., 2006; van Bysterveldt et al., 2006).

Trenholm and Mirenda (2006) investigated the home and community literacy experiences of individuals with DS. They collected survey data from the parents/caregivers of 224 Canadian individuals with DS ranging in age from 3 to 42 years. Of these, 105 children were aged between 5 and 13 years, an age span comparable to that of the children in the current study. The parents reported on the literacy experiences of the participants in four main areas: goals, priorities and interest placed on literacy achievement, their child's abilities and experiences with reading and with writing, and the parents' perception of barriers to literacy development. Although no parents ranked learning to read or write as their number one priority for their child, learning to read was identified by over half the respondents as being as one of the three highest priorities for their child aged 5 - 13 (56% of parents of 5 - 9 year olds and 62% of parents of 9 - 13year olds). However, a lesser priority was given to learning to write. The highest ranking for learning to write was again demonstrated by parents of participants aged 5 - 13, rated as one of the top three priorities for their child by 18% of parents of 5 - 9 year olds and 24% of parents of 9 - 13 year olds. The children demonstrated high levels of interest in acquiring literacy skills with over 70% of 5 - 13 year olds reported to be "somewhat" or "very" interested in learning to read and to write, and over 80% to be interested in drawing.

Approximately half of the parents in the Trenholm and Mirenda (2006) study indicated they believed the prime age for literacy development in children with DS was between 6 and 12 years old i.e., from the beginning of compulsory schooling. This finding is consistent with the Purcell-Gates (1996) descriptive study, which saw parents increase formal and informal literacy interactions with their child in response to their child entering formal schooling. This suggests they share the predominant 'reading readiness' mind-set of many educational systems. An emergent literacy approach, on the other hand, would encourage parents to prioritise and provide the environment for literacy based experiences and interactions for their child from an earlier age, as well as emphasise the active role of the child in the acquisition of literacy.

1.9.3 Section Summary

A rich home literacy environment which includes frequent exposure to joint book reading and explicit teaching of letter knowledge and print concepts has been associated with positive and persistent effects on children's reading outcomes (Bus & van IJzendoorn, 1988; Bus et al., 1995; Evans & Shaw, 2008; Haney & Hill, 2004; Levy et al., 2006; Scarborough & Dobrich, 1994; Sénéchal & LeFevre, 2002). The HLE of children with disabilities may not be as rich and supportive of literacy as that children with typical development (Fitzgerald et al., 1995; Marvin & Mirenda, 1993) which has serious implications for literacy development in children with DS.

1.10 School environment

For most children, starting school signals the beginning of formal literacy instruction, consequently the school environment is an important influence. There is some evidence to suggest the richness of the school literacy environment also contributes to gains in language and literacy (Buckley & Johnson-Glenberg, 2008; Hansen, 2004; Nystrand, 2006), however, practices that make up the classroom literacy environment for New Zealand children with DS has not been investigated.

1.10.1 School setting

There are over 2000 mainstream schools providing primary education in New Zealand (Ministry of Education, 2008b). An additional 28 schools provide special schooling for children aged 5 – 21 (Ministry of Education, 2008f). Using prevalence figures of 1.17 per 1000 live births (Stone, 2005) and an average birth rate of 57,799 (SD = 1,305) (Statistics New Zealand, 2008a), it can be calculated there are approximately 575 children with DS currently enrolled in primary education in New Zealand. From these figures it may be assumed the majority of schools and indeed teachers will not have experience in educating a child with DS. It is unlikely then, that schools and teachers can readily draw on a familiarity with the nature of the syndrome and a knowledge of appropriate evidence based interventions, attributes identified by Fidler (2005) and Davis (2008) as influential to the provision of inventions for children with DS.

Rather than providing etiology specific instruction, increased teacher's knowledge about the influence of etiologies on learning would support them in their adaptation of the curriculum and provision of support in the classroom (Fidler & Nadel, 2007). Wishart and Manning (1996) reported trainee teachers in the United Kingdom had little understanding of the etiology of DS and its potential impact on learning, with their reluctance to have a child with DS in their class possibly attributable to this lack of knowledge. These findings are consistent with those of Gilmore, Campbell, and Cuskelly (2003) who reported the teachers in their study who rated the benefits of inclusion for children with DS (and for their classmates with typical development) most highly, were those with classroom experience of children with DS. These teachers were also more likely to choose mainstream schools over special schools as the best educational option for children with DS.

Campbell et al. (2003) reported questionnaire data from 274 pre-service teachers before and after they had undertaken an instructional and fieldwork teaching unit targeting knowledge about DS etiology and inclusive education. The researchers reported teachers demonstrated an increase in knowledge about DS and a more positive attitude to inclusive education after they had undertaken the teaching unit. Research findings (Campbell et al., 2003; Gilmore et al., 2003; Wishart & Manning,

1996) clearly illustrate the role of pre-service training to equip teachers with the knowledge, skills and attitudes to enable them to meet the needs of children with disabilities educated in mainstream classrooms.

Evidence suggests British children with DS educated in mainstream schools outperform their peers educated in special schools (Buckley, Bird, Sacks, & Archer, 2006; Turner et al., 2008). The mainstream advantage encompasses a wide range of measures including speech intelligibility, spoken and written language, and socially accepted behaviour (Buckley et al., 2006; Turner et al., 2008). Indeed, as noted by Buckley and colleagues (2006), there are no studies that report any educational advantage from special schooling. In New Zealand however, the siting of many special school satellite classes on mainstream campuses means a clear cut dichotomy of special versus mainstream schooling does not practicably exist (Ministry of Education, 2008f).

1.10.2 Curriculum

Provision of compulsory schooling for all children in New Zealand was mandated less than 20 years ago following amendments to the Education Act (Education Act, 1989). New Zealand primary schools are required to teach children according to the principles, values, competencies and learning areas defined by the New Zealand Curriculum (Ministry of Education, 2007b). The New Zealand English Curriculum Level One (Ministry of Education, 2007b) learning indicators (for Listening, Reading and Viewing and Speaking, Writing, and Presenting) states children will be able to make sense of and create texts “using meaning, structure, visual and grapho-phonic sources” (p6). Additional learning indicators are that children achieving at this level will be able to recognise and spell a bank of high frequency words.

Guidelines for adaptation of the curriculum for children with special needs are available from the Ministry of Education (2008c). The Ministry of Education, Special Education (GSE) is responsible for the provision of services and funding for children with special needs. The Ongoing Resourcing (ORS) and Renewable Resourcing Schemes (RRS) are implemented by GSE and provide resourcing for approximately 7000 students at any one time verified as having high or very high needs (Ministry of Education, 2008d). Most children with DS meet criteria for RRS or ORS funding (Holden & Stewart, 2002).

Some questions exist around the relative importance of teaching functional and social skills compared to academic skills. Teachers of children with intellectual disabilities in a study by Kemp and Carter (2005) identified other skills important for children with disabilities to demonstrate in a classroom setting, including self-help skills, communication and classroom and social skills, with academic skills not prioritised. However, the researchers reported the teachers' perceptions of children's skills identified as important, and objective direct measurement of such skills, were only weakly related. Teachers' perceptions are by definition subjective and as the researchers suggested, their perceptions of children's skills may be influenced by factors other than those purportedly assessed.

Wakeman, Browder, Meier, and McColl (2007) proposed that given the absence of evidence identifying functional skills as prerequisite, these should be taught concurrently with (but not instead of) academic skills. Researchers indicate individuals with cognitive impairment can achieve academic success (e.g. Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006). Turner and Alborz (2003) confirmed such findings, however they noted that academic attainments were not achievable for a small minority of children with DS and cautioned that a shift towards increased academic opportunity and expectation must not be at the expense of relevant and meaningful education for these children.

1.10.3 The influences of teacher's attitudes and beliefs on classroom practice

Bender, Vail, and Scott (1995) investigated the relationship between teachers' attitudes to mainstreaming and their classroom practice. The researchers surveyed 117 teachers and reported more positive attitudes to mainstreaming and greater perceived personal efficacy were associated with greater use of instructional strategies to facilitate learning for children with disabilities in mainstream classrooms. Buell, Hallam, and Gamel-McCormick (1999) also reported a relationship between teachers' personal efficacy beliefs and a more positive response to inclusion. However, the majority of the 202 general education teachers in the Buell et al. (1999) study reported they had insufficient resources and systems in place to support the inclusion of children with disabilities in their mainstream classrooms. In their investigation of inclusion for students with DS in the New Zealand context, Holden and Stewart (2002) identified the need to support teachers to better provide learning opportunities and curriculum adaptations for children with DS, and provided practical guidelines to facilitate inclusion with respect to teaching practice and social interactions, and adaptation of the environment and the curriculum.

Scruggs and Mastropieri (1996) reviewed 28 studies investigating teachers' perceptions of mainstreaming/inclusion for children with disabilities. The reviewers found that although mainstreaming/inclusion was seen as beneficial by the majority of teachers, fewer felt they were adequately supported and resourced to effectively meet the educational needs of a child with a disability in the mainstream classroom. Further, nearly all (96%) of the trainee teachers in Wishart and Manning's (1996) study felt their teacher training did not provide them with adequate training for teaching in an inclusive setting. Thus, the need for adequate training and resourcing of teachers to better provide learning opportunities and curriculum adaptations for children with disabilities is a recurring theme in the literature.

In an attempt to identify the strategies used by American teachers in successful inclusion, Wolpert (2001) surveyed teachers who had been identified by parents of children with DS (aged 4 - 20 years, M = 10;06, SD = 3;0) as successfully including their children in their classroom. A questionnaire was completed by 189 teachers which included questions on curriculum, instruction and classroom practice relating to both the children with DS and their classroom peers. Nearly two thirds (63%) of teachers had some additional special education training, however, fewer than half had received support from their school district in preparation for the inclusion of a child with DS in their class. The majority of teachers reported their class included another child or children with identified learning difficulties in addition to the child with DS. Most classrooms (83%) included teacher-aide support although this support was not exclusively for the child with DS. The children with DS also received other services including speech-language therapy (94%), occupational therapy (62%) and physical therapy (37%) with 52% of help and services presented out of the classroom and 48% provided in the classroom setting.

Teachers reported the most effective instructional settings both for the children with DS and for their classroom peers, were one on one or in small groups. Computer and peer support were also reported as useful and effective but not large group settings. Teachers also favoured giving homework to the children with DS and felt this was important both to maintain a link between school and home and to provide the children with DS extra opportunity to practice the targeted skills. Praise and positive reinforcement was reported by teachers as their preferred classroom and behaviour management style and acknowledgement was given for participation and effort rather than achievement level for the children with DS.

When asked to identify ways in which the inclusion process could be improved, teachers in the Wolpert (2001) study identified a need for extra time both for planning and instruction, and additional information about DS and its potential impact on learning.

1.10.4 Teachers Beliefs about Reading

Reading acquisition is considered to be an achievable goal for many young people with DS. Findings of a study by Çolak and Uzuner (2004) which explored Turkish special-education teachers' beliefs about literacy acquisition by children with cognitive impairment, revealed most teachers believed these children learnt to read in largely the same way as children without cognitive impairment. Additionally, the way the teachers taught reading was determined by their adherence to either a "reading readiness" (Gates, 1937; Morphett & Washburne, 1931) or "emergent literacy"(Teale & Sulzby, 1986) philosophy.

Westwood, Knight, and Redden (1997) developed a questionnaire to assess teachers' beliefs about reading. They too concluded that teachers' practice was strongly influenced by the beliefs they hold about children's early reading development. Further, Mesmer's (2006) research suggested that teachers' adherence to an implicit (or incidental) versus explicit approach to phonics instruction (Tunmer & Chapman, 1999), appeared to influence not just reading instruction but also the types of texts used in the classroom. An example of an approach where phonics instruction is incidental is the whole language approach to reading instruction, reportedly the predominant instructional method in New Zealand schools (New

Zealand House of Representatives, 2001). Proponents of this top-down reading approach (Smith & Elley, 1994) attest that just as they learn spoken language, children will learn written language naturally through exposure to a rich literacy environment (e.g. F. Smith, 1999; Smith & Elley, 1994), and emphasise the contribution of the learner and the literacy environment, the authenticity of the setting, and the nature of the texts, with a focus on reading for meaning ahead of reading accuracy. Contrastively, a bottom-up code emphasis approach (e.g. Chall, 1983; Liberman & Liberman, 1990) is an approach which includes explicit phonics instruction and emphasises the acquisition of the alphabetic principle and phonographic relationships of the language.

1.10.5 Section Summary

Teachers' attitudes to mainstreaming are influenced by their knowledge about disabilities and their perception of self efficacy (Campbell et al., 2003; Gilmore et al., 2003; Wishart & Manning, 1996). Although many teachers expressed largely positive attitudes towards mainstream education for children with disabilities, the majority felt they were not sufficiently trained, resourced or supported to successfully meet the educational needs of children with disabilities in a mainstream classroom setting (Buell et al., 1999; Scruggs & Mastropieri, 1996). Taken as a whole, these findings illustrate teachers' understanding of DS, their perceptions and beliefs about inclusion, and their educational practice including reading instruction, strongly influence the classroom and learning experience of children with DS.

1.11 Summary and thesis aims

Investigations into the spoken and written language profiles of children with DS report wide-spread variability, both in the development of these abilities and in the levels of performance achieved. Interventions to improve these abilities in children with DS have historically emphasised rote learning, however increasing attention is being given to the similarities between the spoken and written language profiles of children with DS and those of children with other spoken and written language impairments. Phonological awareness interventions have been implemented successfully with children with spoken language disorders, however their potential for improving both speech production and written language skills in children with DS has not yet been investigated.

Consistent with current theories of reading, children with DS may be at increased risk of poor reading and spelling given their phenotypic verbal working memory deficits and the lack of attention traditionally given to instruction in phonological decoding skills for this population. Currently there are no systematic investigations into the influence of the New Zealand schooling environment on reading and spelling development in children with DS.

A rich home literacy environment is associated with children's improved language and literacy outcomes, however evidence suggests the home literacy environment of children with disabilities may not be as rich as that of children with typical development. Investigations into the influence of the home literacy environment on emergent literacy skills have typically included pre-school children, but its influence on these skills in school aged children with DS has yet to be examined. There is limited data from controlled intervention studies to provide practitioners as to effective interventions for this population.

An integrated phonological awareness approach to intervention that simultaneously targets speech production, letter knowledge and phonological awareness may be effective in facilitating development in these skills for young children with DS.

The primary aims of this thesis are:

1. To describe the spoken and written language profiles of New Zealand children with Down syndrome.
2. To investigate the environmental variables influencing phonological awareness, and spoken and written language development in New Zealand children with Down syndrome.
3. To evaluate the effectiveness of an integrated phonological awareness intervention on aspects of spoken and written language development in young children with Down syndrome.

Specifically, the following questions are addressed:

1. What are the phonological awareness, speech, language and literacy skills of New Zealand children with Down syndrome?
2. How does the home literacy environment support phonological awareness and literacy development in New Zealand children with Down syndrome?
3. How does the school literacy environment support phonological awareness and literacy development in New Zealand children with Down syndrome?
4. What are the immediate effects of an integrated phonological awareness intervention on the speech, phonological awareness, letter knowledge and early reading and spelling development of New Zealand children with Down syndrome?
5. What are the longer term effects of an integrated phonological awareness intervention for New Zealand children with Down syndrome?

CHAPTER 2

EXPLORING ASPECTS OF SPOKEN AND WRITTEN LANGUAGE PROFILES OF NEW ZEALAND CHILDREN WITH DOWN SYNDROME

2.1 Introduction

Considerable advances have been made in understanding Down syndrome (DS) in the 50 years since its etiology was first identified (Lejeune, 1959). Fidler (2005) examined research investigating the behaviour phenotype of this population across physical, cognitive, language and psychosocial domains and hypothesised as to the direction interventions might take to capitalise on the strengths and remediate the weakness.

A review of the literature (Chapter 1) revealed that individuals with DS have a phenotypic spoken and written language profile which includes elements of both delay and disorder (Bleile & Schwarz, 1984; A. Byrne et al., 2002; Fletcher & Buckley, 2002; Groen et al., 2006; Hodson, 2007b; Miller & Leddy, 1998; Parsons & Iacono, 1992; Smith & Stoel-Gammon, 1983; Van Borsel, 1988, 1996), with considerable individual variation also reported. The poorer expressive language skills relative to receptive language skills has been described as evidence of a specific expressive language deficit (e.g. Chapman et al., 1998), which is in addition to their cognitive impairment. Written language deficits and specific difficulties in oral language skills that are critical for reading and writing success have also been reported (A. Byrne et al., 2002; Gombert, 2002; Roch & Jarrold, 2008; Roch & Leverato, 2008; Snowling et al., 2002).

Little however is known about the spoken and written language profiles of children with DS in the New Zealand cultural and educational environment. This is problematic as both home and school instructional methods have an important influence on children's language development. New Zealand differs from many other countries in that it has a national educational curriculum at both pre-school and school levels.

The pre-school curriculum Te Whäriki (New Zealand Ministry of Education, 1996) is an inclusive curriculum which is compulsory for all pre-school children receiving early childhood services in New Zealand, including those with disabilities. The effectiveness of early intervention for children with disabilities and the principles and practices which facilitate improved child outcomes are well documented in the literature (see Alliston, 2007, for a review). Early intervention support is available for children with disabilities from birth and throughout their pre-school years (Ministry of Education, 2008a).

For school-aged children with disabilities, support is provided through the Ongoing Resourcing (ORS) and Renewable Resourcing schemes (RRS) (Ministry of Education, 2008d). The New Zealand curriculum is also mandated for all children, including those with disabilities (Ministry of Education, 2007b). The school language curriculum has in recent years developed a strong "whole language" approach (Smith & Elley, 1994) to language facilitation and with the integration of most children with DS into mainstream education (Holden & Stewart, 2002) it is important to understand the influences of the NZ curriculum on these children's language development.

Although there are an increasing number of studies investigating issues related to DS in New Zealand, there is an urgent need for further research to investigate the language abilities and profiles of New Zealand children with DS as well as the environments that facilitate them. New Zealand based research investigating issues in DS have examined inclusion and outcomes for children with DS in their transition to school and in mainstream education (Holden & Stewart, 2002; Irwin, 1989; Rietveld, 1996, 2004a, 2004b, 2005). These educationally focused studies typically comprise case studies or small sample sizes. One study conducted by Rietveld (1996) reported literacy development in 3 children with DS prior to school entry and after 4 months of schooling. In addition to reporting some quantitative data on measures of letter knowledge, reading and early print skills, Rietveld interpreted the data from this largely qualitative study according to philosophies of disability. These studies represent an important contribution to the literature around DS in New Zealand, however, a thorough investigation into the spoken and written language profiles of New Zealand children with DS has yet to be conducted. The current study begins to address this need by examining aspects of the spoken and written language profiles of children with DS in primary school education throughout New Zealand.

This study described in this chapter sought to answer the following question:

What are the phonological awareness, speech, language and literacy skills of New Zealand children with DS?

2.2 Method

2.2.1 Research Design

This study employed a descriptive design and was conducted in two parts.

2.3 Part 1 Screening of early developing phonological awareness and literacy skills

2.3.1 Participants

Seventy-seven participants took part in a descriptive study to examine the spoken and written language profiles of New Zealand children with DS. Participants were originally recruited through their schools to take part in a survey exploring the home and school literacy environment of New Zealand primary school-aged children with DS (for a detailed account of recruitment procedures see Chapter 3). Participants had a range of health and medical conditions but did not have any other diagnosed developmental syndromes. Completed surveys were received from parents and/or teachers of 88 children. Following collection of the survey data, participants' teachers administered an assessment battery according to a detailed assessment protocol and test administration script. The assessment battery included screening measures of phonological awareness, letter knowledge and real word decoding. Completed assessments were received for 77 participants comprising 87.5% of the survey sample. These participants were aged between 5; 08 (years; months) and 14; 11 (M= 8; 11, SD = 2; 4). For data analysis purposes, participants were divided into two age groups; 5 - 8 and 9 - 14. Participants aged 5 - 8 years would typically be in classrooms where formal literacy instruction occurred on a regular basis and would have had fewer than three years schooling. By contrast, participants aged 9 - 14 years would typically be in classrooms where the focus was on “reading for learning” as opposed to learning to read and would have had three or more years of schooling.

Assessment measures

- Initial Phoneme Identity (Gillon, 2005)

In this task the examiner names a large colourful picture of an animal and draws the child’s attention to the first sound of that word.

> Examiner: “This is my friend Mouse. Mouse starts with /m/. Mouse likes pictures that start with /m/. Let’s see what pictures he would like. What starts with /m / mat dog book?”

The child is then required to identify the target initial sound in a word, from a choice of three pictures presented and named by the examiner. Corrective feedback is given if required. The test comprised 2 training items and 10 test items.

- Rhyme Oddity (Gillon, 2005)

As with the Initial Phoneme Identity Task, this assessment does not require a verbal response. In this experimental task the examiner presents a large colourful picture of a clown and draws the child’s attention to pairs of rhyming words, telling the child that “rhyming words sound a bit the same”.

> Examiner: “This is my friend clown. Clown likes pictures that don’t rhyme. We will give him all the words that don’t rhyme”. The teacher then places and names three pictures in front of the picture and says “fish, dish, ball, which one doesn’t rhyme?”

This task requires the child to identify the word which does not rhyme from a choice of three, with the position of the rhyming and non-rhyming words randomly assigned.

Corrective feedback is given if required. The test comprised 2 training items and 10 test items, assessing rhyme detection of 10 different rhyme endings.

- Letter knowledge (adapted from Clay's observation letter identification task (1993)).

The child is shown an A4 sheet on which all upper and lower case letters are presented in Size 18 font. The letters lower case "g" and "a" are presented in two different fonts (**g**, **g**, **a**, **a**) as these are often confusing for children. Identification of either one is credited correct. The purpose of the test is to determine which letter names the child knows. The child is asked to point to a letter and tell the teacher what it is. If the child responds with the letter sound this is noted by the teacher and the child is asked if they also know the letter name. This test was intended to be administered to children under 5; 6. For the purposes of this study, the assessment was also administered to older participants who were able to read fewer than 10 words on the Burt Word Reading Test.

- The Burt Word Reading Test – New Zealand Revision (Gilmore, Croft, & Reid, 1981).

This single word decoding test assesses a child's ability to read real words. Words are presented on a sheet in order of increasing difficulty. The test provides age equivalence bands for children aged over 6. Corrective feedback may not be given, however teachers were encouraged to make noncorrective comments such as "great choosing", or "you're working hard" throughout all the testing to maintain the child's motivation.

2.3.2 Data analysis and reliability

All tests administered during Part 1 were scored by teachers during administration and returned to the lead researcher. All score sheets were checked by the researcher before data entry. Additionally an independent researcher checked scoring and data entry on a randomly selected 20% of the score sheets, with scores recorded by the lead researcher. Inter-rater reliability was 96.2% with any discrepancies resolved before analysis.

2.4 Part 1 Results

Data were analysed by age group; 5 - 8 years (Group 1: N=48, M=7; 0, SD= 12.5 m) and 9 - 14 years (Group 2: N=35, M=11;02, SD= 19.2m) to reflect reading development and environment. The number of children completing each task is also reported, as this varies across tasks and was influenced by both the purpose of the assessment and the behaviour and motivation of the participants. A summary of the results of the screening measures is presented in Table 2.1.

Table 2.1. Performance on letter knowledge, phonological awareness and word decoding assessments by group

Assessment	Group 1 (aged 5 - 8)				Group 2 (aged 9 - 14)			
	n	Mean	SD	Range	n	Mean	SD	Range
Age in months	42	86.4	12.7	68-106	35	133.1	19.6	108-179
Letter-name knowledge	33	11.3	10.7	0-26	24	20.9	8.0	0-26
Letter-sound knowledge	24	7.04	9.0	0-25	11	16.3	7.9	0-26
Initial phoneme identity	41	3.9	3.1	0-10	35	7.3	2.6	3-10
Rhyme oddity	42	3.5	2.3	0-8	34	5.0	2.5	0-10
Burt Word Reading test	42	6.8	9.1	0-32	34	21.8	14.6	0-50

Note: Letter-name knowledge and Letter-sound knowledge scores are raw scores, out of a possible 26, Initial phoneme identity and Rhyme oddity scores are raw scores, out of a possible 10; Burt Word Reading Test scores are number of words read correctly

2.4.1 Letter Knowledge

The purpose of the letter knowledge assessment was to determine how many letter names the child knew. As such, letter-sound knowledge was not assessed for all children. Five children declined to complete all the letter knowledge assessments. An additional 11 children did not complete the letter knowledge tasks due to age, as all were able to read more than 10 words on the Burt Word, as per the instructions. However, there were 25 participants who completed letter knowledge assessments who were both above 5;06 and were able to read more than 10 words. Although this was not part of the original protocol, these data were included in the analysis.

Participants were able to identify more letter names than sounds. However scores were not evenly distributed, with both very high and very low scores reported from both groups. For Group 1 children, 29.7% knew no letter names, and 37.8% knew 20 or more letter names. More than half of Group 1 children (54.8%) knew no letter sounds, and 12.9% knew 20 or more letter sounds. Approximately two thirds of Group 2 children completed the letter-name knowledge assessments, of whom 3.8% knew no letter names, and 73% knew 20 or more letter names. Approximately one third of Group 2 children completed the letter-sound knowledge assessments, with results indicating 14.2% knew no letter sounds, and 35.7% knew 20 or more. Mann-Whitney rank sum tests were conducted to compare the performances of the groups. Group differences in favour of Group 2 were significant for both letter-name [Mann-Whitney U = 153.5, $p < 0.001$] and letter-sound knowledge [Mann-Whitney U = 60.5, $p = 0.01$]. Correlational analysis found a fair relationship between participants' age and letter-name [$r = 0.33$, $p = 0.01$] and letter-sound knowledge [$r = 0.36$, $p = 0.03$].

2.4.2 Phonological Awareness

Results for the Initial Phoneme Identity (IPI) task indicated 24.3% of Group 1 and 60% of Group 2 (that is 40.7% of all participants) achieved above chance scores. Above chance was calculated using the binomial test (Portney & Watkins, 2009), which calculates the cumulative probability of achieving the score or a greater score by chance. For a statistically significant result ($p < 0.05$) a score of 7/10 or higher was required.

Using data for the whole sample, correlational analysis was used to examine the relationship between the participants' age and performance on the IPI task, with results indicating a moderate and significant relationship between the two [$r = 0.46$, $p < 0.001$]. A Mann-Whitney rank sum test conducted to compare the performances of the groups found significant group differences in favour of Group 2 [Mann-Whitney U = 289, $p < 0.001$].

Results for the Rhyme Oddity task indicated 9.5% of Group 1 and 26.4% of Group 2 (that is 17.1% of all participants) achieved above chance scores. Above chance was calculated using the binomial test (Portney & Watkins, 2009), with a score of 70% or higher required for a statistically significant result ($p < 0.05$). Correlational analysis found no relationship between participants' age and scores on the Rhyme Oddity task [$r = 0.15$, $p = 0.17$]. However, Mann-Whitney rank sum tests conducted to compare the performances of the groups found significant group differences in favour of Group 2 [Mann-Whitney U = 504, $p < 0.027$].

2.4.3 Word decoding

Results of the word decoding test showed 24% of participants were unable to read any words correctly (39.02% of Group 1 and 5.8% of Group 2) with 6.6% able to decode at a level expected for 7 – 8 year old children. Correlational analysis found a moderate and significant relationship between participants' age and decoding ability [$r = 0.55$, $p < 0.001$]. A Mann-Whitney rank sum test conducted to compare the decoding performances of the groups found Group 2 children significantly outperformed their younger peers [Mann-Whitney U = 256, $p < 0.001$].

A correlational matrix reporting correlations between the variables is presented in Table 2.2. The strongest relationship was between participants' letter-name and letter-sound knowledge. Initial phoneme identity was also strongly correlated with both letter-sound knowledge and single word decoding, with the weakest relationships demonstrated between rhyme and all other variables.

Table 2.2. Pearson's *r* values for correlations between performance on letter knowledge, phonological awareness, and decoding tasks.

	Letter-Sound Knowledge	Initial Phoneme Identity	Rhyme Oddity	BWRT
Letter-Name Knowledge	0.892	0.692	0.504	0.671
Letter-Sound Knowledge		0.713	0.569	0.654
Initial Phoneme Identity			0.548	0.717
Rhyme Oddity				0.394

Note: All correlations are significant to the level of $p < 0.001$

Four of the 14 children who achieved perfect scores on the IPI task did not complete the letter knowledge assessment due to age, however the remaining 10 children all knew at least 23 letter names or sounds. All twenty children who scored above chance on the IPI task and who completed the letter knowledge assessments, knew a minimum of 19 letter names or sounds. However, there were seven children who demonstrated this level of letter knowledge and achieved below chance scores on the IPI task. Regressions analysis was conducted to further investigate the relationship demonstrated between letter knowledge and phonological awareness scores, and any transfer to real word reading. A Best Subsets Regression was used to determine which combination (subsets) of the dependent variables (letter knowledge, initial phoneme identity and rhyme oddity skills) best contributed to the prediction of the dependent variable (real word decoding). Letter-name knowledge alone was found to predict 48% of the Burt Word Reading Test scores, with IPI scores contributing a further 4%. Table 2.3 presents the best two models where *p* values are at or approaching the level of significance ($p < 0.05$).

Table 2.3. Best Subsets Regression Analyses for Burt Word Reading Test

Variables	R^2	R^{2adj}	*P*
Model 1			
Letter-name knowledge	0.496	0.481	<0.001
Model 2	0.551	0.523	0.056
Initial phoneme identity			0.005
Letter-name knowledge			

2.5 Part 1 Discussion

The findings suggest primary school children with DS demonstrate a wide range of phonological awareness and decoding skills, with some demonstrating mastery of phoneme identity and letter knowledge tasks while others were unable to achieve correct scores on any assessment measure. Development of skills with maturation was evident. As a group, the older children achieved significantly higher scores than the younger group on all measures. The rhyme oddity task appeared particularly challenging with many comments received regarding participants' apparent lack of understanding and random choice of answers, and further data analysis evidencing widespread position pattern responses.

The weaker correlations between performance on the rhyme task and all the other variables appears to support the assertion that phoneme level, not rhyme level awareness is most associated with reading skills (Hulme et al., 2002; MacMillan, 2002; Muter et al., 1997). Additionally, the findings appear to confirm those of Gombert (2002) and Snowling et al. (2002) who have identified a specific rhyme deficit in children with DS.

As is the case with children with typical development, participant's letter-name knowledge was in advance of their letter-sound knowledge (Arrow, 2007; McBride-Chang, 1999; Worden & Boettcher, 1990). The robust correlational relationships between the letter knowledge and phoneme awareness tasks, coupled with the high letter knowledge evidenced by all children with high IPI scores, implies letter knowledge is prerequisite for phoneme awareness in this population. However, there were still a number of children with high letter knowledge who were unable to achieve above chance scores on the IPI task, which illustrates letter knowledge alone was not sufficient to consolidate phoneme level awareness in children with DS.

2.5.1 Clinical implications

The findings suggest there is a need for explicit phonological awareness instruction in addition to letter knowledge instruction, to be routinely given to children with DS and for this instruction to continue throughout their primary school years. The efficacy of phonological awareness intervention needs to be rigorously explored for this population (see Chapter 5).

2.6 Part 2 In-depth language investigation

2.6.1 Participants

Children who were able to decode 10 or more words on the Burt Word Reading Test (Gilmore et al., 1981) were eligible to take part in an additional investigation. Thirty-two children met this criterion, of whom 31 agreed to participate in further assessment. Initial data analysis revealed the speech-language therapists who implemented the assessments following training from the researcher failed to adhere to the standardised testing protocols for four of the participants, to an extent where the validity of the results could not be established. These data were, therefore, excluded from the analysis, resulting in a sample size of 27 participants. These participants were aged between 5;11 (years; months) and 13;01 (M= 9;08, SD = 2;2) and were assessed on measures of speech, phonological awareness, reading and narrative skills. These assessments were administered by participants' speech-language therapists (SLTs). SLTs were largely employed by the Ministry of Education- Special Education (GSE) to provide SLT services to children with high needs or very high needs (Ministry of Education, 2008d) with the remainder employed by their special school or other fund-holder, or employed privately. Permission was received from GSE, from participating special schools and from families sourcing private SLT services, for the child's SLT to administer the assessments in the course of their practice with the children. A condition of this permission was that the assessments would be limited to those which would be routinely used by the SLTs in their practice.

The following assessments were administered in Part 2 of the investigation:

- New Zealand Articulation Test (Moyle, 2004).

This single word articulation test assesses single and multi syllabic words elicited by naming pictures. The test was normed on New Zealand children, with standard scores available for children aged 5;0 to 7;11. Where a spontaneous response could not be elicited by the picture or semantic cue, a response was elicited following delayed imitation. All responses were transcribed via broad transcription and samples were analysed using PROPH (Long & Fey, 2005). Percentage consonants correct-revised (PCC-R) scores are presented. Within the PCC-R metric, both clinical and non-clinical distortions are scored as correct, whereas within the PCC (Shriberg & Kwiatkowski, 1982) analysis, distortions are scored as incorrect, thus giving them the same weighting as substitutions and omissions. Shriberg, Austin, Lewis, McSweeney and Wilson (1997) recommended the PCC-R as the measure which is most appropriate to use when comparing the speech of individuals who are diverse in both age and in speech profiles, as is the case for the children in the current study.

- Clinical Evaluation of Language Fundamentals-Preschool Edition 2 Phonological awareness subtest (CELF-P-2) (Wiig, Secord, & Semel, 2004).

This 6 part subtest assesses word, syllable, and rhyme awareness and is designed to measure emerging phonological awareness in very young children. As fewer than half the participants were able to achieve above chance level scores on the IPI task described in Part 1 of the study, the CELF-P-2 subtest was selected in order to assess emerging awareness at a simpler level that that measurable by the IPI task.

- The Neale Analysis of Reading- 3rd Edition (Neale, 1999).

This reading test consists of a series of passages of increasing difficulty. The child is required to read each passage aloud to achieve a reading accuracy score with any reading inaccuracies prompted or corrected by the examiner. Subsequently, children are required to answer a number of questions related to the story to achieve a reading comprehension score. The test is standardised on Australian children and provides normative data on reading levels of children in their first seven years of schooling, with age equivalent scores calculated from raw scores. The test uses year of schooling to determine standard scores, stanines and percentile ranks. As year of schooling was not easily defined in the current population, and floor effects were apparent, raw scores were used for analyses. Neale (1999) reports a satisfactory reliability of the test, with test-retest reliability coefficients of .95 for reading accuracy and .93 for reading comprehension.

- Personal narrative.

Narrative language skills were assessed via a personal narrative task using a protocol described by Westerveld and Gillon (2002). According to this protocol, children are shown a series of pictures and after hearing a scripted introduction by the therapist, children are invited to tell a past personal experience.

2.6.2 Data analysis and reliability

The phonological awareness subtest of the CELF-P-2 was scored by SLTs during administration. All tape recorded assessments were checked against these score sheets by the researcher before data entry. Additionally an independent researcher checked scoring and data entry on a randomly selected 20% of the score sheets with scores recorded by the lead researcher. Inter-rater reliability was 99.6% with any discrepancies resolved before analysis.

<u>Transcription and Analysis</u>

Speech samples

All NZAT assessments were tape recorded using a high quality tape recorder. The majority of SLTs had attempted some transcription during the assessments.

However, for fidelity purposes these transcriptions were only used where fine discriminations could not be made from the tape recording or when isolated background noise obscured production of the sound. The lead researcher listened to all the tapes, transcribed all the speech samples via broad transcription. and entered the data into PROPH (Long & Fey, 2005) for analysis. An independent researcher checked scoring and data entry on a randomly selected 20% of the score sheets with scores recorded by the lead researcher. Inter-rater reliability was 96.4% with any discrepancies resolved before analysis.

Reading Measures

All reading assessments were tape-recorded using a high quality tape recorder. The lead researcher listened to all the tapes and scored all results according to the administration and scoring manual. Quantitative measures of reading accuracy and comprehension were calculated using raw scores. No qualitative analysis of reading measures was undertaken. An independent researcher checked scoring and data entry on a randomly selected 20% of the score sheets with scores recorded by the lead researcher. Inter-rater reliability was 98.8% with any discrepancies resolved before analysis.

Narrative Measures

All oral narrative language samples were tape-recorded, using a high quality tape recorder. Samples were transcribed by the lead researcher using standard Systematic Analysis of Language Transcripts conventions (SALT; Gillon, Westerveld, Miller, & Nockerts, 2002; Miller & Chapman, 2003). Utterance segmentation was based on communication units (CU), using Loban (1976) rules. Only complete and intelligible (C&I) utterances were used for analysis; interrupted and abandoned sentences were excluded, as well as utterances containing unintelligible segments.

Microstructure Analysis The personal narrative samples were cut after the first 50 C&I utterances and analyzed at microstructure level. For the four participants who produced fewer than 50 utterances (22, 27, 29, 39), the entire sample was used for analysis. Quantitative measures of language ability that have been shown to distinguish between children with language impairment and children with typical language development were selected and calculated automatically using SALT (Gillon et al., 2002; Miller & Chapman, 2003).

- Grammatical competence was measured as 1) grammatical complexity: the mean length of CU in morphemes (MLU), and 2) grammatical accuracy (GA): the percentage of grammatical CUs (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004). Utterances that were not considered grammatically accurate were coded in SALT during the transcription process.
- Semantic diversity was based on the number of different words (NDW). Several studies have indicated that NDW derived from 50 C&I utterances is a promising quantitative indicator of expressive vocabulary (e.g., Miller, 1996; Watkins, Kelly, Harbers, & Hollis, 1995).

Macrostructure Analysis All personal narratives were analysed and coded by an independent researcher experienced in "high point analysis" (McCabe & Rollins, 1994). According to this type of analysis, the three longest narratives are selected for possible analysis.

As the longest narrative is not necessarily the best, McCabe and Rollins (1994) suggest analysing the three best narratives and crediting the child with the most complex narrative produced. Narratives are scored using a series of yes or no questions examining the content of the narrative which McCabe and Rollins depict in a flow chart. The researchers described the following narrative structures a) one event b) two event, c) miscellaneous: two past evidence without logical sequence d) leapfrog: non-sequenced or has omitted events e) chronological sequential but without evaluation f) end-at-high-point: builds to high point but no resolution g) classic: builds to high point with resolution. Children typically produce two-event narratives at age 2 - 3, end-at-high-point narratives at age 5, and classic narratives by aged 6 (Engel, 1995; Hughes, McGillivray, & Schmidek, 1997; Peterson & McCabe, 1983). Chronological narratives are produced by children of all ages.

Reliability

Twenty percent of the remaining transcripts were analyzed by an independent examiner, experienced in language transcription. The percentage of agreement between the two examiners was as follows. Transcription reliability (including utterance segmentation) in percent utterance agreement: 87%. Error coding reliability in percent error-code agreement: 92%. With regards to the high point analysis, full agreement was reached between the independent examiner and lead researcher, with any initial discrepancies resolved after discussion.

2.7 Results

Participants' age and assessment data on measures of speech, phonological awareness, reading and narrative production are summarised and presented in Table

2.4. Two children were unwilling to participate in the phonological awareness assessment. For all other assessments, n = 27.

Table 2.4. Descriptive data on measures of age, speech, phonological awareness, reading and narrative production

		Mean	SD	Range
Age in months		114.1	26.98	68 – 154
Speech:	**PCC-R**	78.2	9.25	55.2 - 93.5
	PVC	92.8	7.0	69.9 – 100
Number of words sampled		92	23.5	43 – 129
PA		13.1	4.2	4 – 24
Reading:	**Accuracy**	14.3	12.1	0 – 42
	Comprehension	1.5	2.2	0 – 7
Narrative:	**MLUM**	2.5	1.0	1.1 – 5.5
	NDW	58.9	26.2	19 – 126
	GA	93.0	7.3	72 – 100
	PIU	83.1	10.6	58 – 98

Note: PCC-R =Percent consonants correct-revised; PVC = Percent vowels correct; PA = Phonological Awareness, raw scores out of a possible 24; MLUM = mean length of utterance in morphemes; NDW = Number of different words; GA = Percentage of grammatically accurate utterances; PIU = Percentage of intelligible utterances analysed; Maximum possible scores presented in parentheses.

2.7.1 Speech Characteristics

A one way analysis of variance (ANOVA) was used to compare the percentage of early, middle and late developing sounds (Shriberg, 1993) present in participants' speech samples (see Table 2.5). Results revealed significant differences between the three measures ($p < 0.001$), with a developmental progression and an increased variability apparent across this progression. A pairwise comparison (Tukey Test) showed significant differences ($p < 0.05$) between early versus late, and middle versus late, but not between early and middle.

Table 2.5. Percentage of early, middle and late developing sounds from NZAT samples

	Mean	**SD**	**Range**
Early	89.7	6.7	70.1 – 100
Middle	83.1	10.7	54.0 – 100
Late	52.5	18.2	10.9 – 81.9

Further analysis of speech data (see Table 2.6) revealed the most predominant error type was substitution, with omissions, distortions and additions featuring in approximately equal proportions. Although the data revealed considerable variability within the group, 59% of participants demonstrated all four error types in their speech samples.

Table 2.6. Percentage of error types from NZAT samples

	Mean	SD	Range
Substitutions	70.8	18.2	26.5 – 100
Omissions	11.0	9.0	0 - 37.3
Distortions	9.3	10.5	0 - 44.1
Additions	8.8	8.1	0 - 34.8

Speech data were further analysed to determine which speech error patterns were predominant in participant's speech. Table 2.7 presents the ten most commonly used processes and the percentage of participants using each process. All children used more than one process.

Table 2.7. Percentage of participants using phonological processes.

Phonological processes used	Percentage of participants
Gliding	88.8
Cluster simplification	88.8
Fricative simplification	85.1
Context sensitive voicing	81.4
Cluster reduction	77.7
Deaffrication	59.2
Later stopping	51.8
Velar fronting	37.0
Palatal fronting	29.6
Glottal substitutions	29.6

Liquid deviations were common, with gliding (e.g. /r/ →/w/, /l/ → /j/ or /w/) one of the most frequently occurring processes. Liquids were also frequently deleted or simplified in consonant clusters (e.g. flower → /foʊwə/, blue → /bju/). Vowelisation of postvocalic or syllabic /l/ (e.g. apple → /æpʊ/) is common in New Zealand English (Hay, Maclagan, & Gordon, 2008) and was not considered an error. Cluster simplification and reduction were also frequently occurring processes, which commonly co-occurred (e.g. straw → /dwɔə/). This example also demonstrates stopping and voicing errors. Use of multiple error patterns was widespread amongst participants and frequently involved voicing errors, simplification and substitutions simultaneously (e.g. fridge → /fwiʃ/, spider → /beɪdə/). All but 4 of the 27 children used an /f/ for /θ/ substitution ("TH" fronting), however, this is becoming more common in New Zealand speech and is considered by some to be a dialectic variation (Hay et al., 2008).Voicing errors were also common amongst participants and included pre- and post-vocalic devoicing (e.g. zip → /sɪp/, pig → /pɪk/) and pre- and post-vocalic voicing (e.g. pig → bɪg/, truck → /dwʌg/). Unusual and atypical processes were also evident in participants' speech including syllable reduction (e.g. animals → /æmʊz/), glottal substitutions (e.g. pencil → /pɛʔsʊ/), epenthesis (e.g. truck → /tʌwʌk/), metathesis (e.g. pacific → /səpɪkə/), coalescence (e.g. train → /seɪn/), idiosyncratic substitutions (e.g. money → gwʌni/) and sound preferences (e.g. overuse of /s/ in: magic →/bæʔsɪk/, dolphin → /soʊfɪn/, chair → /seə/).

2.7.2 Phonological Awareness

Analysis of the phonological awareness results across the six subsections indicated the strongest skills were demonstrated for the blending tasks, both at word level and at syllable level (see Table 2.8). A significant difference was found between participants' scores on the two rhyme tasks, with scores on the rhyme detection task significantly higher than rhyme production scores [Mann-Whitney U = 858.5, $p < 0.001$]. The nature of the detection task suggests the rhyme detection scores are inflated by chance. Participants are presented with two words and asked if they rhyme (yes or no). Three of the four word pairs do rhyme, thus children who responded yes to all items, as was the case for 16 participants, will achieve a score of 3. Contrastively, only eight of the participants were able to generate any rhyming words and only one child achieved the maximum score for this task.

Table 2.8. Participants' raw scores on the six subsections of the CELF-P-2 phonological awareness subtest

	Mean	SD	Range
Compound words (blending) (4)	3.2	1.2	0 - 4
Syllable blending (4)	2.6	1.2	0 – 4
Sentence segmentation (4)	2.0	1.3	0 – 4
Syllable segmentation (4)	2.1	1.5	0 – 4
Rhyme detection (4)	2.5	1.1	0 – 4
Rhyme production (4)	0.7	1.1	0 – 4

Note: Maximum scores are in parentheses.

2.7.3 Reading

Analysis of NARA data, using age equivalent scores calculated from raw scores, revealed participants demonstrated comparative weaknesses in reading comprehension compared to reading accuracy. However, floor effects prevented statistical analyses being undertaken using these scores. Eighteen of the 27 participants were able to achieve reading accuracy scores which were measurable by the NARA (i.e. age equivalent of 6;0 or greater). All of these participants achieved poorer comprehension than accuracy scores, with 10 achieving scores of < 6;0. For the 8 participants who were able to achieve a comprehension score of 6;0 or greater, the discrepancy between accuracy and comprehension scores was extremely variable and ranged from 1 month to 20 months. For three participants, the discrepancy was over 1 year, for 4 participants the discrepancy was between 5 and 8 months, with one participant having a one month difference between the two scores.

Analysis using reading accuracy and comprehension raw scores were undertaken to investigate the relationship between the three reading measures of reading comprehension, accuracy and decoding (BWRT). Linear regression analyses were performed, with moderate to strong relationships found between all three measures (reading accuracy and decoding [$r = 0.80$, $p < 0.001$], reading accuracy and reading comprehension [$r = 0.77$, $p < 0.001$], reading comprehension and decoding [$r = 0.70$, $p < 0.001$]). Best subsets regression analysis also demonstrated decoding was a significant predictor of reading comprehension, with single word decoding scores alone (BWRT) predicting 49% ($p = 0.006$) of reading comprehension (NARA comprehension raw scores). Best subsets regression analysis with reading accuracy as the dependent variable, revealed decoding, phonological awareness and letter knowledge all contributed to reading accuracy. Table 2.9 presents the best three models which account for up to 95% of the variance and have p values which are at the level of significance ($p < 0.05$).

Table 2.9. Best Subsets Regression Analyses for NARA-Accuracy

Variables	R^2	R^{2adj}	*P*
Model 1			
Burt Word Reading Test scores (decoding)	0.69	0.66	<0.001
Model 2			
Burt Word Reading Test scores	0.92	0.90	<0.001
Letter-name knowledge			<0.001
Model 3			
Burt Word Reading Test scores	0.96	0.95	<0.001
Initial phoneme identity scores (from Part 1)			0.011
Letter-name knowledge			<0.001

Significant relationships were also found between chronological age (CA) and reading ability, on the three reading measures of decoding [r = 0.52, p = 0.005], reading accuracy [r = 0.56, p = 0.002], and reading comprehension [r = 0.54, p = 0.003].

To examine the relationship between reading abilities and other variables, children were divided into two groups (A and B) based on reading ability. Reading Group selection was determined by performance on the comprehension component of the NARA. Participants with scores of 1 or zero were assigned to Group A (n = 20), and those who were able to more consistently demonstrate comprehension, with scores of 2 or more, were assigned to Group B (n = 7). Six participants achieved error scores on the NARA practice passage above the cut off point for completing the NARA. These participants were allocated a score of zero for both reading accuracy and reading comprehension, and thus were assigned to Group A. An independent samples t-test found the mean age of Group B children (the better readers), was significantly greater than that of Group A children (the poorer readers) [t (25) = -2.48, p = 0.02].

2.7.4 Narrative Microstructure analysis

Chronological age was proposed as a key predictor of performance on language and connected speech measures. To test this assertion, linear regression analyses were performed to investigate the relationship between CA and mean length of utterance in morphemes (MLUM), grammatical accuracy (GA), number of different words (NDW) and percentage of intelligible utterances (PIU). Moderate correlations were found between CA and NDW [r = 0.41, p = 0.028] however, results indicated no significant relationships existed between CA and MLUM [r = 0.35, p = 0.067]; CA and GA [r = 0.20, p = 0.29] or CA and PIU [r = 0.24, p = 0.22].

2.7.5 Relationship between reading, speech and narrative measures

Independent samples t-tests were performed to determine whether performance on language and speech measures was influenced by Reading Group membership. Significant group differences were found to exist for MLU [t (25) = -4.07, p = 0.023] (with equal variances not assumed) and NDW [t(25) = -4.15, p < 0.0001], with significantly greater scores on both measures achieved by Group B children. Between group comparisons on measures of grammatical accuracy and errors evidenced no significant difference between the groups on the GA measure [t (25) = 1.15, p = 0.25], however further analysis revealed significant group differences in morphological errors [t (25) = 2.85, p = 0.01], with omitted bound morphemes restricted to Group A children. No group differences were apparent for measures of PIU [t (25) = -1.13, p = 0.26] or for PCC-R [t (25) = -0.38, p = 0.70] and PVC [t (25) = -1.09, p = 0.28] analysed from the NZAT sample. A summary of language, speech and reading scores by Reading Group is provided in Table 2.10.

Table 2.10. Participants' speech, language and reading measures by reading group.

Reading Group	**A (n = 20)**	**B (n = 7)**
	Mean	**Mean**
CAmm	109.3	135.5*
MLU	2.20	3.69*
NDW	49.2	86.7**
GA	93.9	90.2
OBM	3.0*	0.0
PIU	81.7	87.0
PCC-R (NZAT)	77.8	79.4
PVC (NZAT)	91.9	95.3

IPI (Part 1)	6.9	9.2*
CELF-P:2 subtest total	12.5§	16.0§
Letter name knowledge (Part 1)	24§	26§*
Letter sound knowledge (Part 1)	17.8	20.6
Decoding (BWRT)	21.2	38.7*
Reading accuracy (NARA raw scores)	9.0	29.5*
Reading comprehension (NARA raw scores)	0.35	5.0*

Note: CAmm = chronological age in months; MLU = mean length of utterance in morphemes; NDW = number of different words analysed; GA = percentage of grammatically accurate utterances analysed; OBM = number of omitted bound morphemes; PCC-R = percent consonants correct-revised; NZAT = New Zealand Articulation test (Moyle, 2004); PVC = percent vowels correct; IPI = Initial Phoneme Identity task; CELF-P:2 subtest = Clinical Evaluation of Language Fundamentals-Preschool 2nd Edition (Wiig et al., 2004) phonological awareness subtest BWRT = Burt Word Reading Test New Zealand Revision (Gilmore et al., 1981); NARA = Neale Analysis of Reading - 3rd Edition (Neale, 1999); §Median scores reported as data not normally distributed; *significantly greater at the level of 0.05; **significantly greater at the level of 0.001

T-tests were performed to examine whether group differences were apparent on the phonological awareness and letter knowledge tasks. No significant differences were found between the groups on the CELF-P:2 subtest measure [Mann-Whitney U = 32.5, p = 0.06]. Although results revealed Group B children significantly outperformed Group A children on the phonological awareness measures of IPI, a linear regression using age as the only dependent variable found group made no further contribution once age was added in.

The relationship between speech and intelligibility was also investigated. No significant predictors of intelligibility were found amongst either speech (PCC-R or PVC) or language measures (MLU, NDW, OBM or GA), however the correlation between intelligibility and percentage of omission errors (from the NZAT sample) approached significance [r = -0.338, p = 0.08].

2.7.6 Narrative Macrostructure analysis

Participants' best personal narratives were analysed using high point analysis and narrative structures described by (McCabe & Rollins, 1994). Not all narrative structures were produced in the current study. Participants' narratives were categorised as one of the following types presented for the most part in developmental order (see Table 2.11).

Given the strong relationship apparent between microstructure measures and reading group, macrostructure measures were also examined by group. Numbers of children from each group producing each type of narrative is also presented in Table 2.11.

Table 2.11. Number of participants producing narrative types

	Number of participants	
	Group A	Group B
One event	4	1
Two event	7	0
Three event	5	1
Chronological (4 event)	2	0
Chronological (5 events or more)	2	1
End at high point	0	3
Classic	0	1

Results of the macrostructure analysis showed most participants produced early developing narrative structures, with 18 of the 27 producing one-, two-, or three-event narratives. Four participants produced more advanced narratives structures. Analysis by reading group revealed production of more advanced narratives was restricted to participants in Group B, who were also older, and better readers. Table 2.12 presents an early and a later developing narrative, produced using the same visual prompt.

Table 2.12. Two examples of personal narratives produced by participants with Down syndrome

	Visiting the dental nurse, by Thomas, aged 8; 11
E	that's right.
E	have you ever been to see the dental nurse?
C	yeah.
E	what happened the last time you went?
C	it hurt.
E	did it?
C	yeah.
E	I bet you were brave.
C	I was cry/ing.
E	oh no.
	Visiting the dental nurse, by Emily, aged 12; 6
E	<oh look>.
C	<the dentist>.
E	I *have been to a dentist before [nga].
E	the dental nurse <came to school>.
C	<at the school>.
E	yeah.
E	(tell me) tell me about that.
C	I got (I do/n't know) about here a tooth out [nga].
	=fingers in mouth while talking.
E	oh yeah.
C	about here got pulled out.

E you got it pulled out?

C yeah.

C xx.

E tell me that again, slow down.

C xx.

E you got your tooth pulled out~

C right up there.

=fingers in mouth to show where.

E yeah.

C out.

C don't know how he did it.

C but xx.

E what do you think he did?

C I think they got this thingy.

C they wriggle/ed it.

E yeah.

C they twist/ed it.

C and she pull/ed.

C and it was out.

E twisted and pulled and then it was out.

C yeah.

E mm.

C easy.

E well.

C *it did/n't even hurt [nga].

C *I did/n't scream or anything [nga].

E wow, you are amazing.

Note: E = Examiner; C = Child; x = Unintelligible word or segment; dysfluencies and reformulations are in parentheses; an equals sign = is used to preface contextual descriptions; greater than and less than signs < > are used to indicate overlapping speech; a tilde ~ is used to indicate an intonation prompt; an asterisk * is used to indicate an omitted word

2.8 Discussion

This study examined the phonological awareness, letter knowledge, speech, language and reading abilities of New Zealand children with DS. Results from both Part 1 and Part 2 of the investigation revealed considerable variability between individuals across all measures. Development of skills with maturation was evident for all measures except speech. This finding is consistent with researchers who reported speech deficits and reduced intelligibility are widespread and persistent in this population (Dodd, 1972; Kumin, 1994; Miller & Leddy, 1999; Roberts, Stoel-Gammon et al., 2008; Smith & Stoel-Gammon, 1996).

The results of the speech sound analysis revealed the participants with DS produced speech that was in many ways qualitatively and quantitatively similar to the speech of younger children with typical development (e.g. Bernthal & Bankson, 2004; Porter & Hodson, 2001). Hodson and Paden (1981) described the phonological processes present in the speech of their participants with unintelligible speech patterns. Analysis of the speech of the participants with DS in the current study revealed a number of similarities with the speech of these children. These similarities included the presence of numerous error patterns, as well as patterns not occurring in the speech of Hodson and Paden's control children with typically developing speech. Thus findings of the current study provide support for the claim that the speech of individuals with DS contains elements of both delay and disorder (Bleile & Schwarz, 1984; Hodson, 2007b; Miller & Leddy, 1998; Parsons & Iacono, 1992; Smith & Stoel-Gammon, 1983; Van Borsel, 1988, 1996).

The average percentage of intelligible utterances in the narratives of participants in the current study (M= 83.1%, SD = 10.6%), was entirely consistent with the intelligibility of narratives produced by individuals in Chapman et al.'s (1998) study (M = 83%, SD = 11%), and with the average percentage of intelligible words in connected speech (80%) produced by the speech delayed children in Shriberg et al.'s (1986) study.

Results of the phonological awareness subtest demonstrated participants experienced more difficulty with the segmentation tasks than the blending tasks, both at sentence and syllable level. Better scores on the syllable segmentation task compared to the sentence segmentation task suggests performance on the latter measure may have been impacted by participant's verbal memory. The mean MLUM achieved by participants in the narrative assessment was 2.5, however three of the four test items in the sentence segmentation task exceeded this.

As with the rhyme oddity task assessed in Part 1 of the study, rhyme appeared to be an area of particular difficulty, with rhyme generation scores substantially lower than all other scores. Chance effects on the rhyme recognition task prevent any assumptions being made about the relationships between rhyme level skills and word and syllable level skills.

Researchers have shown children with DS present with an uneven reading profile, with a comparative weakness in reading comprehension compared to decoding and accuracy (A. Byrne et al., 1995; A. Byrne et al., 2002; Carr, 1988; Fletcher & Buckley, 2002; Groen et al., 2006). The results of the current study confirm these findings. The considerable variability in reading levels reported in this study is also in line with other research findings (Cardoso-Martins et al., 2008; Groen et al., 2006; Sloper et al., 1990).

Better readers also had better language skills in terms of MLU and NDW, although no differences existed between the reading groups on other narrative language measures of percentage of GA, intelligibility, nor on measures of speech. Increased chronological age was associated with better performance on the language measures of NDW, OBM and on all reading measures. Contrary to the hypothesis of a syntactic ceiling (Fowler, 1990), these findings support those of Chapman et al., (1998) and Thordadottir et al., (2002), who reported individuals with DS continued to make gains in measures of syntactic complexity and MLU. Further, although grammatical accuracy was similar between the two reading groups in the current study, the omission of bound morphemes was restricted to Group A (who were younger), which provides evidence of continued syntactic development. Given the severely restricted MLU demonstrated by the younger participants, it is plausible that expressive rather than semantic language deficits (Boudreau & Chapman, 2000) may have been the limiting factor in their ability to produce the more advanced narrative structures demonstrated by their older peers.

The current study would have benefited from the inclusion of a comprehensive language assessment which included semantic, syntactic and receptive language measures as well as non-verbal mental age assessment measures. These data would have allowed for an examination of the relationships between language domains and the spoken and written language skills demonstrated by participants. Spoken and written language abilities have also been associated with lower hearing thresholds (e.g. Laws & Gunn, 2002), however hearing assessments were not conducted in the current study. Nonetheless, this investigation represents the first attempt to examine the spoken and written language profiles of New Zealand children with DS, and provides data representing a sizeable proportion of this population.

CHAPTER 3

LITERACY ENVIRONMENTS FOR CHILDREN WITH DOWN SYNDROME: WHAT'S HAPPENING AT HOME?

3.1 Introduction

It is important to expand our understanding of the HLE of children with Down syndrome (DS) in order to inform parents and professionals of relationships between HLE variables and positive literacy outcomes for children with DS and indicate ways to enhance their HLEs. Investigations can provide evidence to support development of targeted interventions specifically aimed at facilitating literacy with this population. As discussed in Chapter 1, little is currently known about the HLE of children with DS.

There is a substantial body of research which demonstrates that HLEs which feature frequent exposure to joint book reading and where parents engage in explicit teaching of letter knowledge and concepts of print are associated with improved reading outcomes for children (Sénéchal & LeFevre, 2002; Sénéchal et al., 1998). The influence of the HLE on children with disabilities is an area which warrants further investigation, however, current research investigating the HLEs of children with disabilities suggests the HLE may not be as rich for these children (Fitzgerald et al., 1995; Marvin & Mirenda, 1993). No previous investigations have been conducted in this area for New Zealand children with DS.

In general, New Zealand home environments are rated very favourably in terms of facilitating children's early literacy development. One of the findings from the Progress in International Reading Literacy Study (PIRLS, 2005/2006) (Mullis, Martin, Kennedy, & Foy, 2007) indicated that New Zealand parents were more likely to engage their child as a pre-schooler in literacy related activities compared to the other 39 countries which participated in the study (as measured by parental report). However, no data related specifically to children with special needs or children with DS was collected in this study.

The study described in this chapter adopted an emergent literacy framework to explore key features of the HLE of school-aged children with DS in New Zealand across three broad themes:

1. What are parents' priorities regarding literacy for their child with DS?
2. How does the HLE of children with DS support literacy development? Specifically:
   i) What are the frequency and duration of literacy interactions?
   ii) How do parents facilitate and encourage their child's literacy develop?
3. In what ways do children with DS participate in literacy interactions?

3.2 Method

3.2.1 Research design

This descriptive study reports survey data gathered via questionnaire on the home literacy environment of children with DS, completed by parents of participants.

3.2.2 Survey design

A Developing Literacy Questionnaire was modelled on and adapted from the Early Literacy Parent Questionnaire by Boudreau (2005)[1]. It was piloted with six parents of children with DS and modified in light of their feedback. The final version consisted of 49 questions under the following headings: *Educational Setting; Reading Books; Response to Print; Language Awareness; Interest in Letters; Writing and Television/Computer.* Respondents were also invited to make additional comments at the end of the questionnaire. The questions encompassed a number of broad themes including frequency and duration of literacy interactions, other ways parents support and facilitate literacy, parents' priorities for their children at school, and the child's literacy skills. The majority of the items called for binary responses, fill in the blanks or Likert (1932) scalar responses that could be quantified. Approximately 20% called for more qualitative descriptive responses. For example, following a question which asked parents to indicate how often they helped their child with their reading, they were asked about the type of help they gave their child. Other descriptive questions were overtly designed to encourage a positive approach to the activity of filling in the questionnaire, such as "What are some of your child's favourite books?" and "What do you enjoy most about reading with your child?" To determine the internal consistency of the questionnaire and to evaluate the extent to which the items measured a single construct, Cronbach's alpha, a correlation statistic, was calculated (Portney & Watkins, 2009). For the 30 questions assessed using a Likert (1932) scale and appropriate for all parents to answer, Cronbach's alpha equalled .921. These results are based on the 63% of parents who responded to all 30 questions. However, generalisation to the whole sample is appropriate as no pattern was observed to

[1] A copy of the survey is included in Appendix A. Adapted with permission of the author.

missing responses and response rates were over 92% for all 30 questions included in the analysis. (A parallel survey completed by participants' teachers was also developed and is reported in Chapter 4).

3.2.3 Participant selection

All eligible mainstream and special primary schools in New Zealand (approximately 2,060) were approached via a letter of introduction, inviting those with a child with DS on their school roll to participate in the survey. Initial expressions of interest in the study were received from responding schools on behalf of 169 children. Schools were sent project information sheets, surveys and consent forms to distribute to parents and teachers and were provided with a stamped self-addressed envelope to return the surveys to the lead researcher. Sixty-five parents or teachers subsequently declined to participate. Reasons given for non-participation included school involvement in other projects such as professional development or educational review, teacher's workload, teacher and parent health, and families' domestic circumstances. A further 16 failed to return the survey. Completed surveys were received from parents for 85 children equating to a return rate of 50%. This cohort represents an estimated 15% of the children with DS in New Zealand primary education (years 1- 8)[2]. (Children are required to attend school from the age of 6 (Year 1) although they may, and most do, attend from 5 years of age).

[2]Although there are no New Zealand national prevalence data for Down syndrome births, Stone(2005) reported stable yearly prevalence data of 1.17 per 1000 births between 1997 and 2003. Mean New Zealand birth rate for the period during which participants were born (1992 to 2001) was 57,799 (SD = 1,305)(Statistics New Zealand, 2008a). From these data it can be estimated that 65-70 children with Down syndrome were born in New Zealand annually during that period and that approximately 575 children with Down syndrome are in school years 1-8.

3.2.4 Participants

The participants were 85 children with DS (38 girls and 47 boys) aged between 5;04 (y;m) and 14;11 (M = 8;11, SD = 2;6). Participants' age and gender distribution are reported in Figure 3.1. Criteria for inclusion were a diagnosis of DS and enrolment in the school programme in years 1-8 (for children aged 5 to 14). Given that fluctuating or compromised health status is prevalent in children with DS, children were not excluded on the basis of significant ongoing medical concerns, hearing or visual impairment or a diagnosis of additional developmental disabilities.

Participants' mothers/stepmothers made up nearly 90% of respondents. Fathers completed almost 5% of the questionnaires with a further 3.5% completed jointly by parents. The remaining questionnaires were completed by the participants' legal guardians.

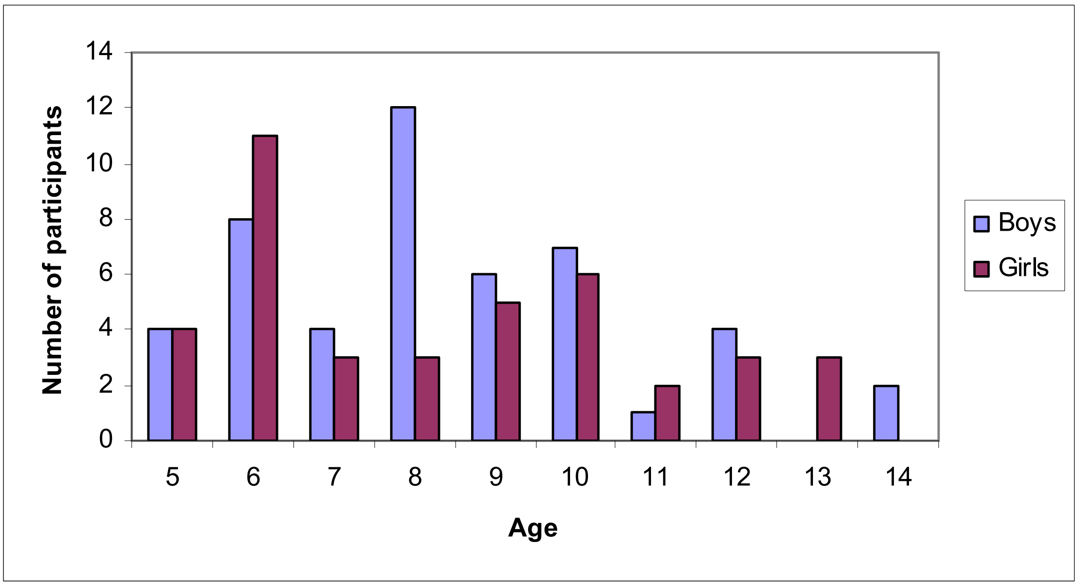


Figure 3.1. Participants' age and gender distribution

The 85 participants came from 55 mainstream schools (64 participants) and nine special schools (21 participants) based throughout rural and metropolitan New

Zealand[3]. The schools represented a range of socio-economic levels as indicated by the New Zealand Ministry of Education's decile system (Ministry of Education, 2007a). A school's decile is based on the socio-economic standing of the community from which a school draws its pupils and is based on national census data. Decile 1 schools have the highest proportion of students from low socioeconomic communities with decile 10 schools having the lowest proportion of students from low socioeconomic communities. Participants by school type and decile are presented in Figure 3.2.

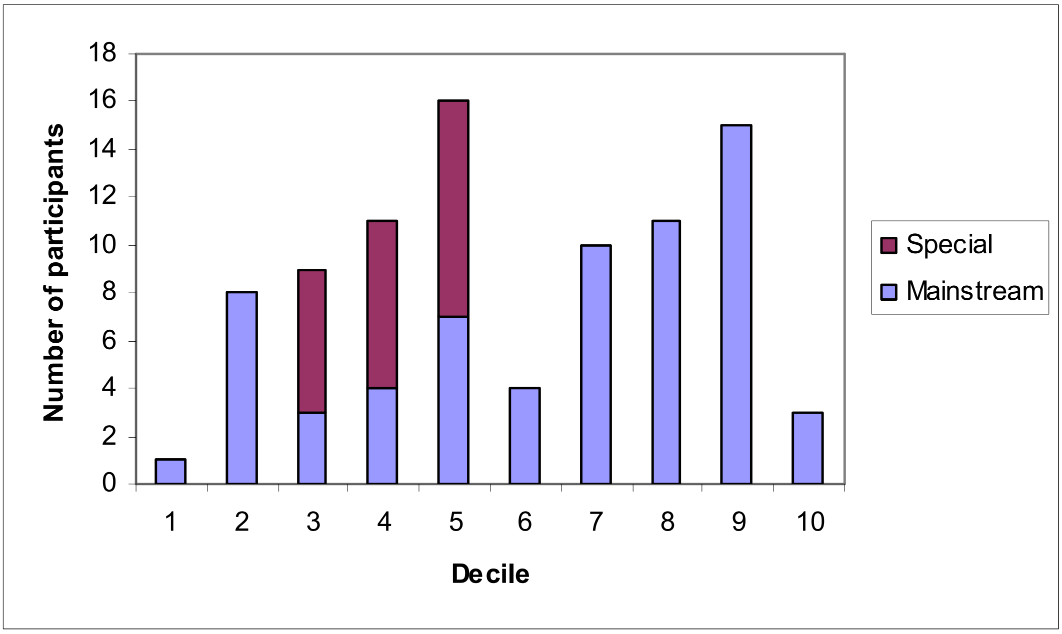


Figure 3.2. Participants' school type and decile

Year one to eight schooling in New Zealand is provided in a number of school settings (Ministry of Education, 2008g). State primary and intermediate schools and their integrated equivalents are co-educational and follow the New Zealand Curriculum (Ministry of Education, 2007b). Additionally the school programme in

[3]There are 28 non-residential special schools in New Zealand located in 14 different towns and cities. Sixty-eight percent of the special schools are located in the six largest urban areas. Special schools provide education and specialist therapies to children with high needs aged 5 -21. Attendance at a special school requires permission from Group Special Education (Ministry of Education, 2008f).

integrated schools includes a philosophical or religious special character. Full primary schools offer education to students in years 1 – 8, contributing schools offer education to students from years 1 – 6, intermediate schools offer education to students in years 7 and 8 only, and composite schools offer education at both primary (years 1 – 8) and secondary (years 9 - 13) level (Ministry of Education, 2008g). Participants in the study attended one of nine different school settings (see Figure 3.3).

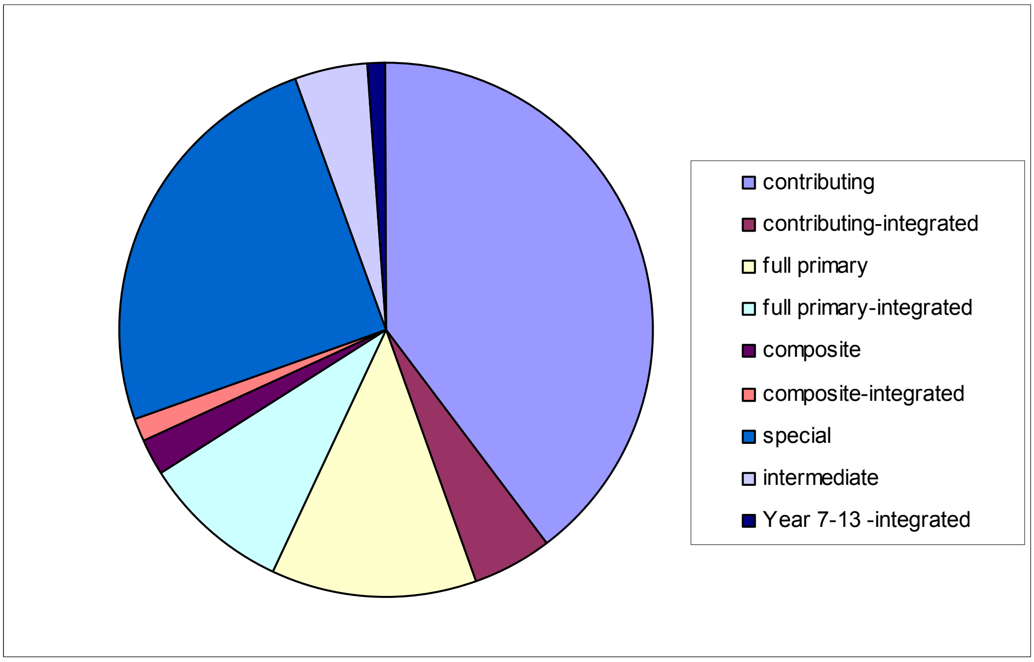


Figure 3.3. School settings attended by participants

All respondents reported their child received additional learning and teaching support at school. Specialist support including speech-language therapy (SLT), and learning support, is provided within the special school system. For children attending mainstream schools, learning support typically consists of services from a specialist teacher for 0.1 of a school week and teacher-aide support hours ranging from 5 to 25 hours per week (M = 17.2, SD = 4.63). Children who meet eligibility criteria receive SLT services through the Ministry of Education, Special Education (GSE) (Ministry of Education, 2008d). Eighty-one percent of respondents reported their child received SLT services. This included children who were having a therapy break. A further 6.1% were reported to be eligible for services but were not receiving them due to a lack of available therapists. Parents identified five different provision conditions through which their child received SLT services (see Figure 3.4).

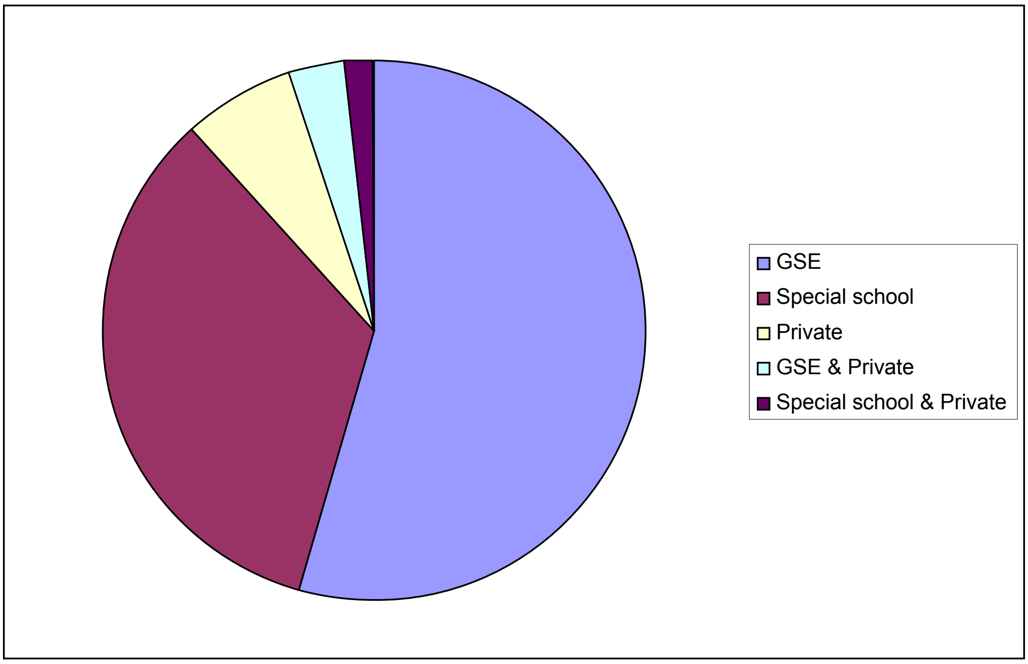


Figure 3.4. Proportion of providers of speech-language therapy services

Frequency of SLT services for eligible children attending mainstream schools varied considerably (see Figure 3.5), with the unavailability of therapists reportedly affecting half of those children who were not currently receiving SLT services.

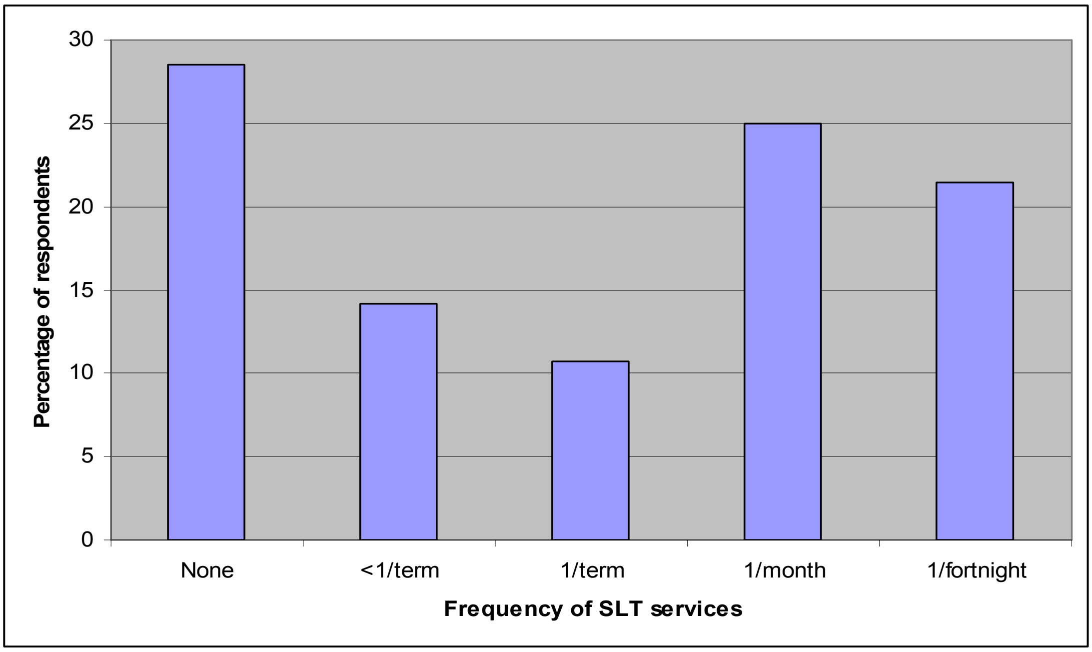


Figure 3.5. Reported frequency of speech-language therapy services provided to participants attending mainstream schools

3.2.5 Data analysis and reliability

All coding and data entry was checked by the lead researcher. Additionally an independent researcher coded a randomly selected 20% of the survey returns and checked reliability of data entry and survey interpretation with scores recorded by the lead researcher. Inter-rater reliability was 99.8% with any discrepancies resolved through discussion.

The results presented below represent analyses by descriptive and non-parametric statistics of both the sample as a whole and divided into two age groups: Group 1 (5 - 8 years; N = 48, M = 7;0, SD = 12.5 m) and Group 2 (9 - 14 years; N = 37, M = 11;02, SD = 19.2m). The division between the groups was made on the basis that participants aged 5 - 8 years were typically in classrooms where formal literacy instruction occurred on a regular basis, whereas participants aged 9 - 14 years were typically in classrooms where the focus was on “reading for learning” as opposed to learning to read.

3.3 Results

Results are presented within three broad themes, for all participants and by age group when group differences are apparent.

3.3.1 Parents’ priorities regarding literacy for their child

When asked to report on how important they rated classroom reading instruction for their child in comparison to other classroom activities, 79% of Group 1 parents and 86.4% of Group 2 parents selected classroom reading instruction as either their first or second most important activity. Similarly, when asked to rank skills in order of importance for children to learn at school, an equal proportion of parents in each group (43.2% Group 1; 43.7% Group 2) placed reading in the first position and another approximately 40% in both groups placed it in second ranked position. Writing appeared to hold the third ranked place of importance in parents’ minds after social skills and reading. Despite the high rankings parents gave to literacy learning at school, not all parents participated in regular discussion about their child’s literacy with the teacher or teacher aide. The pattern of response was similar between groups with 63.4 % of Group 1 parents and 74.2% of Group 2 parents reporting they discussed issues relating to their child’s literacy at least monthly.

A key measure of a rich HLE is that literacy activities are a source of interest and pleasure for both parent and child. A number of questions in the survey addressed these issues. Notwithstanding their lack of engagement with their child’s teacher about their child’s learning to read, parents were very clear about the value of reading at home. When asked what they most enjoyed about reading with their child, parents’ responses revealed five main themes, summarised in Table 3.1. Seeing their child's interest in books and the enjoyment their child gained from the story was identified by over one third of parents as being what they most enjoyed about reading with their child and over one quarter reported time spent together with their child gave them most enjoyment.

Table 3.1. Percentage of respondents reporting what they most enjoy about reading with their child.

Outcome	Percentage of Respondents
Child's pleasure and interest	36.0
Child's speech and language progress	25.3
Child's achievement and progress	18.6
Spending time together	17.3
Child's engagement with the story	8.0

One measure of the emphasis on literacy in the home is the number of books the family owns. Figure 3.6 reveals that 10% percent of parents and 5% of children owned fewer than ten books while 42% of parents and 30% of children owned over 100 books. The 5% of children with the fewest books were all in the younger age group (5-8 years). The mean and median number of books owned was 50 - 75 for all children and was 50 - 75 and 75 - 100 for parents. Eighty-two percent of families reported they received published materials including newspapers and magazines.

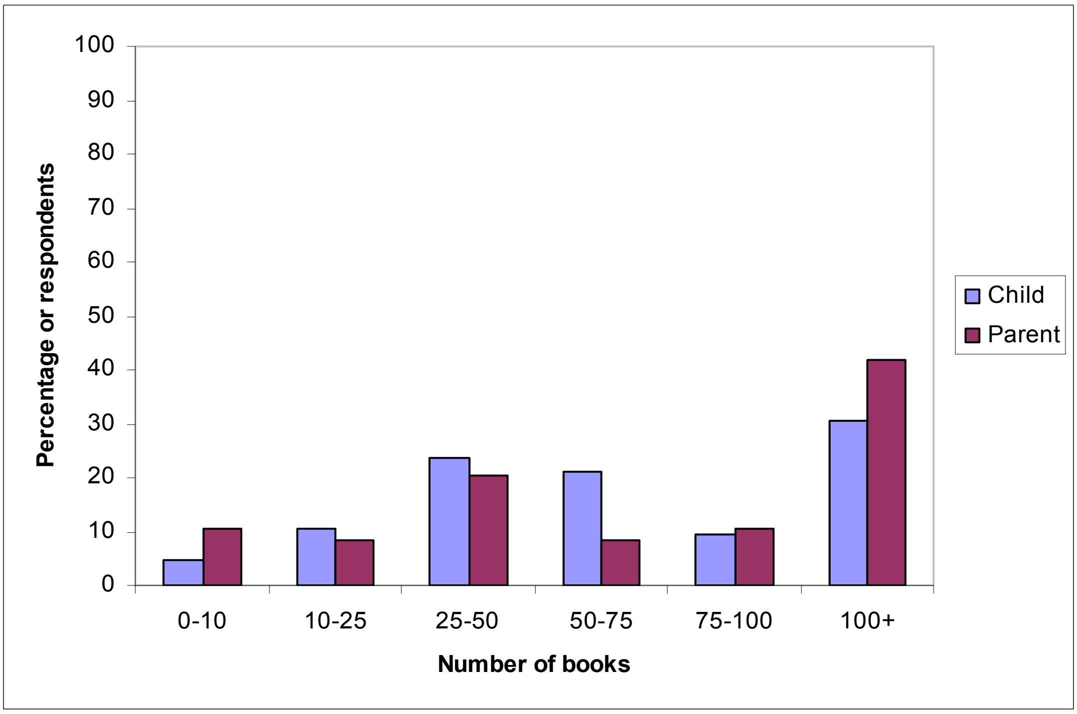


Figure 3.6. Number of books owned by children and parents

The majority of children in the study were introduced to books at a young age, with 66% of parents reporting they began reading together when their child was a baby (i.e. <12 months old) and 11% when their child was 1 year old. However, 22% of children were reported to be aged between 2 and 5 years when their parents began reading with them. Sixty-eight percent of parents reported they had a designated time for joint reading activities with the most commonly reported times being after school and before bedtime.

3.3.2 HLE support for literacy development Frequency and duration of literacy activities.

When asked about the frequency and duration of reading to their child (parent reads) and with their child (child reads), over 90% of parents reported they read to and/or with their child. Figure 3.7 shows 48% of these parents were reading together with their child daily and over 10% were reading several times per day. Reading times per week averaged 3.8 hours (SD = 3.02 hours) and ranged from ten minutes to fourteen hours. These figures combine reading for pleasure and reading homework.

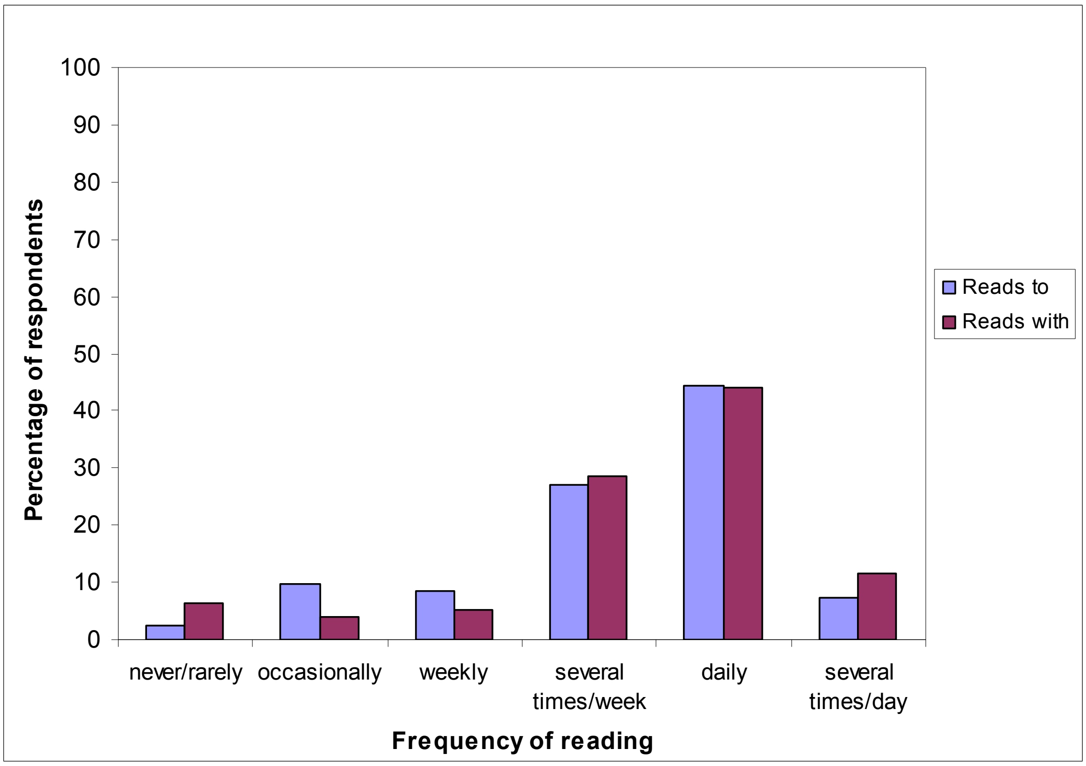


Figure 3.7. Frequency of joint reading

Home reading practice was a regular occurrence for almost all participants. Eighty percent of all participants brought books home from school for home reading practice at least weekly, with 48% engaged daily. Group differences were apparent which approached the level of significance (p = 0.057) (see Figure 3.8). Although 10.4% of Group 1 children (5 - 8 year olds) were reported to never bring home reading practice, a higher proportion of this group had home reading practice on a regular basis. Eighty-five percent of Group 1 children brought home reading practice at least weekly and 58.3% did so daily. By contrast, all children in Group 2 (9 – 14 year olds) were reported to bring home reading practice, although for 27% of them this was 'occasional' or 'rare'. Seventy-two percent of Group 2 children brought home reading practice at least weekly and 35.1% did so daily. Overall, parents reported high levels of reading support for their child with 96% reporting they helped their child with reading, and 62.2% providing help on a daily basis.

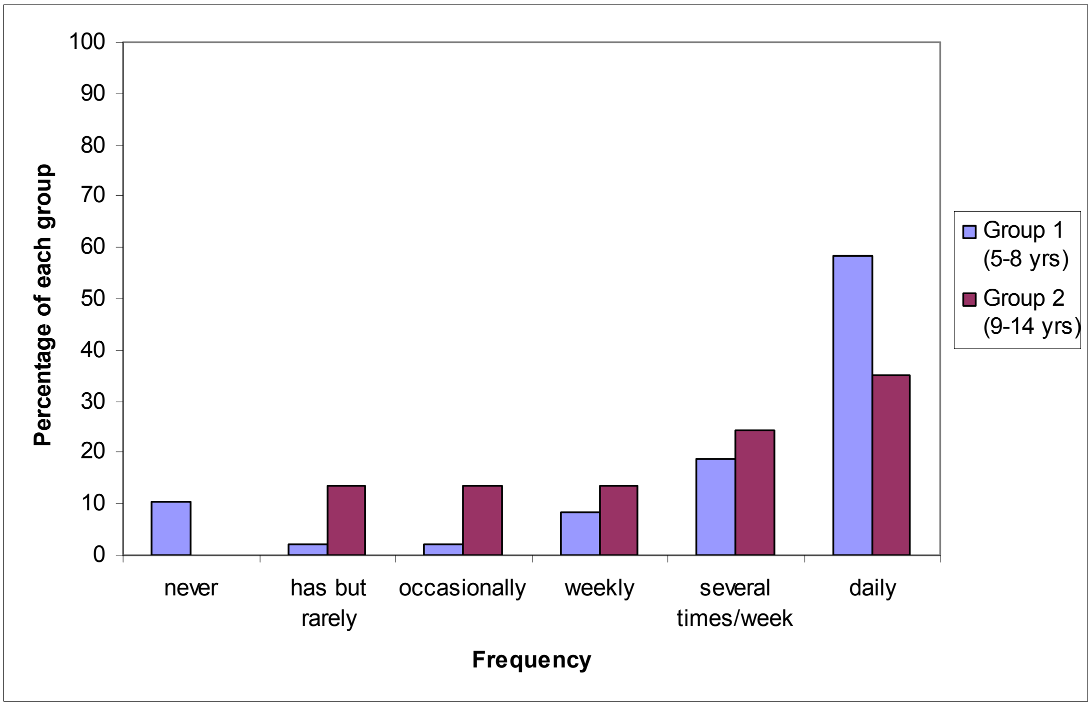


Figure 3.8. Frequency of home reading practice for participants by group.

3.3.3 Parent support and facilitation of literacy acquisition

When asked about the kind of help with reading they gave their children, parents' responses fell into eight main categories, with some parents reporting using several of the techniques shown in Table 3.2 to help their child.

Table 3.2. Percentage of respondents using techniques to help their child with reading at home

Activity	Percentage of respondents
Tell child the word/read to the child	48.2%
Prompt/sound out	28.9%
Read together	15.7%
Keep focused, encourage and praise	14.4%
Point to words	11.8%
Use picture and sign cues	10.5%
Model and support speech clarity and pronunciation	7.8%
Sight words/flash cards	3.9%

The parents' responses revealed that most were actively involved in teaching their child letter names and sounds on a regular basis, usually during story reading activities. Sixty-seven percent of Group 1 parents and 57.3% of Group 2 parents reported teaching letter names and sounds when reading together. Correlational analysis, however, demonstrated no relationship between reported measures of frequency of joint reading and teaching letter names and sounds [$r = 0.04$, $p = 0.75$]. Parents, particularly those of younger children, also incorporated letter knowledge instruction into other activities with their child (58.1% of Group 1 parents versus 52.1% of Group 2 parents).

Over half of all parents reported drawing their child's attention to environmental print such as restaurant and shop names and signs, and street signs at least weekly. Almost 21% of Group 1 parents reported playing language games regularly with their children compared to 32.2% of Group 2 parents. The majority of children were also reported to be regular library users, albeit facilitated by their parents as befits their age. More library activity was reported for older children with 58.3% of Group 1 children and 71.3% of Group 2 children visiting the library at least monthly. One quarter of the younger children were reported to never visit the library compared to 5.7% of older children.

With respect to television, video and DVD viewing habits, parents' responses indicated wide variation in total viewing times ranging from 0.56 hours to 33.5 hours per week (see Figure 3.9). Mean total viewing time for Group 1 children was 14.1 hours per week (SD = 7.8, range = 0.81 – 31.5), that is 2.01 hours per day. Mean total viewing time for Group 2 children was 14.9 hours per week (SD = 7.2, range = 3.1 – 33.5), that is 2.12 hours per day. The most frequently watched television programmes, reported by over 90% of parents, were cartoons. Many parents reported high levels of video and DVD ownership (for example 30, 100, 200) with over 10% of respondents reporting they had "too many to name". Most frequently reported titles included cartoon movies and interactive musical shows. Increased total viewing hours was moderately correlated with age for children in Group 2 [$r = 0.46$, $p = 0.005$] with an estimated increase in total viewing time of 0.18 hours per month of age (2.16 hours per year of age).

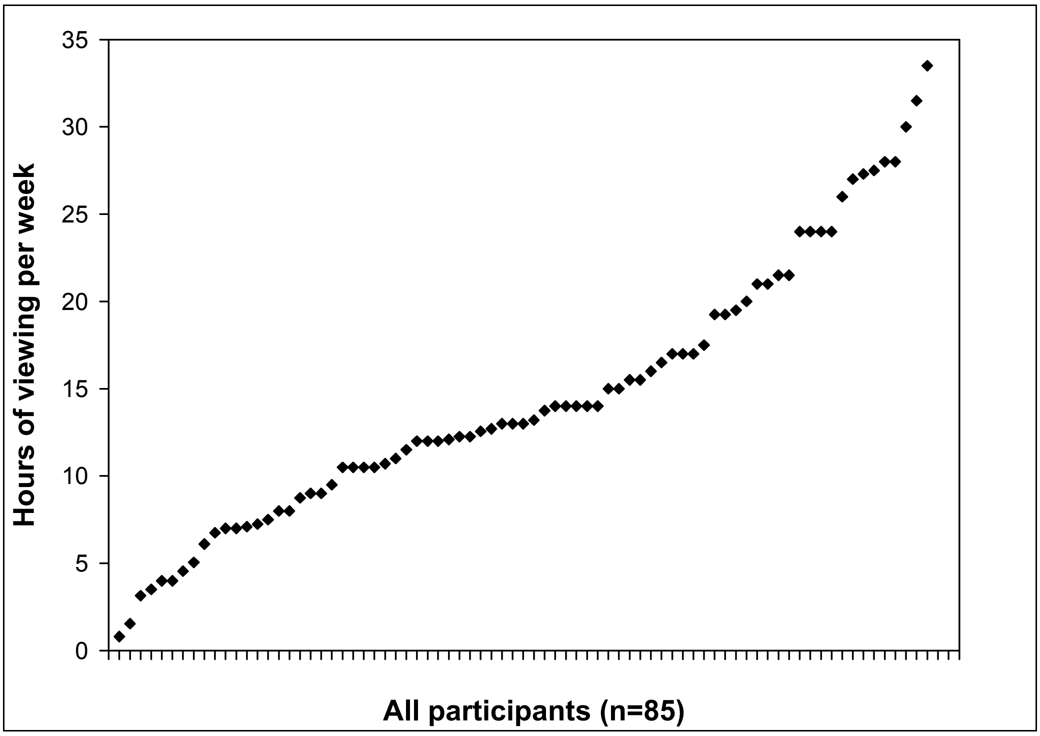


Figure 3.9. Children's television, video and DVD: total reported viewing hours per week.

When asked whether and how often their child drew, wrote (or attempted to write) letters of the alphabet, words or stories, parents reported drawing as the most common activity with 50% of both groups drawing daily. Story writing was the least common daily activity with 15.2% of Group 1 children and 22.8% of Group 2 children writing, or attempting to write, stories every day. The majority of Group 1 children (67.3%) and 35.2% of Group 2 children had yet to write or attempt to write stories and a number of children in Group 1 were reported to be not yet engaged in any drawing or writing. The percentage of each group engaged in each activity and the frequency of that activity decreased as the complexity of the activity increased (see Table 3.3).

Table 3.3. Percentage of children engaged in specific literacy tasks

Frequency	Drawing		Letters		Words		Stories	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Not yet	4.3	0	13.0	0	28.8	2.8	67.3	35.2
Occasionally	13.0	16.6	15.2	20.0	22.2	11.4	13.0	20.0
Weekly	4.3	8.3	6.25	2.8	4.4	2.8	0	5.7
Several times/week	28.2	25.0	17.3	8.5	13.3	22.8	4.3	14.2
Daily	50.0	50.0	47.8	68.5	31.1	60.0	15.2	22.8

It is worth noting that a question about tools children used for writing revealed a rich array of writing implements and surfaces was available to all children in the study including a range of pens, pencils, crayons, chalk, paint, paper, and whiteboards.

Parents reported that written homework tasks were less common than home reading practice. Half of all children were reported to 'never' have written tasks for homework, with 24% having written tasks for homework 'weekly' or more frequently, and 11% engaged in written homework tasks 'daily'. Significant group differences were apparent (p = 0.004) with Group 2 children more likely to have regular written homework tasks (see Figure 3.10).

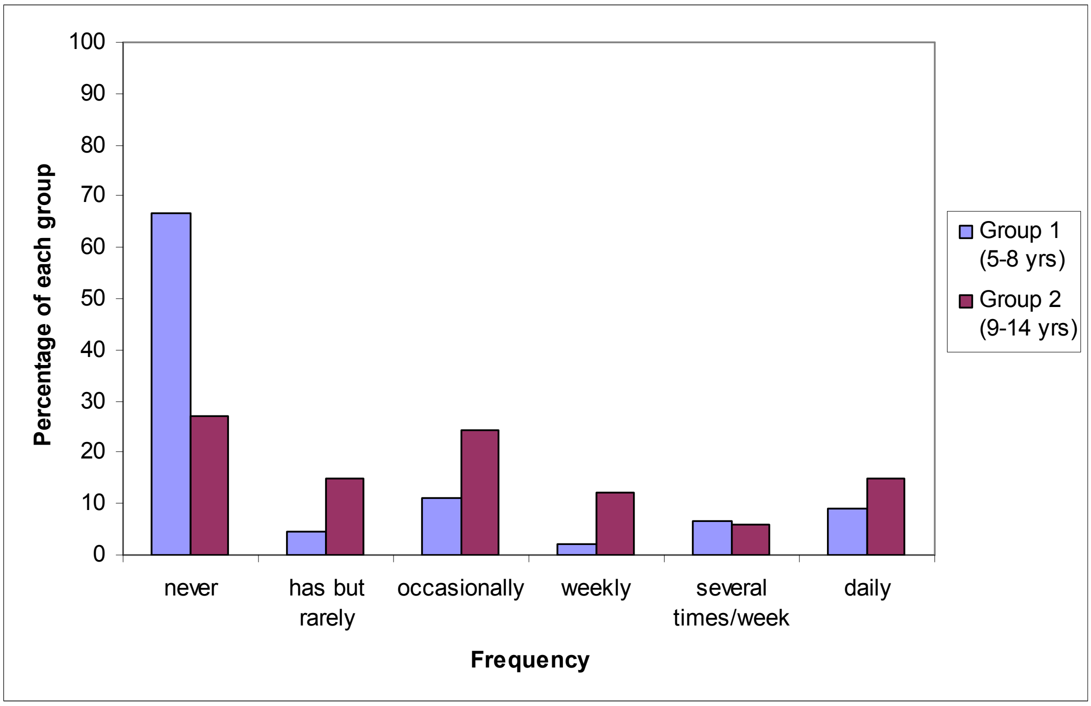


Figure 3.10. Frequency of written homework tasks for participants by group.

Not surprisingly given the lack of writing homework being assigned, 66% of parents reported they 'never' or 'occasionally' helped their children with writing; 4% provided help on a 'daily' basis. The kind of help parents gave their child with writing are presented in Table 3.4 with some parents reporting using several techniques to help their child. Small to moderate correlations were found between the frequency of homework literacy tasks and the frequency of parents provision of help ([$r = 0.57$, $p < 0.0001$] for reading and [$r = 0.32$, $p = 0.006$] for writing).

Table 3.4. Techniques used by parents who help their child with writing at home

Activity	Percentage of respondents
Write word for child to copy/trace	40.5%
Hand over hand	24.3%
Spelling	24.3%
Letters	8.1%
Topic discussion	8.1%
Resources	2.7%

Approximately half of all New Zealand households have a computer (Statistics New Zealand, 2008b), but home computer ownership was much higher than the national average for survey respondents, with 88.2% of parents reporting they owned a home computer and 81.1% of these reporting their child with DS had access to it, equating to 71.7% of all children in the study having access to a home computer. Active computer use was more common for older children with 91.1% of Group 2 children compared to 73% of Group 1 children reported to use their home computer. As well as using drawing and word processing programmes, children predominantly played “educational” games including alphabet and phonics based games, as well as interactive reading, spelling, numeracy and problem solving games. Children were reported to spend an average of 2.51 hours per week on the computer (SD = 1.86, range 0.5 – 8) which equates to just over 30 minutes per day. There were no age group or gender differences.

An important factor influencing the facilitation and encouragement of literacy is parents' awareness of, and ability to cope with, the inevitable challenges. Parents identified a number of challenges associated with reading and writing for their child, most articulating several of those listed in Table 3.5.

Table 3.5. Percentage of respondents identifying challenges associated with reading and writing for their child.

Challenges	Percentage of Respondents
Fine motor skills and control	36.7
Learning and memory	32.3
Speech and language	23.5
Frustration and behaviour	20.5
Attention and motivation	16.1
Vision and hearing	8.8
Availability of suitable books	8.8

Parents also reported ways they had found to manage these challenges with the majority focusing on addressing the areas of fine motor control and skills, frustration and behaviour, and attention and motivation. Thicker pens, white board markers, magnetic letters and slope boards were offered as adaptations to traditional writing equipment, with computer use suggested as an alternative. Parents emphasised the need for repetition and practise in acquiring reading and writing skills and suggested enlisting the support of family members and teaching support staff to promote this. Specific teaching practices were also identified including visual cues and supports and verbal techniques such as questioning and commenting. Praise and incentives were identified as important in maintaining and promoting children's attention and motivation, along with providing the child with choices from a variety of literacy based activities.

3.3.4 The participation of the child during literacy interactions

As reported earlier, seeing their child's interest in books was a source of pleasure for many parents. When asked about their children's interest in books compared to other activities Group 1 parents more often picked books as a preferred interest than parents of Group 2 children (see Figure 3.11). Between group differences were significant ($p = 0.03$).

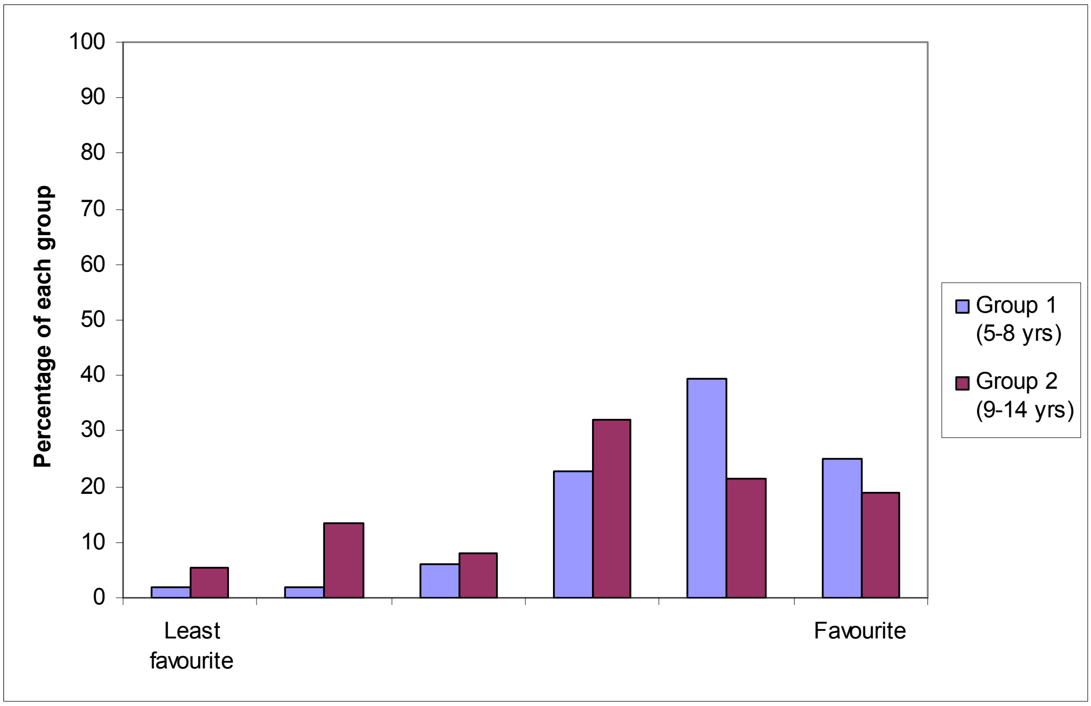


Figure 3.11. Children's reported interest in books as a favourite activity

Despite this reported high level of interest in books however, as Table 3.12 shows, when asked to report on their child's engagement with the pictures, characters and events in a familiar book when reading together, parents of children in both groups reported high numbers of children 'not yet' or 'rarely' asking about events or characters in the story. The reported frequency of engaging in these behaviours differed between the two groups, however differences were not significant. Behaviours engaged in by more than 25% of each group are highlighted in boldface type.

Table 3.12. Percentage of each group engaged in commenting and questioning behaviours

	Comments on pictures		**Asks about pictures**		**Asks about characters or events**	
	Group 1	**Group 2**	**Group 1**	**Group 2**	**Group 1**	**Group 2**
Not yet	10.6	2.1	23.4	10.8	**45.8**	24.3
Has but rarely	6.3	5.4	21.2	16.2	8.3	21.6
Occasionally	17.0	24.3	21.2	**35.1**	16.6	**40.5**
Few times/story	21.1	21.6	6.3	10.8	12.5	5.4
Often/usually during story	**44.6**	**45.9**	**27.6**	**27.0**	16.6	8.1

A similar picture emerged for engagement with text. Parents were asked to report on their child's engagement with the story line or text when reading familiar books together and whether their child participated in the story telling by saying or reading the next word or line. As with commenting and questioning behaviours, many children took a passive role during joint story reading activities. Although analysis showed Group 2 children took a more active role than their younger peers, over 30% of this group of children were reported to never or rarely participate in the story telling activity. Fewer children in Group 1 participated in story telling with just over half (53.3%) 'saying' and 36.7% 'reading' the next word or line at least occasionally.

When asked about their children's reading abilities, all parents of Group 2 children reported their child was reliably able to identify her or his own name, compared to 62.5% of Group 1 children, with a further 18.7% of Group 1 able to identify their own name 'usually', 14.5% 'often' and 4.1% 'occasionally'.

Similar group differences were apparent on other reading measures. Fifty-seven percent of Group 1 children and 68.7% of Group 2 children were reported to pretend to read by sitting with the book and producing speech similar to the actual story, at least occasionally during joint story reading activities, and nearly half of these children (comprising 25.7% of Group 1 and 31.2% of Group 2) did so often or usually during the story. Although more older children were reported to be able to read independently, at least occasionally, than their younger peers (81.1% of Group 2 children compared to 58.3% of Group 1 children), *regular* independent reading was similar between the groups with 29.1% of Group 1 children and 32% of Group 2 children reading independently every day. Point biserial correlation for this data found no significant relationship between regular independent reading and age [$r = 0.32$, $p = 0.16$] in the 20 regular independent readers.

Children's ability to read environmental print was also investigated with 97.23% of Group 2 children reportedly able to identify these kinds of words at least 'occasionally' and over 59% able to demonstrate this skill 'daily'. By contrast, 72.3% of Group 1 children could identify these kinds of words at least 'occasionally', and 23.4% could do so on a 'daily' basis. Parents reported the words most commonly recognised by their child included fast food restaurant and other shop names, food and beverage labels and logos, traffic signs and high frequency words taught at school.

When asked whether their child knew all the letter names and letter sounds, parents reported letter-name knowledge to be in advance of letter-sound knowledge with 52.7% of children reported to know all letter names and 28.3% reported to know all letter sounds. No child was reported to have complete letter-sound knowledge without complete letter-name knowledge although the reverse was true for 21.5% of children. Analysis by age group indicated more older children were reported to know all letter names ($p = 0.018$) and letter sounds ($p = 0.008$) than their younger peers with 67.6% and 45.1% reported for Group 2 children compared to 39.4% and 13.8% reported for Group 1 children respectively.

3.4 Discussion

This descriptive study gathered survey data on the HLE from parents of 85 New Zealand school-aged children with DS. The survey adopted an emergent literacy framework to explore participants' HLE across three broad themes.

The first of these themes explored the parents' priorities regarding literacy for their child with DS. The findings of this study suggest most parents place a high value on supporting their children's literacy development. Classroom literacy instruction was identified as a priority by the majority of parents. Additionally, reading and writing skills were ranked amongst the most important skills for their child to learn at school. The homes of the children in this study were generally rich in literacy resources, both for reading and writing experiences. The mean and median number of books owned by children in the study was similar to the number reported by middle-high SES parents in the Sénéchal (1998) study. The PRILS (Mullis et al., 2007) report revealed New Zealand to be one of the countries where a high percentage of 4th grade children had high numbers of children's book in their homes (36% owned 100+ books, 4% owned <10 books), with reported figures entirely consistent with those reported in the current study.

While there was 5% of children (in Group 1) who owned fewer than ten books, it is unlikely, in line with Marvin and Wright (1997) and Trenholm and Mirenda (2006), that a lack of literacy resources was a major determiner of the literacy experiences that occurred in the home. There was only one instance where a parent reported both they and their child with DS owned fewer than 10 books.

Early onset of story reading activities has been associated with improved oral language (DeBaryshe, 1993) in children with typical development and early reading instruction has been associated with increased speech and language skills in young children with DS (Buckley, Bird, & Byrne, 1996). While many parents in the current study engaged in reading with their children from an early age, many did not engage with books with their children until shortly before school.

These findings are consistent with those of Ricci, who reported the literacy environment and experiences of the children with DS in her study appeared to be most strongly associated with mental age rather than chronological age. Consequently, children (who will go to school on a chronological age schedule) will arrive at school with fewer emergent literacy skills at the onset of formal schooling and formal literacy instruction than their peers with typical development. As with the parents in studies by Trenholm and Mirenda (2006) and Purcell-Gates (1996) the view of parents in the current study is consistent with a ‘reading readiness’ approach. There is a suggestion in the current data that parents believe learning to read begins with the onset of formal schooling and is the responsibility of the teacher, even while they are happy to do the reading homework required of them and their children.

The second theme investigated features of the HLE, specifically the frequency and duration of literacy interactions and the ways in which parents facilitated and encouraged their child’s literacy development. The findings suggest most parents are actively providing a rich and positive home literacy environment for their children with DS. Not only were books available to the children in the study, but parent engagement with their child in reading was a frequent and positive experience in most of the homes. Over 90% of parents and children in the study reported reading together, a practice which began early in the child’s life for two thirds of the families. Although time spent reading together was extremely variable, the majority of parents reported they had a regular reading time and for 60% of families joint parent child reading was part of their daily routine. Findings suggest this joint reading was valued most for its social and emotional benefits rather than for its contribution to the acquisition of language and literacy skills, however parents were also actively engaging with the print material and encouraged their children’s emergent literacy behaviours. In particular, many engaged in the kinds of strategies that have been shown to encourage phonological awareness and speech and language development (Justice & Ezell, 2000; Justice & Ezell, 2002; Scarborough & Dobrich, 1994; van Bysterveldt et al., 2006; Ziolkowski & Goldstein, 2008).

Half of all children were engaged in some drawing or writing activities every day, however only 35% of children were reported to write (or attempt to write) words and 15% to write or attempt to write stories. Moreover, some children although they are already at school, have yet to draw or write at all. Additionally, far fewer parents reported regularly helping their child with writing than with reading. Significant correlations were found between parents helping their child with reading and writing and children's frequency of reading and writing homework. These findings allude to the role of the school in encouraging literacy in school-aged children with emergent levels of literacy and an apparent reliance of many children on school work done in the classroom or for homework to develop their writing skills. Of concern is that many of the parents in the study reported that their children 'never' or 'rarely' brought home writing homework. It must be noted, however, that failure to draw and write did not seem to be because the necessary implements are unavailable.

Letter knowledge instruction has been found to be predictive of later reading outcomes for young children with typical development (Bus & van IJzendoorn, 1988; Haney & Hill, 2004; Levy et al., 2006; Sénéchal & LeFevre, 2002). Most parents in the current study reported actively teaching their child letter names and sounds, however, consistent with the findings of Sénéchal and LeFevre (2001), parent-teaching of letter names and sounds was not correlated with joint story reading frequency.

Parents also appeared to be taking advantage of a range of other opportunities to encourage literacy. Many children were encouraged to learn from the environmental print of signs and logos and other frequently seen words. Many parents engaged in language games with their children and most children spend time on language rich exposure through TV and other electronic media.

Finally, parents were aware that learning to read and write poses major challenges for their children, and that levels of frustration over fine motor control and difficulties of attention for example, present greater challenges to their children than to many others. Nonetheless, they reported finding ways to stay positive and to work with their children constructively to support their emergent literacy in the ways reported here.

The final theme focussed on the ways children with DS participate during literacy interactions and included the children's engagement with literacy activities and the literacy skills they demonstrated. Children's literacy interest is an important contributor to reading development and is one of the factors identified by Frijters et al. (2000) as associated with children's phonological awareness, letter knowledge and vocabulary. Children's interest in books was significantly higher in younger children than in their older peers. The classification of children in this study into two groups reflects the typical classroom literacy environment of the children in each age group. As such, the literacy skills and interests of the younger children may be more aligned with the classroom instruction they are receiving. Contrastively older children who face an increasing discrepancy between their literacy skills and their classroom literacy programme may have become disengaged from a literacy programme at school that is incongruent with their skills and interests.

Intervention studies have investigated the role of the parents in facilitating their child's active participation in shared reading, using a dialogic reading technique (e.g. Hargrave & Sénéchal, 2000; Whitehurst et al., 1988), with gains in expressive language demonstrated by children who received the intervention. The current study reports children's spontaneous comments and questions about the pictures, text, characters and events as measures of their level of active participation during joint story reading. Children were most engaged with literacy tasks which were less cognitively and linguistically demanding, engaging more with pictures than text, commenting more than questioning, and questioning more about pictures than characters or events, with many children reported to take a passive role during joint story reading. Hargrave and Sénéchal (2000) demonstrated active rather than passive participation in a shared book reading activity resulted in greater improvement on children's vocabulary measures. Future research directions may include programmes which provide parents with strategies to encourage and promote active involvement during joint book reading by their child with DS.

As is the case with children with typical development, participants' letter-name knowledge was in advance of their letter-sound knowledge (Arrow, 2007; McBride-Chang, 1999; Worden & Boettcher, 1990). Although older children knew significantly more letter names and sounds than their younger peers, fewer than half of the group had complete letter-name and letter-sound knowledge. Given the strong link between letter knowledge and reading, low levels of letter knowledge are of concern. Buckley et al. (1996) reported some children with DS were able to use alphabetic strategies to read novel words, however such ability is contingent on having phoneme-grapheme connections. Single word reading skills were reported to be more advanced in older children than younger children. Additionally, a higher proportion of older children were reported to pretend to read, and to read independently at least occasionally. However, regular independent reading was equivalent between the two groups. Although these findings point to the development of a reading vocabulary of sight words, common words and environmental words over time, this development does not appear to be sufficient to promote regular independent reading.

3.5 Limitations

The major limitation of this study is that the data are based on parental report. The accuracy of the parents' responses and the children's reported skills, therefore, cannot be verified. To counterbalance the view of the parents, the teachers of these same children were asked a similar set of questions. The results of this investigation are reported in Chapter 4. Even with this second data source, it may still be that the respondents who agreed to participate in the study were those who placed a higher priority on literacy and therefore presented a more positive representation of the literacy environment. Socio-economic factors have been reported to be influential on children's literacy outcomes (Blachman, Ball, Black, & Tangel, 1994; Dodd & Carr, 2003; Duncan & Seymour, 2000; Justice, Kaderavek, Fan, Sofka, & Hunt, 2009) however, in the current study, although the schools decile information was available, this information was not included in any analyses, and no formal information was gathered on families' socio-economic status.

Despite these limitations, the study represents the first attempt to gather systematic data regarding home literacy environments and practices for New Zealand children with DS. The study provides valuable information for parents and professionals about what literacy environments children with DS currently experience and may shape directions for future investigation with this population.

CHAPTER 4

LITERACY ENVIRONMENTS FOR CHILDREN WITH DOWN SYNDROME: WHAT'S HAPPENING AT SCHOOL?

4.1 Introduction

International research into reading outcomes for children with typical development reports New Zealand Year 5 children compare favourably with their peers from around the world (Mullis et al., 2007). The majority of classrooms are well resourced and are staffed by well trained teachers (Mullis et al., 2007). Although these findings present a largely positive picture for literacy development in children with typical development, little is known about how the New Zealand classroom supports reading and writing development for children with Down syndrome (DS).

In a New Zealand case study investigating the development of early literacy skills in 3 children with DS and their mainstream classroom environments, Rietveld (1996) reported mixed outcomes. After four months at school, two of the children were no longer able to demonstrate all the literacy skills that they could at school entry. Although the children were welcome in the mainstream classroom, Rietveld identified the teacher's attitudes to disability and the expectations around literacy acquisition as key influences on classroom practice and the literacy learning environment for the pupils with DS.

The study described in this chapter explored key features of the school literacy environment and its influence on the phonological awareness and literacy development of school-aged children with DS in New Zealand as reported by their teachers.

The study examined the question:

How does the school environment of children with Down syndrome support literacy development? Specifically:

i) What are the frequency and duration of literacy interactions?

ii) What instructional methods do teachers use to teach literacy?

iii) In what ways do children with Down syndrome participate in literacy interactions?

iv) What literacy skills do school aged children with Down syndrome demonstrate?

v) What are the challenges teachers identify regarding literacy instruction for children with Down syndrome and how do they meet these challenges?

4.2 Method

4.2.1 Research design

This descriptive study reports survey data gathered via questionnaire on the school literacy environment of children with DS, completed by teachers of participants.

4.2.2 Survey design

A 35 item questionnaire was modelled on and adapted from the Early Literacy Parent Questionnaire by Boudreau (2005)[4] and the parallel survey completed by participants' parents (reported in Chapter 3). The survey was first piloted with five teachers of children with DS. Following feedback from the pilot survey further adaptations were made in consultation with these teachers. This feedback included recommendations to include some questions where teachers could explain or describe a situation or setting pertinent to their particular pupil. Pilot surveys were not included in the analysed data.

The survey included questions under the following headings: Educational Setting; Towards Independent Reading; Shared Reading; Writing; Spelling. Teachers were also invited to make additional comments at the end of the survey. The survey questions encompassed four broad themes including frequency and duration of literacy interactions, the role of the child during literacy interactions, the child's literacy skills, and other ways literacy is supported. Survey items were presented in a variety of formats to gather both quantitative and qualitative data. The majority of the items called for binary responses, fill in the blanks or Likert (1932) scalar responses that could be quantified. Approximately 40% called for more qualitative descriptive responses. These descriptive questions frequently followed a series of quantitative questions. For example, following a question which asked teachers how often their pupil received extra help with her/his reading they were asked about the sort of help their pupil received. Following feedback from the teachers involved in piloting of the survey, descriptive questions where teachers were able to describe a situation or setting were included, for example "Describe what reading activities your pupil

[4] A copy of the questionnaire is included in Appendix B. Adapted with permission of the author.

participates in". As with other descriptive questions, these were typically presented after a series of quantitative questions.

To determine the internal validity of the questionnaire and the extent to which it measured a single construct, Cronbach's alpha was calculated (Portney & Watkins, 2009). For the 18 questions assessed using a Likert (1932) scale and appropriate for all teachers to answer, Cronbach's alpha equalled .858. These results are based on the 77% of teachers who responded to all 18 questions. However, generalisation to the whole sample is appropriate as no pattern was observed to missing responses and response rates were over 93% for all 18 questions included in the analysis.

4.2.3 Participants

The participants were 87 children with DS (40 girls and 48 boys) aged between 5;04 (y;m) and 14;11 (M = 8;11, SD = 2;6) described in detail in Chapter 3. Survey respondents were participants' teachers. Eighty four of the 87 participants were also reported on by their parents.

Although 75% of participants were reported to be enrolled at mainstream schools and 25% at special schools[5], the actual educational setting in which children participated was not as clear cut. For this reason, direct comparisons between children in different educational settings (e.g. mainstream versus special schools) were not possible. Teachers reported that approximately half of the children enrolled in mainstream schools and two thirds of those enrolled in special schools actually spent the entire school day in that setting. The remaining children experienced a variety of educational settings (see Table 4.1). The category "other setting" includes unspecified withdrawal from the class for small group or individual instruction, informal breaks

[5] See Chapter 3 for information on special schools.

from the classroom not including other instruction, and children finishing school early.

Table 4.1. Percentage of children participating in mainstream and special school settings as reported by teachers

Educational setting	Percentage of children
100% mainstream class	35.6
90% mainstream class , 10% other setting	2.2
80% mainstream class , 20% special/satellite class	5.7
80% mainstream class , 20% other setting	13.7
60% mainstream class , 40% special/satellite class	6.8
60% mainstream class , 40% other setting	5.7
50% mainstream class , 50% special/satellite class	1.1
40% mainstream class , 60% special/satellite class	2.2
40% mainstream class , 60% other setting	1.1
20% mainstream class , 80% special/satellite class	2.2
10% mainstream class , 90% special/satellite class	5.7
100% special/satellite class	17.2

4.2.4 Data analysis and reliability

All coding and data entry was checked by the lead researcher. Additionally an independent researcher coded a randomly selected 20% of the survey returns and checked reliability of data entry and survey interpretation with scores recorded by the lead researcher. Inter-rater reliability was 99.38% with any discrepancies resolved through discussion.

4.3 Results

Data were analysed using descriptive and non-parametric statistics. Initial analysis included the total sample. Data were further analysed by age group: 5 - 8 years (Group 1: N = 48, M = 7;0, SD = 12.5 m) and 9 - 14 years (Group 2: N = 37, M = 11;02, SD = 19.2m). Participants aged 5 - 8 years would typically be in classrooms where formal literacy instruction occurred on a regular basis, whereas participants aged 9 - 14 years would typically be in classrooms where the focus was on "reading for learning" as opposed to learning to read. Data are presented for teachers of all children and by age group when group differences are apparent.

For each of three key areas of literacy development: reading, including letter knowledge, writing, and spelling, the results focus on three themes:

- teachers' reports of children's participation in literacy instruction,
- teachers' perceptions of children's literacy skills and their support of these developing abilities,
- teachers' identification and management of the challenges associated with teaching literacy skills to children with DS.

The results first focus on these themes with respect to reading, then to writing and finally to spelling.

4.3.1 Reading

Participation in Reading Instruction

Teachers reported how often their pupil participated in activities related to reading instruction. Almost all children were reported to take part in reading activities (95.4%) at least occasionally. Younger children were more likely to participate regularly than their older peers, with 91.6% of children in Group 1 participating several times a week and 75% participating every day. Seventy-nine percent of children in Group 2 were reported to participate in reading instruction activity several times a week and 68.4% participated every day (see Figure 4.1). Group differences were not significant.

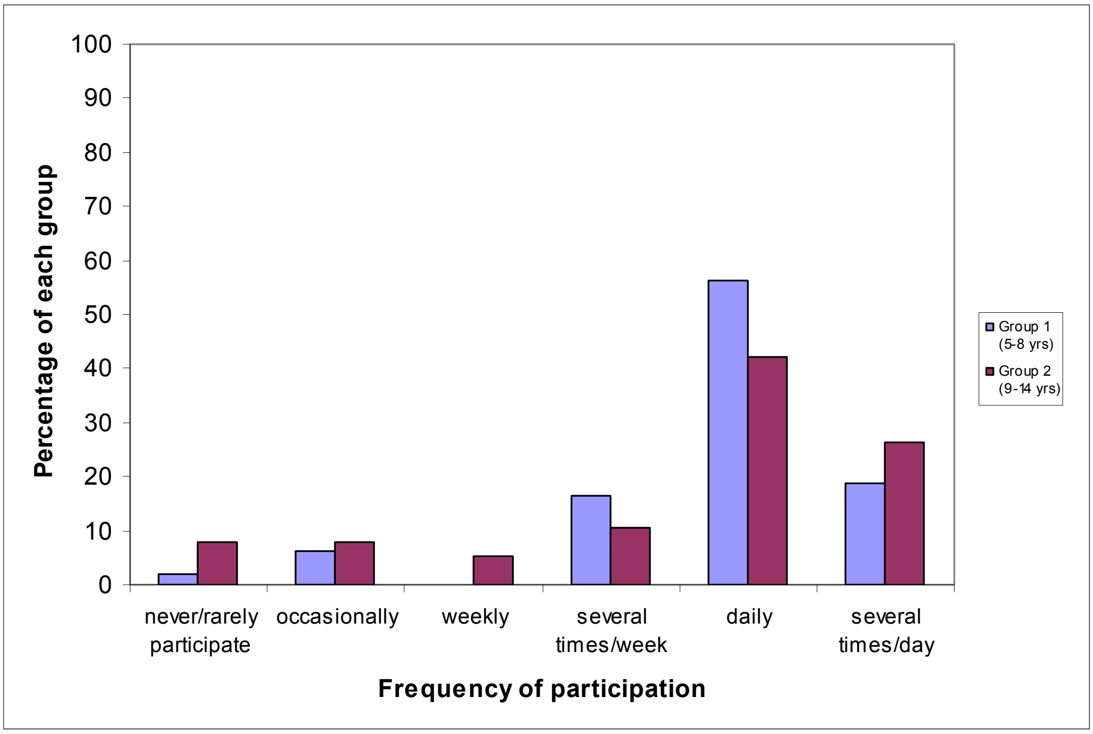


Figure 4.1. Frequency of participation in reading instruction activities in the classroom by group as reported by teachers

On average, children spent 3.64 hours per week (SD = 2.55, range = 0.5 – 12) participating in reading instruction activities in the classroom. This equates to approximately 45 minutes per school day. Children typically took part in individual and group reading instruction activities with 75.2% receiving individual reading instruction, 81% receiving small group instruction and 44.7% receiving large group instruction. Forty percent of children received reading instruction in all three formats. Teachers also identified the different activities their pupil with DS typically participated in, in relation to reading instruction in the classroom. Responses were summarised into thirteen main categories with percentages reported in Table 4.2. Total percentages sum to over 100% as children typically participated in several different reading instruction activities.

Table 4.2. Percentage of each group reported by teachers to be participating in specific reading instruction activities

Activity	Group 1	Group 2
Instructional/guided reading	63.0%	47.0%
Memory/sight words	50.0%	29.4%
Shared/buddy reading	43.4%	50.0%
Big books/poems	43.4%	23.5%
Phonics/alphabet	26.0%	17.6%
Independent reading	26.0%	32.2%
Tapes/CDs/listening post	15.2%	11.7%
School library	15.2%	5.8%
Language and comprehension	13.0%	17.6%
Watching/listening/holding the book for the class	10.0%	8.8%
Commercial reading programmes	6.2%	8.8%
Computer	6.2%	8.8%
Silent reading	2.1%	14.7%

Forty percent of teachers reported there were classroom reading activities in which their pupil did not participate. The majority felt non-participation was because the activities being presented in the class were at a level which was too difficult for the child to participate in. As one teacher of a child with DS in a mainstream classroom put it “Louise (aged 9;11) has an individual programme. She does not participate in any class instruction”. For a minority of respondents, the child’s behaviour and motivation were reported to influence non-participation. Table 4.3 summarises non-participation in reading activities as reported by teachers.

Table 4.3. Percentage of respondents (teachers) reporting activities related to reading that participants do not participate in

Activity	**Percentage of respondents**
Unable to participate in any class reading activity	35.2
Class/guided reading	35.2
Comprehension activities	20.5
Reading aloud/Oral language reading activities	14.7
Participates in all class reading activities	5.8

Home reading practice

Home reading practise was a regular expectation by teachers. Seventy-eight percent of all participants were reported to take books home from school for home reading practice at least weekly, with 48.2% doing so daily. Significant group differences were apparent (p = 0.003) (see Figure 4.2). Although 10% of children in both groups were reported to never take home books intended for reading practice, a higher proportion of Group 1 were allocated home reading practise on a regular basis. Eighty-one percent of children in Group 1 had home reading practice at least weekly and 63.2% did so daily. Seventy-three percent of children in Group 2 had home reading practice at least weekly and 28.9% did so daily.

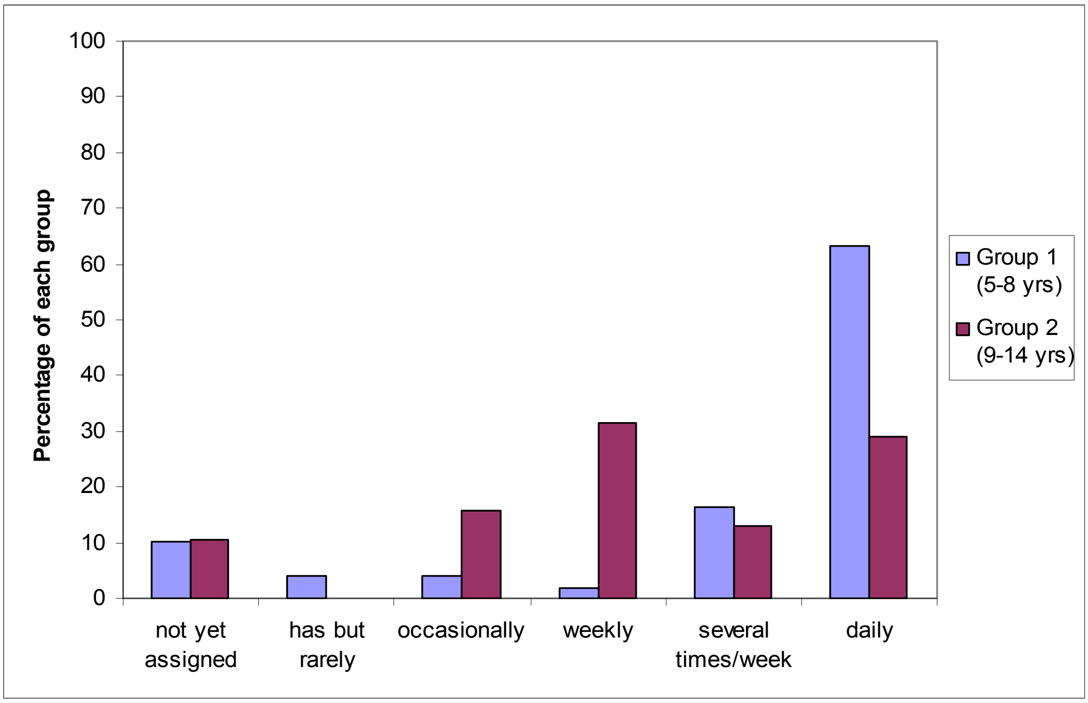


Figure 4.2. Frequency of assigned home reading practice for participants by group as reported by teachers

Participation in Shared Reading Activities

The majority of children were reported to participate in shared reading activities on a regular basis. Children from Group 1 were more frequently involved, with 91.6% participating in shared reading several times per week and 68.7% every day. Seventy-six percent of children in Group 2 participated in shared reading several times per week and 50% did so every day. Group differences were not significant.

Children's Engagement with Pictures and Characters during Shared Reading

Teachers were asked to report on their pupil's engagement with the pictures, characters and events within a book during shared reading and whether they commented on or asked questions about the pictures, or asked questions about the characters or events. Results are reported in Table 4.4. Reported frequency of comments and questions about pictures were largely similar between the two groups with just over 30% of each group commenting on or asking questions about the pictures regularly during shared story reading. A minority of children were reported to ask questions about the story characters or events with 6.3% of children in Group 1 and 10.8% of children in Group 2 doing so regularly during shared story reading. High percentages of children from both groups (82.9% of children in Group 1 and 32.4% of children in Group 2) were reported to 'not yet' or 'rarely' ask about events or characters in the story. Group differences were significant ($p<0.001$). Many children appeared to take a very passive role during shared story reading with teachers reporting over 40% of all children 'never' or 'rarely' made any comments or asked any questions during shared reading. For 14.5% of children, reported participation in shared reading was limited to listening to the story and for 13.4% of children, participation consisted of choosing the book, holding the book or turning the pages for the teacher or another pupil to read. As one teacher wrote "Mike (5;8) is very passive at this stage, he loves to use the 'reading wand' and be the 'page turner'".

Table 4.4. Percentage of each group engaged in commenting and questioning behaviours

	Comment on or ask about pictures		Ask about characters or events	
	Group. 1	Group. 2	Group. 1	Group. 2
Not yet	27.0%	16.2%	82.9%	32.4%
Has but rarely	25.0%	13.5%	8.5%	29.7%
Occasionally	16.6%	37.8%	4.2%	27.0%
Few times/story	6.25%	13.5%	2.1%	8.1%
Often/usually during story	25.0%	18.9%	4.2%	2.7%

Children's Reading Abilities

Teachers reported their pupils' unsupported reading behaviour. Over seventy percent of children (74.1% of children in Group 1 and 71.4% of children in Group 2) were reported to pretend to read by sitting with the book and producing speech similar to the actual story, at least occasionally during unsupported story reading activities, and nearly half of these children did so 'often' or 'usually' during the story. Seventy percent of children were reported to be able to read independently at least occasionally. However significant group differences were apparent (p<0.001) with

46.6% of children in Group 1 not yet able to read independently compared to 16.2% of children in Group 2. More of the older children (62.1%) were engaged in regular independent reading compared to their younger peers (28.8%).

Additional Support with Reading

Ninety percent of children were reported to receive extra help with their reading, with 62% of children receiving help on a daily basis. Extra support was typically provided by the child's teacher aide. Teachers identified six categories of reading support their pupil with DS received. Table 4.5 reports the percentage of each group receiving specific reading instruction support. Total percentages sum to over 100% as children typically received more than one kind of support. All additional reading support was provided using activities that also occurred in the classroom reading instruction programme and were therefore familiar to the child.

Table 4.5. Percentage of each group receiving specific reading instruction support

Activity	Group 1	Group 2
Instructional/guided reading	100%	80.0%
Language and comprehension	31.8%	25.7%
Phonics/alphabet	25.0%	14.2
Memory/sight words	11.3%	2.8%
Commercial reading programmes	9.0%	22.8%
Shared/buddy reading	4.5%	2.8%

Letter Knowledge Instruction

Teachers were actively involved in teaching letter names and sounds on a regular basis with 65.8% of children in Group 1 and 70.7% of children in Group 2 receiving regular letter knowledge instruction during story reading activities. Teachers more commonly incorporated letter knowledge instruction into other activities with their pupil, particularly with younger children, with 91.5% of children in Group 1 and 80.6% of children in Group 2 receiving letter knowledge instruction a few times, often or usually during other joint activities.

Teachers also reported the different activities their pupil participated in, in relation to letter knowledge instruction in the classroom. Teachers' responses were summarised into eight main categories with percentages reported in Table 4.6. The majority of these activities involved explicit letter-name and letter-sound instruction. Many teachers reported using commercial programmes such as Jolly Phonics and Letterland, for example, as well as informal activities such as alphabet puzzles, games and CDs. Teachers also used a variety of resources in their classrooms to bring their pupil's attention to letter names and sounds. These included alphabet wall charts and friezes; magnetic, felt and playdough letters and alphabet flash cards. Total percentages sum to over 100% as children typically participated in a number of different letter knowledge instruction activities.

Table 4.6. Percentage of children participating in activities to teach letter knowledge as reported by teachers

Activity	Percentage of children
Explicit alphabet activities	63.6%
Phonics activities	49.3%
Writing	28.5%
Phonological awareness activities	23.3%
Reading	19.4%
Matching/sight word games	12.9%
Computer	6.4%
Speech language therapy	3.8%

Children's Letter Knowledge

Teachers were asked to report whether their pupil with DS knew all letter names and letter sounds. Letter-name knowledge was reported to be in advance of letter-sound knowledge ($p = 0.002$) with 41.6% of children reported to know all letter names and 22.2% reported to know all letter sounds. No child was reported to have complete letter-sound knowledge without complete letter-name knowledge although the reverse was true for 19.7% of children. Analysis by age group indicated more older children knew all letter names ($p < 0.001$) and letter sounds ($p = 0.021$) than did their younger peers with 66.6% and 38.2% reported for children in Group 2 compared to 22.9% and 11.1% reported for children in Group 1 respectively.

Associated challenges

Teachers were asked to identify challenges associated with providing reading instruction for their pupil. Responses were summarised into ten main categories with percentages reported in Table 4.7. Total percentages sum to over 100% as teachers typically identified more than one challenge. Establishing and maintaining pupil's attention and motivation posed the most challenges for teachers when providing reading instruction and was identified by more than half of respondents. Children's reduced speech intelligibility and limited expressive language were also commonly identified. Over 10% of children were described by their teacher as "non-verbal".

Table 4.7. Percentage of respondents identifying challenges associated with providing reading instruction for their pupil.

Challenges	Percentage of respondents
Attention and motivation	56.0
Speech and language	42.4
Frustration and behaviour	33.3
Availability of suitable books	30.3
Learning and memory	19.6
Reading comprehension	16.6
Lack skills to be included in class activities	16.6
Vision/hearing/health	12.1
Poor phonological awareness and letter knowledge	10.6
Reading assessment	6.0

Teachers also reported ways they had found to manage challenges associated with providing reading instruction for their pupil, with the majority focusing on addressing the areas of frustration and behaviour, and attention and motivation. Specific programmes and teaching practices were also identified including commercially available programmes, visual cues and sign language.

4.3.2 Writing/Drawing

Participation in Writing Activities

Teachers reported how often their pupil participated in activities related to writing. Fifty-seven percent of all children were reported to participate in writing activities in the classroom every day, while 5.7% of children 'never' or 'rarely' participated in classroom writing activities. On average, children spent 2.6 hours per week (SD = 2.07, range = 0.33–14) participating in writing instruction activities in the classroom. This equates to just over 30 minutes per school day.

Teachers identified four main categories of writing activities their pupil typically engaged in. The percentage of children participating in each category is reported in Table 4.8. Total percentages sum to over 100% as children characteristically engaged in a number of different writing activities.

Table 4.8. Classroom writing activities identified by teachers with percentage of children participating

Activity	Percentage of children
Writing sentences and stories	61.9%
Drawing/pre-writing and fine motor activities	51.1%
Handwriting/writing letters and words	45.2%
Copying and tracing	36.9%

Forty percent of teachers reported there were writing activities in the classroom in which their pupil with DS did not participate. These typically were activities which involved group work and activities with a focus on comprehension, which were pitched at a more advanced level.

Home writing practice

Assignment of written homework tasks were significantly less common than assignment of home reading practice ($p < 0.001$). Fifty-eight percent of all children were reported to never have written tasks for homework, with 24.4% having written tasks for homework weekly or more frequently, and 5.8% being assigned written homework tasks every day. Between group comparison revealed significant group differences ($p < 0.001$) (see Figure 4.3). Children in Group 2 were more likely to have written homework with 40.5% receiving written tasks for homework at least weekly and 8.1% were assigned written homework tasks every day. Homework tasks included writing words and sentences in a worksheet or diary format or spelling list.

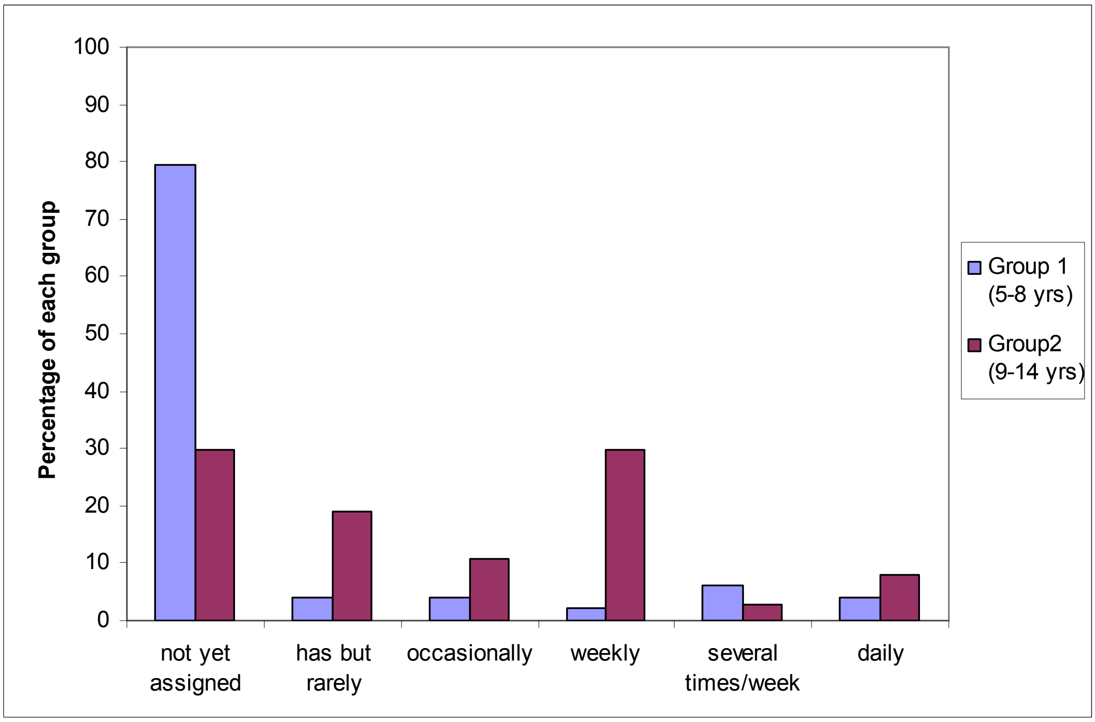


Figure 4.3. Frequency of assigned written homework tasks for participants by group as reported by teachers

Children's Writing Abilities

Teachers reported their pupil's drawing and writing attempts, specifically they were asked whether their pupil drew, wrote (or attempted to write) letters of the alphabet, words or stories, and how often they engaged in these literacy tasks. Significant group differences ($p = 0.01$) were apparent for all tasks with the exception of drawing, with a greater percentage of children from Group 2 more frequently engaging in more complex activities. Nearly half of the children in Group 1 (46.9%) and 13.5% of children in Group 2 had yet to write or attempt to write stories and over 10% of children in Group 1 were reported to not yet engage in any of the drawing and writing activities. Table 4.9 presents the percentages of each group attempting specific literacy tasks.

Table 4.9. Percentage of each group attempting specific literacy tasks at school as reported by teachers

Frequency	Drawing		Letters		Words		Stories	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Not yet	12.2	0.0	18.3	2.7	26.5	2.7	46.9	13.5
Occasionally	10.2	26.3	6.12	0.0	4.08	2.7	4.08	8.1
Weekly	4.08	7.8	4.08	2.7	0.0	0.0	4.08	10.8
Several times/week	30.6	13.1	12..2	13.5	20.4	8.1	12.2	27.0
Daily	46.9	52.6	59.1	81.0	48.9	83.7	32.6	40.5

Additional Support with Writing

Ninety-five percent of children were reported to receive extra help with their writing, with 74.3% of children receiving help on a daily basis. Extra support was typically provided by the child's teacher-aide. Teachers identified seven categories of additional support with writing their pupil with DS received (see Table 4.10). Over 70% of children were reported to receive additional but unspecified support with writing from their teacher-aide, however the providers of the other reported support were not always identifiable.

Table 4.10. Percentage of each group receiving additional writing support as reported by teachers

Activity	Group 1	Group 2
Unspecified Teacher-Aide support	74.4%	70.5%
Provision of specialist resources (e.g. thick pens)	37.2%	26.4%
Writing mechanics (e.g. pencil grip, spacing)	37.2%	26.4%
Behaviour and attention	18.6%	11.7%
Fine motor skills/Occupational Therapy	16.2%	11.7%
Content/spelling/grammar	11.6%	17.6%
Computer	9.3%	2.9%

Computer Use

Over ninety seven percent of classrooms were reported to have a classroom computer and 81.1% of the participants with DS were reported to use it. Computer access was more common for older children, with 89.4% of children in Group 2 accessing the classroom computer compared to 74.4% of children in Group 1. Children spent an average of 1.6 hours per week on the computer (SD = 1.3, range = 0.33–8) which equates to approximately 20 minutes per school day. The computer activities children predominantly engaged in were maths, reading and alphabet games, drawing (including Kid Pix® and Microsoft Paint®) and word processing (including Clicker® and Microsoft Word®).

Associated challenges

Teachers were asked to identify challenges associated with providing writing instruction for their pupil. Responses were summarised into eight main categories with percentages reported in Table 4.11. Total percentages sum to over 100% as teachers typically identified more than one challenge. Physical skills and coordination as well as establishing and maintaining pupil’s attention and motivation posed the most challenges for teachers when providing reading instruction. These two categories were each identified by 40% of respondents.

Table 4.11. Percentage of respondents identifying challenges associated with providing reading instruction for their pupil by group

Challenges	Group 1	Group 2
Physical/coordination and fine motor skills	51.1%	25.0%
Attention, motivation and behaviour	39.5%	40.6%
Extra support and adaptation needed	30.2%	31.2%
Content generation and comprehension	18.6%	31.2%
Vision and hearing	9.3%	9.3%
Letter knowledge	9.3%	0.0%
Lack skills to be included in class activities	6.9%	0.0%
Assessment	4.6%	3.1%

Teachers also reported ways they had found to manage challenges associated with providing writing instruction for their pupil, with the majority focusing on providing alternative or adapted resources such as thicker pens and slope boards, as well as occupational therapy to promote writing skills. Additional supports such as verbal and visual cues were identified as helpful in supporting both letter formation and content generation. The majority of children (67.8%) were reported to usually draw or write about personal experiences, which were typically supported with pictures or photographs. Nine percent of children were able to write about class topics and 8.0% about imaginative themes. Teachers aimed to increase children's motivation to participate in writing instruction activities by varying the tasks and providing praise and incentives.

4.3.3 Spelling

Participation in Spelling Instruction

Teachers reported 44.1% of all children never or rarely participated in any classroom spelling instruction activities. Significant group differences were apparent ($p < 0.001$) with 65.3% of children in Group 1 not participating in any classroom spelling instruction. By contrast the majority of children in Group 2 received regular spelling instruction with 62.1% receiving spelling instruction several times per week and 32.4% receiving spelling instruction on a daily basis. Those children who received spelling instruction spent on average 1.4 hours (SD = 1.0, range = 0.3 – 4.5) per week which equates to approximately 16 minutes per day. Teachers identified six main categories of spelling instruction activities their pupil typically engaged in. The percentage of children participating in each category is reported in Table 4.12. Total percentages sum to over 100% as some children engaged in more than one spelling instruction activity.

None of those children who received spelling instruction took part in the regular class spelling programme instead receiving an adapted and simplified programme. Teachers also reported their pupil with DS did not participate in spelling assessments and few had spelling homework.

Table 4.12. Percentage of children participating in activities to teach spelling

Activity	**Percentage of children**
Rote learning of high frequency/sight words	47.0%
Phonics/ letter knowledge/ phonological awareness	29.4%
Commercial spelling programmes	21.5%
Activities based on class topic	9.8%
Whiteboard activities	7.5%

Associated Challenges

As well as cognitive, memory and vocabulary demands, teachers cited poor phonological awareness, letter knowledge and reading skills as challenges to providing spelling instruction to their pupil with DS. Lack of attention and low motivation to engage with spelling were also evident, with fewer than 10% of children reported to seek help with spelling and many teachers reporting challenges in keeping their pupil on task.

4.4 Discussion

This descriptive study gathered survey data on the classroom literacy environment from teachers of 87 New Zealand school-aged children with DS. The survey explored the school literacy environment provided by teachers across three broad areas: reading, writing and spelling. Within each area, three themes were explored: children's participation and skills, the provision of additional support, and the management of challenges.

Nearly all children were reported to take part in reading instruction in the classroom, although time spent on this activity was extremely variable from one teacher to another. Group differences were not significant; however reading instruction was of slightly longer duration in the older age group, and occurred slightly more frequently in the younger age group who typically participated in a wider range of reading activities than their older peers. These findings are in line with the rationale on which group allocation was made.

Longer total reading instruction time has been associated with better reading outcomes in some studies (e.g.Taylor, Pearson, Clark, & Walpole, 1999). Taylor et al. surveyed seventy grade 1 – 3 teachers from 14 schools across four American states and gathered questionnaire data about school and classroom practices related to reading. Using pupil's composite literacy scores to categorise the effectiveness of the instruction, the researchers reported the "most effective" schools provided an average of 134 minutes per day of total reading instruction, compared to 113 minutes per day provided by the "moderately effective" and "least effective" schools in the study. However, the Progress in International Reading Literacy Study (PIRLS) 2005/2006 (Mullis et al., 2007) report results reveal little relationship between reading instruction time and reading outcomes, as many factors contribute to the effectiveness of the instruction. According to the PIRLS (Mullis et al., 2007) report, the international average number of hours of reading instruction allocated to Grade 4 (NZ Year 5) students per week is 2.5 hours (SD = 0.02) The PIRLS study reports a NZ mean of 3.2 (SD = 0.09). These figures are consistent with, though less variable than the mean reading time of 3.64 (SD = 2.55) hours per week reported in the current study, but in contrast to the figures reported by Taylor et al. (1999).

For children in the current study, reading instruction most frequently took place in small groups or in a one on one context, consistent with the findings of an investigation by Wolpert (2001), in which teachers identified these settings as the most effective instructional settings, both for children with DS and their peers with typical development. These teachers also identified shared/buddy reading as an effective strategy for reading instruction. Taylor et al (1999) also reported small group reading instruction characterised the “most effective” classrooms in their study.

Despite these findings, reading instruction as reported by the New Zealand teachers in the current study was also regularly provided in a large group setting, a phenomenon which is common internationally (Department for Education and Employment, 1998), but not widely reported by the New Zealand teachers in the PIRLS study (Mullis et al., 2007). When reporting the organisational approach with which they always or almost always taught reading, 61% of New Zealand teachers in the PIRLS study reported teaching reading to small same-ability groups, with 8% reporting individualised teaching as their predominant reading instruction approach. However, 62% also reported using a variety of organisational approaches when teaching reading. The use of multiple approaches was also apparent in the current study, although teachers were not asked to report their predominant approach, therefore direct comparison between these two results is not possible. However, given the reported disparity between the needs and skills of the participants with DS and their classroom peers with typical development, widespread large group reading instruction is nevertheless surprising and may be of limited use.

Teacher’s interpretations of what constituted participation in reading activities may have impacted their responses to questions on both participation and non-participation in reading activities. For example, the inclusion or exclusion of behaviours such as watching, listening, and holding the book for the class, may have impacted both the rate of reported participation in reading instruction at a large group level and in shared reading, as well as the class reading activities participants reportedly did not participate in. Kemp and Carter (2005) alluded to the weak relationship between teachers' perception of children's skills and behaviours and objective measures of those skills and behaviours. It may be that other behaviours such as attention or the presence or absence of disruptive behaviours also impacted teachers' interpretation of children's participation in reading instruction. Attention, motivation, behaviour, cognition and physical limitations were all frequently identified as challenges associated with providing literacy instruction for their pupil with DS particularly with writing and spelling. Consistent with teachers in the Wolpert (2001) study, teachers utilised positive reinforcement and praise to improve motivation and to promote and extend participation in activities. Despite these attempts, for many children these challenges influenced their participation in the literacy instruction or activity.

The data relating to reading instruction, letter knowledge instruction and additional reading support presents a confusing and somewhat contradictory picture. When teachers described the activities related to reading instruction their pupil participated in, the use of a memory or sight word strategy for reading instruction was widely reported and was the second most common reading instruction activity engaged in by Group 1 children. However, high levels of participation in reading big books and poems suggests that this strategy may occur against a background of a whole language approach to reading instruction in many classrooms (Smith & Elley, 1994), although specific information regarding this was not gathered. When describing additional reading support provided for the pupils with DS, much less emphasis appears to be placed on memory and sight word instruction; instead the predominant focus of the additional reading instruction support was instructional/guided reading typically provided in a one on one setting with the child's teacher-aide.

Participation in phonics and alphabet based reading instruction activities was reported for nearly a quarter of all children, both in the classroom reading instruction and in the additional reading instruction support they received. Teacher's assertions that the additional support utilised familiar activities suggests the children who received the phonics and alphabet instruction did so in both settings.

These findings are in apparent conflict with teachers' reported letter knowledge instruction. Although only about one quarter of children were reported to participate in phonics- and alphabet-based reading instruction activities, more than twice as many were reported to receive letter knowledge instruction during story reading activities and more than three times as many during other activities. A possible explanation for these seemingly contradictory reports may be that the way teachers have reported their instruction of reading and letter knowledge reflects their underlying beliefs about the nature of the relationship, and the connections made between the two. It may also reflect the teachers' philosophical views about how explicit any phonics and alphabet instruction should be, within what are likely to be predominantly "whole language" classrooms (New Zealand House of Representatives, 2001), and thus how teachers report such instruction.

The majority of teachers reported giving reading homework to their pupil with DS on a regular basis. Although a significantly greater emphasis on regular reading instruction was not evident in the classrooms of children in the younger age group, this emphasis was apparent in the allocation of regular reading homework. Younger children were more than twice as likely to have reading homework every day, however equal proportions of younger and older children were reported to never have reading homework. The importance of providing children with DS with the opportunity for extra reading practice has been identified by teachers as an important part of their effective teaching practice (Wolpert, 2001). Teachers in Wolpert's study also emphasised the role of homework as a mechanism for linking home and school. The significant correlation between the allocation of homework and provision of help identified in the parent survey (see Chapter 3) suggests giving children homework is an effective way to encourage parents to be involved in their child' s literacy learning and to provide further assistance to supplement their formal literacy instruction at school. Both frequency of joint reading at home and explicit parent teaching of literacy related skills are associated with improved reading outcomes for children (Sénéchal & LeFevre, 2002; Sénéchal et al., 1998).

Despite children receiving regular literacy exposure including reading instruction, shared reading, and reading homework, when asked to report on their pupil's engagement with the pictures, characters and events in a familiar book when reading together, teachers of children in both groups reported low levels of regular engagement with these tasks. Responses from parents to the same question presented in the parent questionnaire (see Chapter 3) suggested that although some children took a passive role during joint story reading, overall children were reported to demonstrate much greater engagement with the pictures, characters and events in a familiar book when reading with their parent than when reading with their teacher or teacher-aide. Research suggests teacher's responsiveness is affected by the language abilities of young children (Girolametto, Hoaken, Weitzman, & van Lieshout, 2000; Girolametto & Weitzman, 2002), thus low levels of child responsiveness in the current study are likely the product of both teacher and child variables. Rimm-Kaufman, Voorees, Snell, and La Paro (2003) highlighted the lack of attention given to understanding how teacher's interactions with children can facilitate participation for children with disabilities.

Children's unsupported reading behaviours do evidence some kind of engagement with books, with the majority of children reported to engage in what might be described as pre-reading behaviours and similar numbers able to demonstrate some independent reading skills. Significant group differences in reading ability suggests reading development over time, with significantly more older children engaged in regular independent reading.

Consistent with the development of letter knowledge in children with typical development (Arrow, 2007; McBride-Chang, 1999; Worden & Boettcher, 1990), for children in the current study letter-name knowledge was in advance of their letter-sound knowledge. However teachers reported fewer than half the children had complete letter-name and letter-sound knowledge. Given that the majority of children were reportedly able to read independently, such a finding may be evidence of a disconnection between reading instruction and letter knowledge and suggests an instructional strategy with a visual rather than phonological approach to reading. Such an approach may facilitate the build up of a sight word vocabulary. However, consistent with Share's (1995) self-teaching hypothesis, it does not provide the reader with a strategy with which to read unfamiliar words, nor does it facilitate the repeated successful phonological decoding experiences which permit "self-teaching" and thus spelling and writing development to occur.

Children's poor phonological awareness and letter knowledge were one of the least commonly reported challenges associated with providing reading instruction identified by teachers. However, independent assessment of children's letter knowledge and phonological awareness skills (see Chapter 2) coupled with assessment of this knowledge as reported by teachers, indicated that many of the participants had limited knowledge in both areas. Thus, this low level of identification may be attributable to the lack of emphasis placed on these skills with regard to reading instruction, rather than to children's actual skill level.

One explanation for the apparent incongruity in these data is that teachers may have been providing reading instruction using a method where these skills were not required (e.g. sight word instruction), and thus their absence did not present as a challenge. Similarly, when the lack of these skills was identified as a challenge, this may have offered a rationale for providing such an instructional method. It is equally plausible that teachers may have tried to address the lack of skills by providing extra support in this area. As teachers reported using several different reading instruction strategies and providing several different kinds of additional support, it is not clear from the data what teachers did in response to these challenges, nor how the challenges influenced their subsequent teaching practices. Clearly this is an area for further research.

The responses to questions about writing showed that in comparison to reading activities, far fewer children took part in regular writing activities in the classroom and less time was spent on these activities. However, the frequency and duration of writing instruction was largely consistent with that reported by Graham and colleagues (Graham, Harris, Fink-Chorzempa, & MacArthur, 2003; Graham, Harris, & Fink, 2000). Although writing sentences and stories was the most commonly reported writing activity, activities which involved the mechanics of writing and drawing rather than the content were also widely reported. Handwriting difficulties have been identified as constraining the accuracy and fluency of text production in beginning writers with and without a learning disability (Graham et al., 2000). The emphasis on writing components in the current study seems in contrast to the reading instruction approach which appeared to include much less emphasis on the components of reading. Additionally explicit links between reading and writing and the integration of both components into instructional activities appeared to be absent.

Half the children were reported to be engaged with drawing every day, but far fewer children were reported to be regularly engaged in the more complex writing tasks receiving regular additional writing support. As with the classroom writing activities, the additional writing support emphasised the mechanical aspects of writing, with much less emphasis on story content. Buckley and Johnson-Glenberg (2008) suggested computer use by children with DS may support both story content and the mechanical demands of writing. For a small number of children, teachers specified the additional writing support their pupil received involved using the classroom computer. However, over 80% of all children were reported to access their classroom computer including reading, alphabet and word processing programmes. Thus, although teachers reported that children participated in many literacy related activities on the computer, it appears teachers may perceive computer use as a stand alone activity rather than as a medium for reading and writing instruction and practice.

In a study investigating instructional adaptations for struggling writers, Graham et al., (2003) reported nearly one third of teachers did not make use of computer support for their pupil who was struggling with writing, despite computers being readily available.

Teachers in the current study also reported that using the computer was extremely motivating for their pupil, and as such it was used as a reward following completion or participation in a less motivating activity. Given the constraints that the mechanics of handwriting can have on writing output (Graham et al., 2000), as well as the benefits associated with using assistive technology to support writing (MacArthur, Ferretti, Okolo, & Cavalier, 2001) and children's motivation to use computers, it appears this limited use of computers as a medium for reading and writing instruction and practice may potentially be a missed opportunity for children for whom writing is challenging.

In contrast to reading homework which was allocated to the majority of children in the current study, fewer than half the children ever had written tasks for homework and the allocation of daily written homework was rare for children in either group. Teachers reported writing was challenging for participants in the study and recognised the need for the provision of extra support and adaptation to meet these challenges. Given recognition of the need for additional support with writing at school, and the significant relationship between the provision of homework and receipt of parent help (see Chapter 3), it is surprising that the additional practice and teaching that writing homework would provide was not utilised.

The third area explored spelling, and showed that although far fewer children took part in spelling instruction than reading instruction, the average time per week devoted to spelling instruction was similar to that reported by Graham and colleagues (Graham et al., 2003; Graham et al., 2008), who surveyed over 250 American primary grade teachers and their provision of writing and spelling instruction for children who were struggling with these skills. However, far less frequent use of phonics instruction for spelling was reported by the teachers in the current study than was reported by Graham et al. (2003; 2008).

Some parallels between the types of instructional activities used for reading and spelling were apparent in the current study. The predominant spelling instruction activity which nearly half of those receiving spelling instruction were reported to participate in, involved the rote learning of high frequency words and sight words. The proportion of children who participated in spelling instruction with a phonological awareness and letter knowledge focus was similar to that reported for reading instruction, a finding which suggests teachers who do use this instructional strategy, do so when teaching reading, writing and spelling. Although significantly more Group 2 children participated in regular spelling instruction, none were reported to take part in the regular class spelling programme and fewer than ten percent of all children engaged in spelling instruction where activities were based on the class topic.

Phonological awareness skills and letter knowledge have been associated with better readers with DS (Cupples & Iacono, 2000, 2002; Goetz et al., 2008; Gombert, 2002; Roch & Jarrold, 2008; Snowling et al., 2002). Additionally, researchers report associations between reading and spelling skills in individuals with DS (A. Byrne et al., 2002; Cardoso-Martins et al., 2008). These findings are consistent with stage models of reading and spelling (Ehri, 2000; Frith, 1985), which propose that the understanding of the alphabetic principle underpins the skills for learning to read and to spell. Frith (1985) suggested that children use an alphabetic strategy for spelling before they can do so do for reading. An integration of reading and spelling instruction, as recommended by Treiman (1998) would provide opportunities to facilitate understanding of the alphabetic principle across both abilities. In contrast, a separation of reading, writing and spelling instruction minimises the opportunity for children to connect knowledge across domains and bring strategies to bear to support learning in a related environment. The limited connection between children's writing and spelling activities and the activities of the class or class topic suggests a widening gap between children's reading and writing abilities as the needs of the children with DS become increasingly divergent from those of their classroom peers. Not only does this limit the opportunity for reading and spelling to facilitate each other, it also reduces the chances for children with DS to be involved in classroom activities with their peers.

Both bottom-up (Chall, 1983; Liberman & Liberman, 1990) and top-down (Smith & Elley, 1994) reading and writing instruction methods were reported in this investigation. An integrated approach to reading, writing and spelling instruction is potentially compatible with both bottom-up and top-down reading instruction methods. For example, bottom-up activities would provide direct instruction about letter-sound correspondences and phoneme awareness skills to facilitate reading, writing and spelling development. In contrast, a top-down approach might emphasise the authenticity of the activity and the contribution of the learner, by having children read, write and spell about topics that are relevant for them. However, in order to do so, children still need to have an understanding of letter knowledge and phoneme awareness, whether embedded in a literature rich environment or via direct instruction. Results from the current study suggest that for many children with DS, this is not the case.

The implications of the way in which literacy instruction occurs, are that for many children with DS, literacy is not presented in an integrated way and explicit links between spoken and written language are not evident. Further, the majority of children did not have the prerequisite letter knowledge or phoneme level skills to facilitate independent reading, which suggests either these skills are not taught, or they are taught in such a way that the children are not able to extract and integrate this necessary information from the literacy instruction they receive. Teachers reported using both top-down and bottom-up teaching strategies, with many teachers reporting using both concurrently in their classrooms. Thus, although the literacy components presented to the children in the current study may be in keeping with the learning objectives of the New Zealand English Curriculum (Ministry of Education, 2007b), it appears the explicit nature of the instruction and the integration of the components critical for effective literacy instruction for children with DS may be lacking.

CHAPTER 5

THE EFFECTIVENESS OF AN INTEGRATED PHONOLOGICAL AWARNESS INTERVENTION FOR CHILDREN WITH DOWN SYNDROME

5.1 Introduction

Children with Down syndrome (DS) are reported to have widespread and persistent speech deficits which contain elements of both delay and disorder (Bleile & Schwarz, 1984; Hodson, 2007b; Kumin, 1994; Miller & Leddy, 1998; Miller & Leddy, 1999; Parsons & Iacono, 1992; Roberts, Stoel-Gammon et al., 2008; Smith & Stoel-Gammon, 1983; Van Borsel, 1988, 1996). As well as containing more phonological error patterns than the speech of children with typical development (Hodson & Paden, 1981), speech production in DS is also reported to be inconsistent (Dodd & Thompson, 2001). Impaired planning and phonological assembly are implicated in inconsistent production (Dodd et al., 2005; Dodd & McCormack, 1995; Dodd et al., 1994). Poorly specified phonological representations may further impact the accuracy of phonological assembly (Griffiths & Stackhouse, 2002). Jarrold et al. (2009) suggested children with DS may have particular difficulty achieving a precise phonological representation of a word. As well as impacting speech production, accurate phonological representations of words have also been shown to be important for phonological awareness development (Rvachew, 2006; Sutherland & Gillon, 2007).

Strong phoneme awareness ability is associated with better reading outcomes in children with typical development (Hulme et al., 2002; MacMillan, 2002; Muter et al., 1997) as well as children with DS (Cardoso-Martins & Frith, 2001; Cupples & Iacono, 2000, 2002; Goetz et al., 2008; Gombert, 2002; Lemons, 2008; Snowling et al., 2002). Interventions which link phonological awareness and letter knowledge have been used with children with spoken language impairment (Denne et al., 2005; Gillon, 2000; 2002; 2005; Hesketh et al., 2000; van Kleeck et al., 1998), and intervention which integrates these component with speech targets, has been shown to be effective for children speech disorders (Gillon, 2005; McNeill et al., in press).

Although initial evidence suggests that phonological awareness intervention may improve reading in children with DS (Cupples, 2008; Goetz et al., 2008; Lemons, 2008), the impact of this type of intervention on speech production in this population has yet to be explored. The study described in this chapter investigates the effectiveness of an integrated phonological awareness intervention approach on the speech and phonological awareness development of pre-school children with DS. Specifically it was hypothesised that the experimental intervention would improve participants';

1. Speech production accuracy in trained and untrained speech targets;
2. Letter name and letter sound knowledge; and
3. Phonological awareness skills on untrained phoneme level tasks.

5.2 Method

5.2.1 Research Design

A multiple single-subject repeated measures design was used in this study to evaluate the effectiveness of the intervention for each of the participants.

5.2.2 Participants

Ten children (5 girls and 5 boys) with DS participated in the study. The participants were recruited from a group of 13 four and five-year old children who were enrolled in a transition to school programme for children with DS at a specialist early intervention centre. The centre provides services for children identified with or at risk of significant deficits or delays in at least two areas of functioning. Children with DS attend weekly or fortnightly clinics from birth to aged 6 years (or until they are transitioned into school). The centre uses an intervention approach which gives:

> *"explicit and constant attention to the whole child in his/her primary familial contexts, rather than to individual aspects of that child in a discipline specific intervention setting. The long-term aim of the therapists is to work in partnership with the parents to prepare their child for inclusion in their community early childhood centre and primary school".*
>
> (The Champion Centre, 2005, p.8)

Participants ranged in age from 4;04 to 5;05 (M = 4;11, SD = 4.08 months) at the start of the intervention. Throughout the intervention participants attended weekly sessions at the centre, in small groups of up to six children where they received an individual programme based on the New Zealand Early Childhood Curriculum (1996, p.8). Each child received services from a multidisciplinary team of specialists/therapists which included a physiotherapist or occupational therapist, a cognitive therapist, a speech-language therapist, a music therapist, an early childhood teacher and a computer specialist. Children saw each specialist/therapist individually and sequentially throughout the morning as well as participating in a group music session. They received no other professional speech and language therapy during the intervention period. Figure 5.1 depicts a visual support provided for families which illustrates the rotation the children and their parents follow.

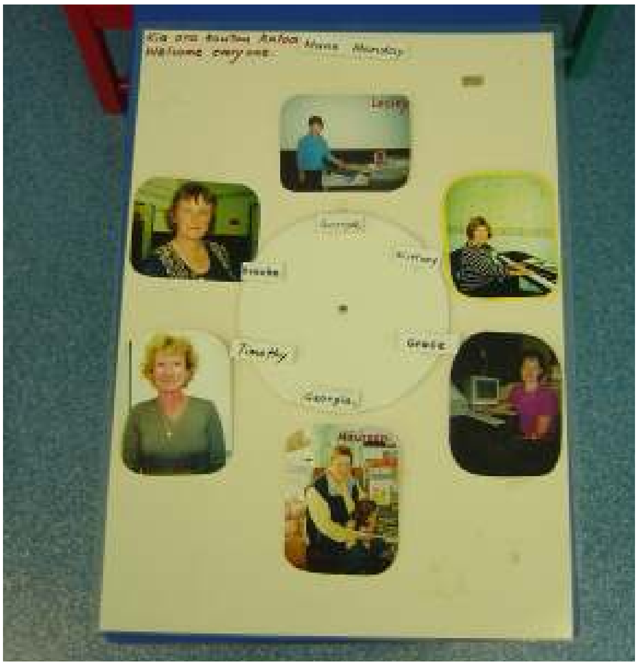


Figure 5.1. Rotation plan for early intervention therapy session[6]

Inclusion Criteria

Written permission for their children to participate in the intervention was received from all parents in line with the University of Canterbury Human Ethics and

[6] From "Beyond the Difference" by The Champion Centre, 2005, p 46. Reprinted with permission of the author.

The Champion Centre Research Committee approval requirements. Following parent consent, criteria for inclusion in the intervention study were:

1) a diagnosis of DS with no known current major medical conditions or additional developmental disabilities such as Autism Spectrum Disorder, Attention Deficit Disorder, epilepsy, or traumatic brain injury, 2) enrolment in the centre's transition to school clinic, 3) standard New Zealand English as a first and only language and 4) no additional speech-language therapy for the duration of the intervention. These criteria excluded three children from the study, one with a serious medical condition and two who intended to leave the centre before the completion of the intervention period. Six children wore corrective glasses and one child was scheduled to have cataract surgery at the completion of the intervention.

Demographic Information

Participants were from a range of socio-economic backgrounds (SES) with three participants coming from low SES backgrounds, 4 from middle SES backgrounds and 3 from high SES backgrounds, according to New Zealand Ministry of Education criteria (New Zealand Ministry of Education, 2006a). Mean Education Levels taken from Elley & Irving (2003, p.8) were used to express reported parental qualification levels with the scale 0-6 as follows:

0: No qualifications

1: Fifth form (now called Year 11)

2: Sixth form (now called Year 12)/ Higher School Qualification/ Overseas Secondary/ Basic Vocational

3: Skilled Vocation/ Intermediate vocational

4: Advanced Vocational

5: Bachelor Degree

6: Higher Degree

Additionally, each family was assigned a rating from the Elley-Irving Socio-Economic Index: 2001 Revision (Elley & Irving, 2003) six-level scale determined by the occupation of the male partner, where a rating of 1 is allocated to the most skilled occupations (e.g. Doctor) and a score of 6 to the least skilled occupations (e.g. labourer). The Index (Elley & Irving, 2003) was revised using data from the 2001 New Zealand Census of Population and Dwellings (Statistics New Zealand, 2001) collected for males aged 15-44 and appropriate for this cohort where all male partners were in full-time work. Table 5.1 details parental education and qualification level.

Table 5.1. Parental Education and Socio-Economic Status

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Maternal Qualification Level	4	3	4	0	4	2	5	5	1	5
Paternal Qualification Level	4	3	2	0	3	2	4	3	1	4
Elley-Irving Index	2	5	3	6	3	3	3	3	4	1

Note: P = Participant

5.2.3 Procedure

Standardised and experimental measures were used to assess the speech, expressive and receptive language, phonological awareness, letter knowledge and hearing of participants. Formal assessment of mental age of the participants was incompatible with the philosophy of the early intervention centre the children attended. Hearing assessments were conducted at the University of Canterbury Speech and Hearing Clinic. All other assessments were conducted individually in a quiet room at the early intervention centre or in the children's home. At least one parent was present throughout. The researcher administered all the experimental tasks. Two senior student Speech-Language Therapists under clinical supervision assisted in the administration of the standardised assessments.

Participants received audiological assessment twice during the intervention period, once during each intervention cycle. One participant failed to attend 3 appointments and was therefore only able to be assessed once during the period. Participants were assessed by audiology students enrolled in the Masters of Audiology programme at the University of Canterbury, under the supervision of a trained and experienced audiologist and clinical educator. Reliable assessment results were not able to be gathered for one child due to non-compliance and a reassessment was subsequently successfully completed by two trained and experienced audiologists. Seven of the ten participants were found to have some degree of hearing loss ranging from slight to moderate. Full results are presented in Table 5.3.

Participants were assessed on the following measures of receptive and expressive language:

Standardised Assessments

- Peabody Picture Vocabulary Test - III (PPVT-III) (Dunn & Dunn, 1997). This receptive vocabulary test requires the child to point to one of four pictures named by the assessor. The test provides normative data for children from aged 2;6 through to adulthood, with satisfactory test-retest reliability coefficients of >.90 reported. The assessment was administered and scored according to the examiner's manual. The assessment yielded standard scores. As standard score floor effects were apparent, both raw scores and standard scores are reported.
- Pre-School Language Scale – Fourth Edition (Australian Language Adaptation) (PLS-4) (Zimmerman, Steiner, & Pond, 2002). This norm-referenced test assesses the child's receptive (Auditory Comprehension) and expressive (Expressive Communication) language for children aged from birth to 6;11. The authors report

a satisfactory test-retest reliability coefficient for the Total Language Score of .97. The assessment yielded standard scores with a minimum score of 50. Standard score floor effects were apparent for the majority of children and as such participant's actual language abilities may not be apparent. Therefore, a Total Language Score (TLS) presented as a language age score is also reported.

Participants' speech production was initially assessed six weeks prior to the start of the intervention using the following measures:

- Hodson Assessment of Phonological Patterns-Third Edition (HAPP-3) (Hodson, 2004). This is a norm referenced and criterion referenced test for children age 2 and over. The test assesses a single word articulation using 50 single and multi-syllabic words elicited by naming manipulatives and line drawings. Where a spontaneous response could not be elicited by the picture or stimulus item, a response was elicited following delayed imitation. Speech data were recorded using a high-quality digital voice recording device (Belkin F8E462). All responses were transcribed via broad transcription.These samples were analysed using Computerised Profiling (PROPH, Long & Fey, 2005).

Initial assessment data for measures of speech and language are reported in Table 5.2.

Table 5.2. Participants' assessment data

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Child's age	4;11	5;0	5;05	4;10	5;02	5;05	4;04	4;09	5;02	4;08
Gender	F	M	F	F	M	F	F	M	M	M
PPVT-III Raw Score[1]	42	3	36	13	18	28	19	39	28	31
PPVT-III Standard Score[2]	81	40[a]	68	48[a]	53	60[a]	65	80[a]	62	73
PLS-4:AC[3]	66	50	50	50	50	50	60	74	51	73
PLS-4:EC[4]	62	50	53	50	50	55	50	79	52	77
PLS-4:TLS[5]	3;4	1;5	2;8[a]	1;8 [a]	2;2	2;5[a]	2;1	3;3[a]	3;0	3;1
Percent Consonants Correct (PCC-R)[6]	66.7	36.2[a]	72.1	22.4[a]	43.8	43.5[a]	38.7	76.1	53.2	53.3
Percent Vowels Correct	97.8	92.0[a]	89.1	93.3[a]	86.4	84.6[a]	100	91.5	85.2	93.5
Total words Analysed	39	25	39	26	21	26	14	50	47	46

Note. Age in years; months; P = participant; [1]Peabody Picture Vocabulary Test– III Raw Score; [2]Peabody Picture Vocabulary Test– III Standard Score; [3] PLS-4:AC = Preschool Language Scale-4 Auditory Comprehension standard score; [4]PLS-4:EC = Preschool Language Scale-4 Expressive Communication standard score; [5]PLS-4:EC = Preschool Language Scale-4 Total Language Score presented as language age score in years; months; [6]PCC-R = Percent consonants correct-revised; [a]denotes unwillingness to participate in the assessment.

<u>Experimental measures</u>

Letter Knowledge and Phonological Awareness experimental measures

- Letter name and letter sound knowledge tasks

Letter name and sound knowledge was assessed using the Gillon Preschool Phonology and Letter Knowledge probes (Gillon, 2005). These probes comprise a lower-case presentation of all 26 letters presented six at a time on an A4 sized grid. The child is required to point to the letter name or sound the assessor names, for example “Which one says ssss?”, or “Show me the letter t”. The letter name and sound probes were administered twice during the assessment session with the appropriate letter identified on both occasions for a correct response to be credited, to reduce the effects of a position response pattern. The phonological awareness and letter knowledge tasks did not require a verbal response.

- Initial Phoneme Identity (Gillon, 2005).

In this experimental task the therapist presents a large colourful picture of an animal and draws the child’s attention to the first sound in a word using the following script

> “SLT: This is my friend hippo. /h/, hippo. Hippo likes pictures that start with /h/”.
>
> The SLT then places and names three pictures in front of the picture and says “bun, hen, peg” which one starts with /h/?”

Corrective feedback is given if required. The test comprised 2 training items and 12 test items, assessing initial phoneme identity skills of 5 different phonemes.

- Initial Phoneme Identity with Words (Gillon & McNeill, 2007)

In this experimental task the therapist presents a large letter and draws the child's attention to the sound it makes using the following script

SLT: "This letter makes the sound /b/".

The SLT then places and names three pictures in front of the child pointing to the written words under the picture, as each word is said.

SLT: "Here are three words: which one starts with /b/? car, bow, sun"

Corrective feedback is given if required. The test comprised 1 training item and 12 test items, assessing initial phoneme identity skills of 6 different phonemes.

- Rhyme Matching

This task was modelled on the experimental rhyme oddity probe from Gillon (2005). The original task required the child to identify the word which did not rhyme from a choice of three and give it to the clown picture, as clown "likes pictures that don't rhyme". In order to reduce the cognitive demands required to process a "negative" instruction, a rhyme matching task was developed using the same stimulus items. The child was required to say or demonstrate whether two pictures rhymed and if they did to give them to clown because "clown likes pictures that rhyme". Two training and 12 test items were presented.

Table 5.3. Participants' hearing, tympanometry, and otoscopy status

P	Method	Hearing status	Ave. Hearing Thresholds (dB)	(DPOAEs)	Tympanometry	Otoscopy	History of Vent. Tubes
1	Play audiometry & VRA via headphones	Normal	20	R: present 2-8khz L: present 3-6khz	Type A bilaterally	R: wax L: vent. tube	2 sets bilaterally (1 tube in situ)
2	VRA via soundfield	Mild rising loss at low frequencies binaurally	25.62	Not attempted	R: Type B high volume c/w patent vent. tube L: Type C with moderate retraction	Normal	1 set bilaterally (1 tube in situ)
3	Play audiometry via headphones	Slight to mild rising conductive loss binaurally	26.25	Not attempted	Type C (moderately retracted bilaterally)	R: normal L: blocked with wax	2 sets bilaterally
4	Play audiometry via headphones	Mild loss at 2 and 4 kHz left ear only, slight loss at 500hz binaurally	20.62	R: present 3-8khz L: present 2-8khz	Type B high volume c/w patent vent. tubes	R: normal, vent. tube L: some wax, vent tube	1 set bilaterally (both tubes in situ)
5	Play audiometry via headphones	Slight loss 2-4 kHz binaurally	21.53	Not attempted	Type A bilaterally	Normal	No

6	VRA via soundfield	Mild-moderate sloping SN loss binaurally with a probable conductive component	39.37	Not attempted	Type B low volume bilaterally c/w OME	R: blocked with wax L: blocked with wax	2 sets bilaterally
7	VRA via soundfield	Moderate rising to mild conductive loss from 500hz-4kHz binaurally	40	Not attempted	Type B bilaterally c/w OME	R: wax L: vent. tube	2 sets bilaterally (1 tube in situ)
8	Play audiometry via headphones	Normal	17.5	Not attempted	R: Type A L: Type A shallow	Normal	No
9	VRA via soundfield	Mild-moderate rising conductive loss binaurally	35.62	Not attempted	Type B bilaterally c/w OME	R: vent. tube L: inflamed	2 sets bilaterally
10	VRA via soundfield	Essentially normal binaurally	20.41	Not attempted	R: Type C with severe retraction L: Type C with moderate retraction	Normal	1 set bilaterally

Note: P = Participant, VRA = visual reinforcement audiometry, SN = sensorineural, R = right ear, L = left ear, Ave. Hearing Thresholds = average thresholds across all frequencies tested, both ears (if tested) and both times (if tested), dB = decibels, OME = Otitis Media with Effusion, DPOAEs = Distortion Product Otoacoustic Emissions, Hz = hertz, kHz = kilohertz, Vent Tubes = Ventilation Tubes

Intervention target selection

Preliminary intervention targets were set based on the initial speech assessment data. Four speech sound targets were selected for each participant. This selection was made with consideration of phonological patterns (Hodson & Paden, 1991; Hodson, 2007a) and incorporated speech goals identified by the parents as important. Parental goals were predominantly initial sounds in the child's or a family member's name. Where possible the target selection combined a speech sound identified as important by the parents with a phonological pattern identified in the Computerized Profiling (PROPH; Long & Fey, 2005) analysis of speech assessment data. For Participant 5 for example, initial /l/ was chosen as a target as this is the first sound of his name and an element of a non-developmental phonological error pattern present in his speech.

Participants were reassessed immediately prior to the start of the intervention to confirm the selection of targets and identify any changes in accuracy of speech sounds over the six week period. The restricted samples produced by some children and the absence of unintelligible words in the samples suggested that children may have avoided saying words they were not able to produce clearly, thus inflating their PCC-R scores at the initial assessment. Seven of the children achieved lower PCC-R scores at the second assessment however a paired t-test showed the change in scores between the two assessment times was not significant (p = 0.198). The second assessment samples were drawn from the following assessment measures:

- Hodson Assessment of Phonological Patterns- Third Edition (HAPP-3) (Hodson, 2004),
- The Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1986). This standardised articulation test provides normative information for males and

females aged from 2;0 to 21;11. The test includes single and multi-syllabic words elicited by naming pictures.

- Diagnostic Evaluation of Articulation and Phonology (DEAP) single trial of the inconsistency subtest (Dodd, Hua, Crosbie, Holm, & Ozanne, 2006). This articulation test includes single and multi-syllabic words elicited by naming pictures. Where a spontaneous response could not be elicited by the picture or stimulus item, a response was elicited following delayed imitation. Speech data were recorded using a high-quality digital voice recording device (Belkin F8E462). All responses were transcribed via broad transcription.These samples were analysed using Computerized Profiling (PROPH; Long & Fey, 2005).

These combined samples were collected from a possible total of 119 words. Participant 2 and 7 provided very restricted samples for analysis from the second speech assessment, undertaken immediately prior to the intervention. Therefore, targets for these participants were based on the initial assessment and parental input and were not adjusted to represent any changes apparent in this latter assessment. Once target selection had been confirmed, participant's performance on these targets extracted from the two speech assessment data sets were converted to a percentage score to form points one and two of the baseline measures pre-intervention. Detailed speech analysis, phonological processes used and selected targets are presented in Tables 5.4 – 5.7.

Table 5.4. The percentage of each sound class produced correctly

Sound Class	**Participants**									
	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Stops	85.7	66.7	90.0	30.8	72.0	83.3	17.4	97.1	83.3	75.5
Nasals	85.2	-	92.0	30.8	53.8	100	41.7	100	76.5	100
Fricatives	58.6	0.0	58.6	19.4	33.3	30.8	16.0	60.0	28.6	44.4
Affricates	18.2	-	27.3	0.0	12.5	0.0	0.0	16.7	0.0	20.0
Glides	63.6	-	62.5	0.0	0.0	100	0.0	0.0	33.3	70.0
Liquids	23.5	-	50.0	0.0	25.0	100	16.7	60.0	28.6	50.0
Clusters	10.7	0.0	35.1	3.0	4.3	57.1	5.0	42.9	27.6	19.6
Vowels	82.1	100	93.1	85.1	76.6	95.0	71.4	97.0	91.3	92.1
Sample information										
Unin. wds	6	1	4	13	17	1	21	0	30	1
Total wds	108	5[1]	105	65[1]	73	20[1]	64	69[1]	70	104

P = Participant, Unin. wds = number of unintelligible words in sample not included in total words analysed, Total wds = total number of words analysed in sample, analysis from Computerized Profiling (PROPH; Long & Fey, 2005), [1]denotes unwillingness to participate in the full assessment

Table 5.5. The percent consonants correct (PCC) for the early 8 sounds, middle 8 sounds, late 8 sounds, and percent consonants correct-revised (PCC-R) for total consonants

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Early 8	74.7	100	81.5	44.2	56.4	81.8	33.3	89.1	86.8	80.2
Middle 8	62.2	0.0	71.4	10.4	37.3	38.5	13.3	83.6	46.2	61.5
Late 8	28.2	0.0	46.1	5.3	21.7	55.6	13.3	43.8	22.4	31.5
Total	54.7	25.0	66.3	19.7	40.4	61.9	20.7	72.5	50.9	56.9

Note. P = Participant; Early ‘8’ = early developing sounds; Middle ‘8’ = middle developing sounds; Late ‘8’ = late developing sounds; (Shriberg, 1993); Total = total percent consonants correct-revised, analysis from Computerized Profiling (PROPH; Long & Fey, 2005).

Table 5.6. Percentage of error types

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Sub	54.5	60.0	61.4	42.7	37.5	50.0	40.0	73.5	52.1	64.5
Omission	41.9	40.0	25.0	53.4	52.8	18.8	49.3	16.3	36.6	28.0
Other	3.6	0.0	13.6	3.9	9.8	25.0	10.6	10.2	11.3	7.5

Note. P = Participant, sub = substitution error, omission = omission error analysis, other = total other errors including distortions and additions, from Computerized Profiling (PROPH; Long & Fey, 2005).

Table 5.7. Participants' phonological error patterns and potential speech sound/letter targets

P	PCC-R	Examples of dominant phonological error patterns	% Usage	Target sounds selected (initial position unless stated)	Control pattern and target[1]
1	40.8	Initial cluster reduction Gliding	84% 91%	/fl/ /gr/ /sp/ /l/	Fronting of inter-dental fricatives Initial & final θ
2	8.3[2]	Final consonant deletion Deletion of initial consonants Context sensitive voicing Deletion of fricatives	100% 28% 50% 75%	/k/ /m/ /t/ /f/	S cluster reduction sm & st
3	45.0	Cluster reduction Stopping	64% 64%	/kr/ /sp/ /sw/ /tʃ/	Fronting of inter-dental fricatives Initial & final θ
4	18.9	Early stopping Final consonant deletion Deletion of final stops Deletion of final nasals	100% 69% 68% 100%	/t/ final /k/ final /n/ final /p/	S cluster reduction S nasals
5	18.8	Cluster reduction Deletion of initial h Liquid deletion Deletion of initial fricatives	100% 91% 60% 50%	/l/ /f/ /sp/ /h/	Fronting of inter-dental fricatives Initial & final θ

6	26.8	Final consonant deletion Later stopping Deletion of final stops	65% 67% 67%	/v/ final /m/ final /p/ final /d/	S cluster reduction sp
7	11.6	Final consonant deletion Deletion of final stops Deletion of final nasals	78% 82% 100%	/p/ /n/ /t/ /b/ all final	S cluster reduction sn & st
8	54.3	Later stopping Cluster simplification	95% 96%	/kr/ /tr/ /ʤ/ /tʃ/	Fricative simplification st
9	44.1	Later stopping Gliding Liquid deletion Deletion/substitution of final k	71% 33% 25% 56%	/l/ /v/ /tʃ/ final /k/	S cluster reduction S nasals
10	54.0	S nasal cluster reduction Substitutions/distortions of fricatives Distortions/substitutions of affricates Deletion/substitutions/distortions of initial h	100% 50% 58% 60%	/h/ /v/ sn/ & /sm/ /tʃ/	Fronting of inter-dental fricatives Initial & final θ

[1]All participants scored 0% correct on control sound targets at pre-intervention. [2]Severely restricted sample

Pre- and post-intervention measures

The following measures were administered pre- and post- intervention to all ten participants.

Speech sound targets

Twelve speech sound cards comprising words of a similar phonological structure were prepared for each of the targeted letters/sounds (i.e. 48 cards per child). Six were randomly selected to be the trained items with the remaining six to be the untrained items. These untrained words were not included in the intervention activities but served as a generalisation measure and were assessed only. Thus all participants completed 48 trials of their individual targets at each assessment time. Correct production of the target phoneme in the appropriate word position was credited correct; however non- targeted phonemes in the word may have been in error. For example a child whose target was final /p/ would be credited as correct with the production of the word "cup" as /tʌp /. An additional set of twelve speech sound cards was prepared for a control measure for each child. This set was not included in the intervention activities and was assessed only. The cards were modelled on the format used by Gillon and McNeill (2007). (Examples of these speech cards are freely available from the following website:

http://www.education.canterbury.ac.nz/people/gillon/resources.shtml).

Participants were assessed on all their target and control speech cards (60 trials) on five occasions throughout the study. The first two administrations completed one week prior and immediately prior to the start of the intervention, comprised the final two baseline measures pre-intervention. Assessments were also completed at the end of cycle one, and at the start and end of cycle two.

5.2.4 Intervention

Intervention procedures

The experimental integrated phonological awareness intervention implemented in this study comprised the following three components:

1. A parent implemented home programme to facilitate letter and sound knowledge. Parents used print referencing techniques at home to bring their child's attention to targeted letters and sounds during joint story book reading four times per week for 10 minutes per session throughout the 18 week intervention period. Two of the child's letter targets were chosen for each session. Each pair formed a particular focus of the parent's print referencing component for three weeks of each intervention cycle. However, any or all of the targets could be included during the break (see Figure 2 for a timeline of the intervention).

<u>Parent training procedures</u>

Prior to the intervention, parents attended an information and training evening outlining the three components of the intervention and detailing the parent print referencing techniques. The parent training procedures followed the same format as for the print referencing pilot study (van Bysterveldt et al., 2006) whereby parents viewed a videotape of a parent working with her child with DS, demonstrating the intervention techniques.

Parents practised the techniques in pairs or small groups and received feedback from the researcher. Written information was also given, along with a laminated prompt sheet specifying the three key parts of the technique: letter name, letter sound, first/last sound in a word. Parents also received training in suitable book selection to maximise the opportunities for using the print referencing techniques. One parent who was unable to attend the training evening received a training session in her own home. Parents' understanding and application of the print referencing techniques was also discussed with an experienced speech therapist on a weekly basis during cycle one of the intervention and with the lead researcher during cycle two of the intervention. While their main focus was to be on the target letters and sounds, parents were instructed to include references to non-targeted letters and sounds when for example, the child pointed to a non-target letter or misidentified a non-target letter or sound.

2. Speech-Language Therapy (SLT) sessions. Participants attended the early intervention centre one morning per week, where they saw each of the six different therapists/specialist who comprised the multidisciplinary team, in 20 minute sessions individually and sequentially throughout the morning. The intervention was delivered in two, 6 weekly cycles separated by a 6 week break (i.e. 4 hours total SLT and 4 hours total LTC). The SLT sessions integrated speech goals with phonological awareness and letter knowledge goals and were implemented by the lead researcher, focusing on the same two speech targets per session that were the focus of the print referencing component.

For example if the child's speech target was the correct articulation of final /p/ in CVC words then the letter p was used in letter sound knowledge activities, and phoneme matching tasks included CVC words ending with /p/. The lead researcher provided a correct model and feedback during all activities. Children were encouraged to engage in tasks that required the articulation of their target speech words, letter name and letter sound knowledge tasks and phoneme matching tasks based on the structure described in Gillon and McNeill (2007) and adapted by the researcher for use with pre-school children with DS.

3. Learning through Computer (LTC). According to the early intervention centre's service delivery model, the Learning through Computer (LTC) programme, in addition to teaching children computer skills, is designed to support and reinforce work from other disciplines with particular emphasis on supporting the SLT goals for the child. It provides children with opportunities to practice and demonstrate skills and understanding of concepts through a different medium. Thus, the LTC programme provided the ideal setting in which to include the Integrated Phonological Awareness Intervention to support and reinforce its goals. LTC sessions comprised phonological awareness and letter knowledge tasks adapted for presentation on a computer to pre-school children with DS. Figure 5.2 depicts a model of the integrated phonological awareness intervention with a brief description of its three components.

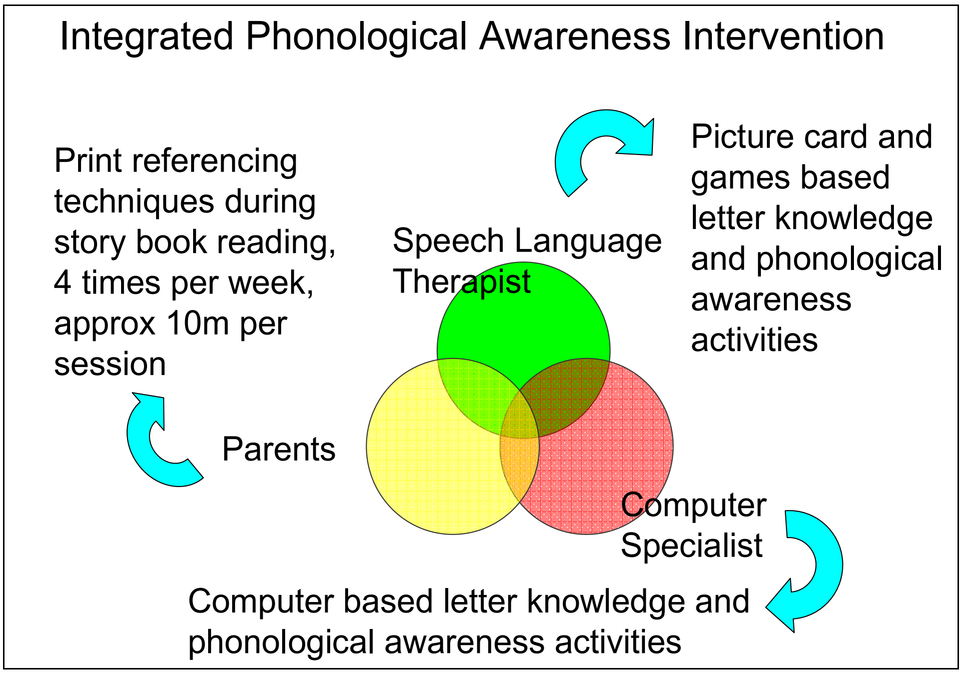


Figure 5.2. Integrated Phonological Awareness Intervention Model and components

Several children had periods of ill health during the intervention and were unable to attend the centre. Two children each received a catch up session in a quiet room in their own home. Participant 10 lived a long distance from the centre and attended on a fortnightly basis. Only one child attended the full 24 centre-based intervention sessions with attendance ranging from 12 to 24 sessions (see Table 5.8). Participants attended an average of 75% of centre based sessions, (approximately 6 hours) equating to a total mean intervention time of 18 hours 8 minutes (SD = 1 hr 18 m).

Table 5.8. Attendance at Speech-Language Therapy and "Learning Through Computer" sessions during the intervention

Sessions attended	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
ST	12	9	11	9	9	11	9	7	12	6
LCT	12	9	11	9	9	11	8	7	11	6
Total	24	18	22	18	18	22	17	14	23	12

Note. P = participant, SLT = Speech Therapy, LTC = Learning Through Computer.

Intervention sessions were conducted in a clinic room at the early intervention centre. A parent/caregiver was present for the majority of sessions. Print referencing sessions were conducted in the child's own home. Session durations were restricted to 20 minutes for the SLT and LTC sessions and 10 minutes for the parent-led sessions in line with the attention span of the participants. Figure 5.3 depicts the timing of the presentation of each of the intervention components and the assessments completed during the baseline and intervention phases.

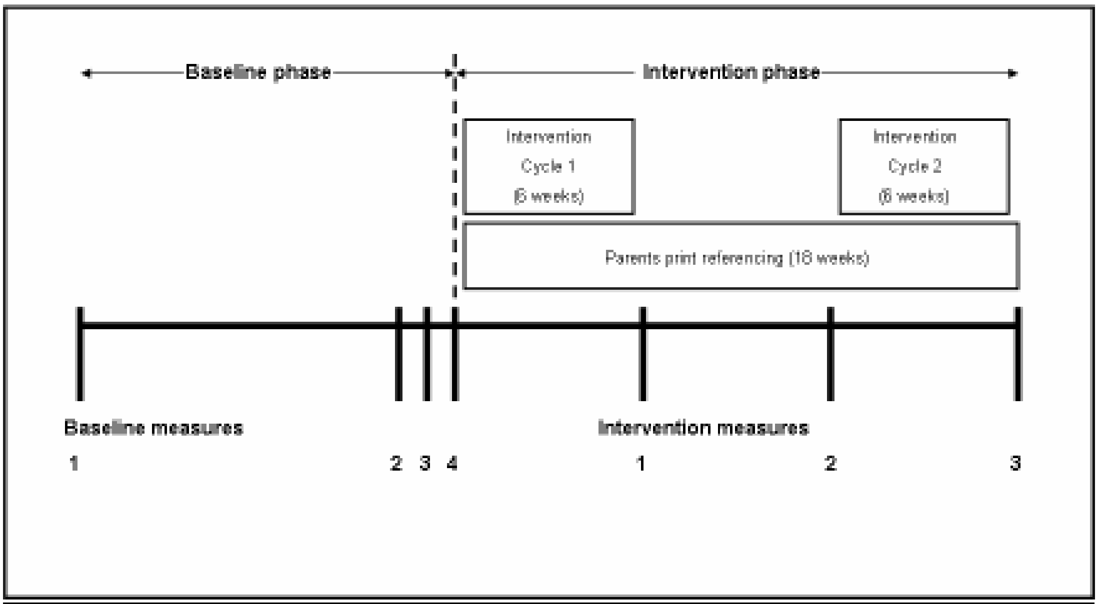


Figure 5.3. Intervention components and assessment timeline

<u>Structure of the sessions</u>

Speech therapy sessions

All speech therapy sessions included the following letter knowledge and phoneme identity and matching tasks based on the structure described in Gillon and McNeill (2007) and adapted by the author for use with pre-school children with DS. Sessions characteristically included four 5 minute activities as this was compatible with the children's attention span and ability to engage with the task. Sessions began with a letter knowledge activity, followed by one or two phoneme identity and matching tasks. Each session also typically contained at least one game where letter-name and letter-sound instruction and phoneme identity/matching were integrated into the one activity. Some examples of activities are described below:

- Letter- name and letter-sound knowledge example

SLT placed poster sized cards of the 2 targets being targeted (e.g. l and k) on the floor and hid 6-10 small cards of each of the letters around the room. These small cards were placed in obvious locations e.g. under a cushion, on a chair etc that were easy for the child to find in a “hide and seek” type format. Alternately the small cards could simply be placed face down and the SLT and child could take turns to turn them over. The letter name and letter sound was then said by the therapist and the child matched it to the corresponding large letter. If the child spontaneously said the letter name and or sound this was reinforced by the SLT. The child then placed a mechanical toy on the large letter card and activated it to jump.

SLT: “What have you found?”

SLT: “Ooh, you’ve found t.”

SLT: “t says /t/. Can you see t, /t/ anywhere?”

Child: “There”. (child points)

SLT: “Oh, good matching, you found…?” (prompting for the target letter name).

Child: “t”.

SLT: “You’re right, and it says…?” (prompting for the target letter sound)

Child: “/t/”.

SLT: “Well done, you matched t, /t/.”

Child places small letter card onto corresponding large letter.

SLT: “Let’s bounce Tigger on t.”

Child activates mechanical toy.

SLT: “What else can we find?”

Child looks for another small card.

- Phoneme identity and matching example

The SLT placed poster sized cards of the 2 targets being taught (e.g. l and k) on the floor. She placed two “bingo” type boards on the floor beside the corresponding letter target. The bingo boards comprise one poster sized sheet with the 6 target words displayed on it with the word written in large bold font underneath each picture. An identical set was cut up for the child to match. For example, where the target was to address final consonant deletion of /k/, the bingo board used included the words *sock, hook, work, beak, wink,* and *book.* These were placed face down and the SLT and child took turns to turn them over. If the child spontaneously said the word, this was reinforced by the SLT. Corrective feedback was provided if required including drawing the child’s attention to the written text. If the child did not spontaneously say the word, it was said by the therapist and the child matched it to the corresponding large letter. Once the words had been matched to their initial of final target phoneme they were then matched to the corresponding picture on the bingo board. During this activity the speech therapist provided at least 12 presentations of phoneme identity and matching.

SLT: “Let’s see what we’ve got. You choose one”.

Child: (child chooses a card and names it) “tap”.

SLT: You’re right, that says tap and there’s the letter t that says /t/”. (points to the text under the picture).

SLT: See, it starts with t. (points to the large letter).

SLT: Let’s check, is it the same?” (compares to large letter).

Child: “Yes”.

SLT: “You’re right, now we need to find the other picture of …? “(prompts the child to respond)

Child: “tap”.

SLT: “You’re right, tap”

Child: (places card on board) “tap”.

SLT: “Good matching”.

For some children the presence of the two bingo boards was too challenging or distracting so the activity was modified to present one target at a time. The phoneme identity and matching tasks were presented after the letter knowledge activity as this gave the child time to “warm up” to the demands of the session. Where possible, letter-name and letter-letter sound instruction, and phoneme identity and matching were integrated into the one activity. An example of this is as follows:

- Combined activity

SLT placed a poster sized sheet on the floor with a racetrack circuit on it. The track was divided into squares on which were placed 6-10 small letter cards for each of the 2 target letters/sounds. Two piles of word cards, each pile comprising the 6 target words for each sound, were placed in the middle of the track. The child, parent and therapist all had a small car and took turns throwing a dice and moving their car around the track. When a person landed on a small letter card a corresponding word card was chosen. Parents were encouraged to provide feedback to the child following the SLT’s model.

SLT: “Your turn to throw the dice”.

Child throws dice.

SLT: “Oh you got a …?”

Child: “Three”.

SLT: “Great, let’s count, one, two, three. You landed on…?”(prompting for the target letter name.

Child: “l”.

SLT: “You did, you landed on l, and it makes the /l/ sound. Now choose a word that starts with l. Which pile is it on?”

Child: (chooses a card) “lamp”.

SLT: “Good talking, you chose lamp. It starts with l that makes the /l/ sound. Let’s say it together; lamp. Show Mum what you got”.

Child: “lamp”.

Mum: “What does it start with?”

Child: “l”.

Mum: “Yes, l says /l/. Good job!”

“Learning Through Computer” sessions

As with the speech therapy sessions, all “Learning Through Computer” sessions included the letter knowledge and phoneme identity and matching tasks based on the structure described in Gillon and McNeill (2007) and adapted by the researcher and computer specialist for presentation on a computer. Sessions characteristically comprised several short activities as this was compatible with the children’s attention span and ability to engage with the task. The computer specialist presented at least 2 activities which included the child’s target letters and sounds. These activities may have included one or more of the child’s trained words; however care was taken to ensure all of the child’s untrained words were excluded.

- Combined activity

The computer specialist showed a presentation produced in Microsoft PowerPoint© which was visually appealing to the child. Participants in the study were all familiar with this presentation format. One of the Microsoft PowerPoint©

presentations consisted of an alphabetised arrangement of all the letters of the alphabet. Each screen contained pictures of words beginning with a target letter with both the upper and lower case letters depicted on one corner of the screen. Additionally the name was displayed underneath each of the pictures in lowercase bold font size 32. Each screen included embedded audio files with some presentations containing imbedded video files. The child was required to click the mouse on a star, or touch the picture on the IntelliKeys© keyboard to forward to the next screen. This activated an audio file with the following example script:

"This is the letter m. It makes the sound /m/".

The child then clicked on or touched a picture (e.g. milk) to hear an audio file of the word being spoken. All the pictures on the screen were linked to audio files of their spoken name. Additionally, some presentations included small video clips where the child clicks the clip to hear and see a person saying the target letter sound. After completion of the activities involving their target letters and sounds participants sometimes chose to view other pages from the Microsoft PowerPoint© alphabet presentation. Examples of a screen from a Microsoft PowerPoint© presentation is included in Appendix C.

5.2.5 Reliability and treatment fidelity

Reliability

Assessment data

All the videotaped standardised assessment sessions conducted by the senior speech-language therapy students were jointly scored, that is, administered and scored by one student and scored by the other student observing. Any differences were resolved by consensus following subsequent viewing of the videotaped session. The researcher reviewed all the videotaped standardised assessment sessions conducted by the senior speech-language therapy students. Additionally, a further 20% of all assessments were rechecked for scoring and data entry by an independent researcher. Any errors were corrected before analysis.

Speech data

The researcher rechecked all speech assessment data. Additionally, 20% of speech assessment data were selected for re-transcription by an independent SLT. Point-by-point analysis showed 92.1% agreement, ranging from 87.7% to 95.0% agreement for pre-intervention assessment samples. Twenty percent of the speech probes were also selected for re-transcription. Point-by-point analysis showed mean agreement of 98.9%, ranging from 83.3% to 100% agreement. Any differences were resolved by consensus after repeated listenings.

Treatment Fidelity

Print referencing sessions.

Parents were videotaped administering the print referencing techniques between 2 and 4 times during the intervention period, and received feedback from the senior speech-language therapy students. After any corrective feedback was received, the parents were given further opportunity to demonstrate correct administration of the print referencing protocol. Additionally, 23 video taped sessions of parents delivering the intervention were viewed by an independent reviewer trained in the print referencing protocol.

The reviewer recorded that nine of the ten parents consistently and accurately implemented the intervention as per their training. One parent however did not consistently use all three strategies in one session, that is, they may have pointed out a letter name but did not identify the letter sound or the letter in a word. Additionally the parent frequently required the child to repeat the text in the story, which was not part of the protocol. Additional training and corrective feedback was given, however, the parent's implementation of the intervention protocol remained inconsistent.

Parents completed a weekly report with an experienced speech-language therapist detailing the frequency of presentation of the print referencing component. While all parents reported they abandoned at least one session due to non-compliance during the intervention period with some parents reporting abandoned sessions every week, they all reported completing four 10 minute sessions of print referencing per week for the full 18 week period. Sessions were largely presented by mothers; 100% in six families, 90% in three families and 70% in one family. Seven of the reviewed sessions (30%) were affected by interaction breakdowns or abandoned subsequent to challenging behaviours from the child, including screaming, grabbing the book, running away, and refusing to listen to the story.

All parents reported occasional reference to non-target letters and sounds. Occurrences most frequently involved the initial letter in siblings' names and the names of favourite book characters. One parent reported this occurred more frequently and included items of environmental print such as a cereal box for example.

Speech therapy intervention sessions

Thirty nine randomly selected intervention sessions (just over 41% of the total sessions) conducted by the lead researcher (a trained speech-language therapist) were evaluated by an independent reviewer familiar with the intervention activities and protocol. The reviewer watched the selected videos which included at least two sessions from each participant, and recorded the presence of the following three intervention elements: letter-name instruction, letter-sound instruction, and phoneme identity and matching. A minimum of 12 productions of each of the targeted letter names and letter sounds by the researcher were required for letter knowledge instruction and 12 explicit references to or productions of the target sounds in a word were required for the phoneme identity and matching tasks.

Analysis of the sampled sessions showed 79.4% (31 sessions) adhered to the treatment fidelity protocol detailed above, with an average of 29 (SD = 13.53) letter-name and 39.4 (SD = 20.82) letter-sound instructions and 45.9 (SD = 20.29) examples of the phoneme identity and matching element per session.

The reviewer also recorded the number of productions of the target letter names, letter sounds, and speech card targets the child made. The wide variation in participants' speech abilities and the impact of behaviour and motivation meant minimum target production across participants was not appropriate. Average production across participants ranged from 0.5 to 29 for letter names, from 0.3 to 22 for letter sounds and from 5 to 32 for whole words. There was also considerable within-participant variability across sessions. The SLT was required to respond with corrective feedback, modelling or cueing on at least 50% of the occasions when the child's letter-name, letter-sound or target word production was in error. The nature of the majority of these responses was to bring the child's attention to the visual support (i.e. letter cards or speech cards) and direct their attention to the phoneme-grapheme connections. As children's correct production of the target sounds was initially very low, this minimum of 50% feedback figure was chosen as it allowed the SLT to bring the child's attention to the error, whilst still maintaining the child's motivation and engagement in the activity. For example, where the target was to address final consonant deletion of /k/, a child's production of the word "beak" as /bi/ may receive the following feedback:

SLT: "When you say / bi/, I can't hear the /k/ sound. Look, there's the letter k, it makes the /k/ sound" (points to the text on the card).

SLT: "This word says / bik/. Try again with the /k/ on the end."

Child: /bi/

SLT: "Good try."

All 39 sessions reviewed adhered to the corrective feedback standard. Corrective feedback figures ranged from 50% to 112% with a corrective response given on an average of 77.9% (SD = 17.3) of error occasions.

Additionally, the reviewer noted the child's overall compliance and engagement within the session and the occurrence of interaction breakdowns. The reviewer identified 28 different challenging behaviours such as biting, pinching, shouting, throwing toys, hiding, and damaging equipment. A total of 90 separate challenging behavioural events, many of several minutes duration, were noted by the reviewer. Interaction breakdowns affected 25 of the 39 sessions reviewed (just over 64%) with 90 separate challenging behavioural events recorded, ranging from 1 to 10 per session (M = 2.3, SD = 2.79) which prevented one or more elements being completed in approximately 18% (7) of the sessions, and the presence of additional visiting specialists impacting the presentation of one element in the remaining session. Four of the participants averaged less than one challenging behavioural event per session, with the remaining six participants averaging between one and seven (M = 3.6, SD = 2.96) events per session. No pattern was observed between the presentation of the different activities and the occurrence of interaction breakdowns.

"Learning Through Computer" sessions

The computer specialist's clinical notes from a randomly selected 32 (just over 34%) sessions were reviewed by the author. Sessions were required to contain at least two of the activities developed by the lead researcher and the computer specialist, known to include the following three components: letter name knowledge, letter sound knowledge, and phoneme identity and matching. The computer specialist did not provide corrective feedback for any speech sound errors, but provided a correct model and non-specific praise such as "good try" and "you're working hard today" throughout the therapy session. These sessions were also overlaid with other programme goals such as mouse skills and following directions. Analysis showed all the reviewed sessions adhered to the protocol and contained at least two activities which included the required intervention components. The computer specialist had recorded incidences of interaction breakdown during 7 (just over 21%) of the reviewed sessions.

5.3 Results

Scoring

Where the assessment was unable to be completed due to a participant's inability to understand the task or an unwillingness to attempt or complete the task, a score of zero was given for that item and the next item was presented, as in Cupples and Iacono (2000). Where participants did not respond during the speech sound assessment, stimulus cards were placed on the bottom of the pile and re-presented later in the assessment. A further non-response resulted in a zero score for that item. For each of the ten participants, correct scores on all target speech sounds were summed to provide a total percentage phonemes correct score for each of the four baseline and three intervention phases' data points.

5.3.1 Speech production accuracy

The data were first analysed to evaluate whether the intervention improved speech production accuracy in trained and untrained speech items featuring the target speech sounds. No statistical difference was found between participants' performances on trained and untrained words ($p \geq 0.1$), therefore these data were combined for all analyses. The two standard deviation band method (Portney & Watkins, 2009) was used to determine whether a statistical difference existed between scores within the baseline and intervention phases. For this method, the mean and standard deviation of the baseline phase are calculated and a two standard deviation band above and below the baseline mean is determined. The mean and the two standard deviation band values are plotted across both the baseline and intervention phases. A significant change in performance between baseline and intervention exists where intervention data points fall outside the banded area (Portney & Watkins, 2009). A linear regression line was also calculated depicting the line which best describes the relationship between speech production performance and time during the baseline phase, and providing an estimate of predicted speech performance during the intervention phase.

Given the possibility of auto-correlation of data in single-subject design (Sideridis & Greenwood, 1997) as well as the fact that the speech data were collected across different time intervals which precluded traditional auto-correlation testing, additional analysis was undertaken using the statistical process control (SPC) model described in Portney and Watkins (2009), which controls for the contribution of time-series data to the probability of Type I error (false positive). This model can be used to verify the existence of stable baseline performances and to determine whether significant change has occurred between baseline and intervention phases (Orme & Cox, 2001).

For this method, the mean of the baseline phase is calculated and plotted as a central line. A moving range score (X-mR), based on the mean variability between adjacent data points during the baseline phase, is calculated to determine the upper and lower control limits (UCL and LCL). These control limits are plotted at three standard deviations above and below the baseline mean across both the baseline and intervention phases. Data within these control limits of common cause variation indicate a stable baseline. Where any one data point falls outside the UCL and LCL (Portney & Watkins, 2009) the variation is described as special cause variation which, when this occurs in the intervention phase, is indicative of a significant change in performance from baseline. SPC analysis was performed for the seven participants who achieved any scores above zero, and therefore demonstrated variability, during the baseline phase.

Effect sizes and confidence intervals (Devilly, 2004) were generated for seven participants. The remaining three participants achieved zero scores at all points during the baseline phase, thus neither SPC analysis nor effect size analysis was appropriate. Further visual analysis was undertaken whereby each participant's results were graphed to reflect performance on individual speech targets. Participants received a number of phonemes correct score for each of their four target sounds and one control sound, each with a possible score of 12. In order to control for the number of opportunities, performance on each of the sounds was plotted for the final two baseline phase and three intervention phase data points.

The speech production gains of one child (Participant 4) analysed via the two standard deviation band method and the statistical process control method are presented in Figures 5.4 and 5.5 respectively. Participant 4's performance on individual speech sound targets is presented in Figure 6. The graphs demonstrating overall speech production changes and performance on individual speech sound targets for all remaining participants are presented in Appendix D.

A summary of change scores, significance and effect sizes for target speech sounds is presented in Table 5.9. A standardised mean difference statistic was calculated using the procedure described in Shadish, Rindskopf, and Hedges (2008). This measure has been developed in an effort to provide a mechanism to compare the effectiveness of single-case designs with between-group designs. This procedure yielded a g statistic of $g = 2.59$ (Hedges adjustment for sample size $d = 2.48$) which is comparable to those reported by Shadish et al. (2008) in their meta analysis of single-case experimental designs.

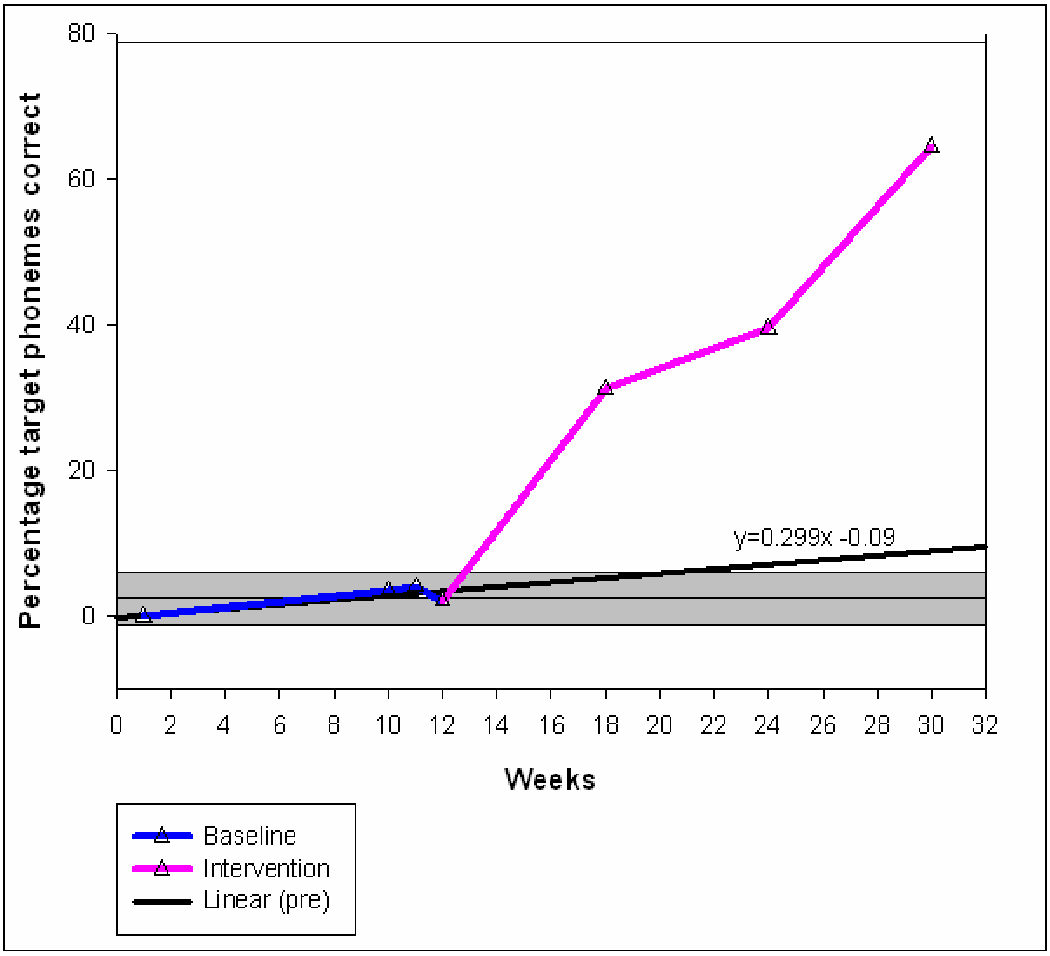


Figure 5.4. Pre- and post-intervention performance for speech sound measures for Participant 4 analysed using the two standard deviation band method.

Performance in the intervention phase must be above the two standard deviation band to demonstrate significant improvement (in this example, the mean and standard deviation of the speech sound measures pre-intervention was M = 2.45, SD = 1.85).

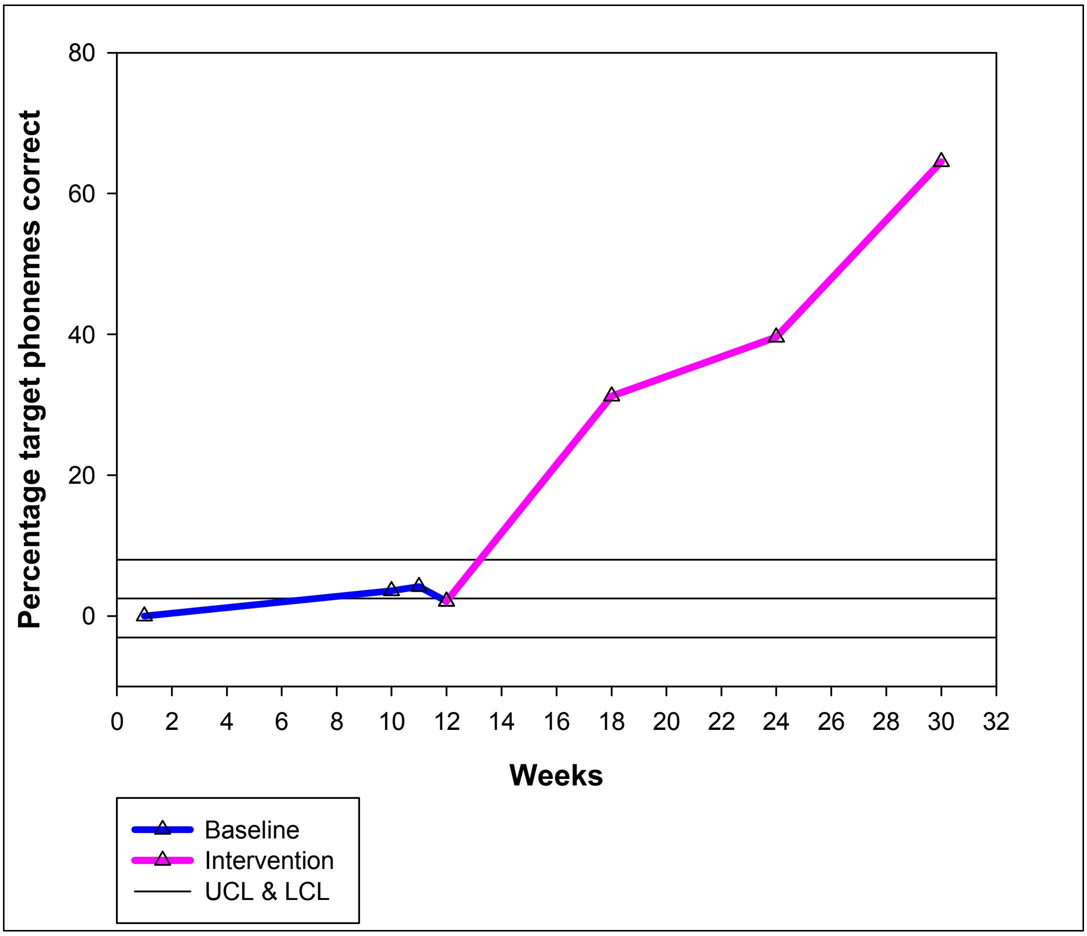


Figure 5.5. Pre- and post-intervention performance for speech sound measures for Participant 4 analysed using the statistical process control method.

Performance in the intervention phase must be above the Upper Control Limit to demonstrate significant improvement (in this example, the UCL = 7.98 and the LCL = -3.0776.

The graphical representations in Figures 3 and 4 present very similarly, with all intervention data points falling above both the 2 SD band and the UCL. This pattern is consistent across participants with the exception of Participant 5, where all three intervention data points fall above the 2 SD band and two of these intervention points fall above the UCL (see Appendix D).

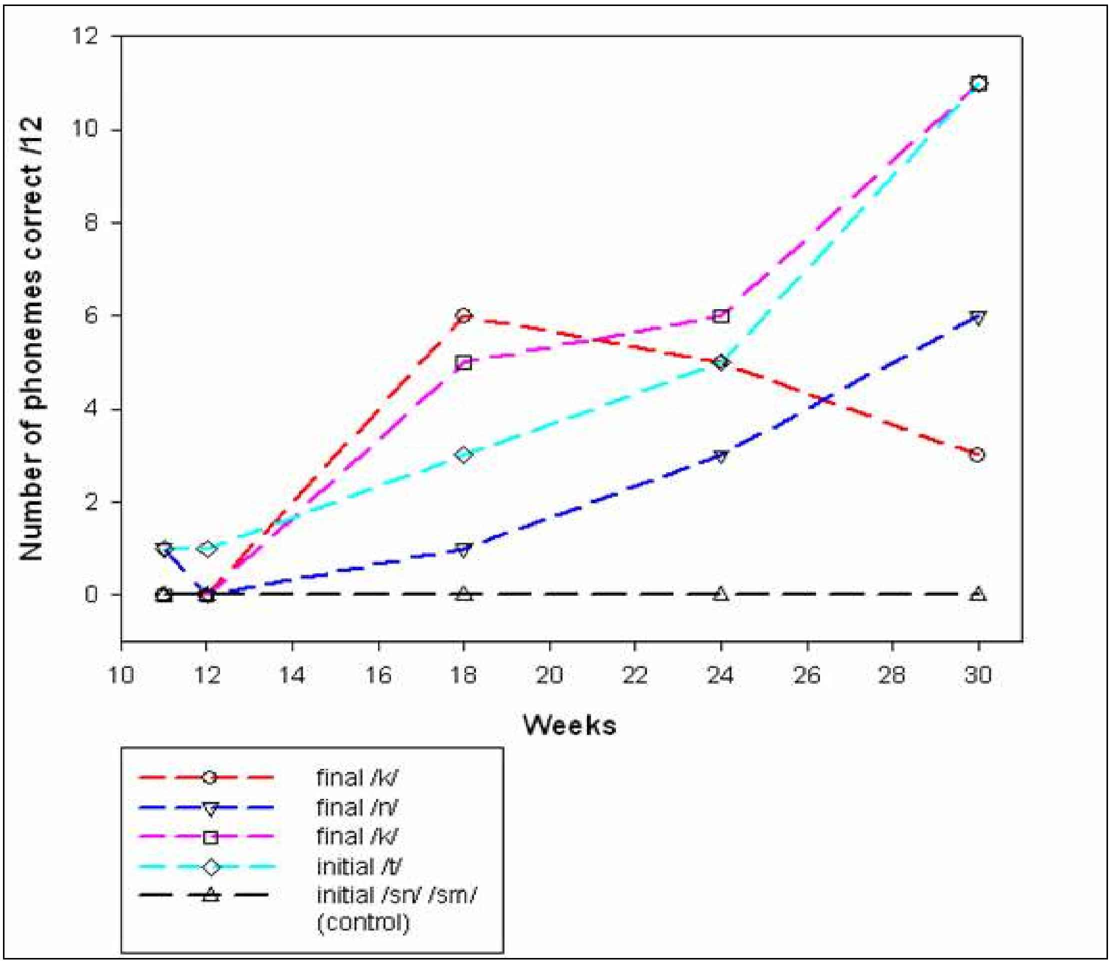


Figure 5.6. Pre- and post-intervention performance for individual speech sound targets for Participant 4.

Table 5.9. Summary of change and effect sizes in target speech sounds

P	Baseline	Intervention	2SD signif?	SPC signif?	Effect Size Cohen's d	-95%CI	+95%CI
1	0.52 (1.04)	13.88 (13.22)	Yes	Yes	1.42	-0.24	3.09
2	0	14.90 (23.12)	Yes	Yes	NA	NA	NA
3	0	61.77 (8.66)	Yes	Yes	NA	NA	NA
4	2.45 (1.85)	45.11 (17.30)	Yes	Yes	3.46	1.11	5.82
5	1.47 (2.94)	15.26 (5.22)	Yes	Yes	3.25	0.98	5.51
6	1.04 (2.08)	52.07 (22.52)	Yes	Yes	3.19	0.94	5.43
7	3.85 (2.70)	38.88 (15.91)	Yes	Yes	3.42	1.05	5.75
8	0	22.77 (15.73)	Yes	Yes	NA	NA	NA
9	11.40 (3.50)	53.11 (14.47)	Yes	Yes	3.96	1.40	6.52
10	4.68 (3.55)	43.74 (16.66)	Yes	Yes	3.24	0.97	5.50

Note: Baseline and intervention scores are the mean and standard deviation of the baseline and intervention scores, P = Participant; 2SD signif? = Significant using the two standard deviation band method; SPC signif? = Significant using the Statistical Process Control method; CI = confidence intervals

Correct production of target sounds ranged from 0% to 10.41% at pre-intervention (M = 2.91, SD = 3.42) and from 20.8% to 70.8% post-intervention (M = 51.42, SD = 16.54) indicating gains of between 20.8% and 66.64% (M = 48.51, SD = 15). A paired samples t-test performed on the grouped data revealed significant differences between the pre- and post-intervention scores [t (9) = 10.02, $p < 0.001$]. Percent Consonants Correct-Revised (PCC-R) and Percent Vowels Correct (PVC) and percentage change for all sounds in participants' speech target words are presented in

Table 5.10. The PCC-R metric, which scores distortions (both clinical and non-clinical) as correct, is recommended by Shriberg and colleagues (Shriberg et al., 1997) as the measure which is most appropriate to compare the speech of individuals with diverse speech and age profiles. Post-intervention gains ranged from 22.5 – 52.7 for PCC-R and between 5.3 and 66.4 for PVC. All participants scored 0% correct on control sounds pre-intervention and six participants remained at 0% correct scores post-intervention, with four participants demonstrating a small improvement in the production of their control sounds post-intervention. All participants showed greater change on target sounds than control sounds, with average difference scores for target sounds ranging from 2.5 to 8 out of 12 and for control sounds from 0 to 3 out of 12. No significant relationships were found between percentage change on target phonemes and pre-intervention measures of PPVT [r = -0.63, p = 0.86], hearing thresholds [r = 0.12, p = 0.73] or chronological age [r = 0.41, p = 0.23].

Table 5.10. PCC-R and PVC of all sounds in participants' speech target words

P	PCC-R			PVC		
	Pre	Post	Difference	Pre	Post	Difference
1	40.8	64.9	+24.1	83.7	91.5	+7.8
2	8.3[1]	62.1	+53.8	28.6[1]	75.0	+66.4
3	45.0	82.4	+37.4	89.7	97.9	+8.2
4	18.9	68.1	+49.2	65.2	80.4	+15.2
5	18.8	41.9	+23.1	77.8	89.7	+11.9
6	26.8	75.3	+48.5	52.4	95.0	+42.6
7	11.6	57.3	+45.7	26.5	60.0	+33.5
8	54.3	76.8	+22.5	91.1	100	+8.9
9	44.1	73.4	+29.3	68.2	93.1	+24.9
10	54.0	78.0	+24.0	82.6	97.9	+15.3

Note: P = Participant; PCC-R = Percent consonants correct-revised; PVC = Percent vowels correct; [1]Severely restricted sample characterised by non-speech sounds

5.3.2 Letter-name and letter-sound knowledge

The data were then analysed to evaluate whether the intervention improved letter name and sound knowledge. Participants' letter-name knowledge was assessed pre- and post-intervention with results presented in Figure 5.7. At pre-intervention, two participants had complete or near complete letter-name knowledge with three other participants able to identify between 1 and 10 letter names. Post-intervention, 7 children were able to demonstrate some letter knowledge. One participant demonstrated a large change, learning a further 13 letter names during the intervention. Four participants pre-intervention and three participants post-intervention were unable to complete the task. Responses included closing the assessment book, pointing to several letters at once and providing no response. These participants were assigned a score of zero. No significant relationships were found between gain scores on letter name knowledge and pre-intervention measures of PPVT [$r = 1.38$, $p = 0.74$], hearing thresholds [$r = 0.40$, $p = 0.32$] or chronological age [$r = -0.007$, $p = 0.98$]. Due to ceiling effects the data from two children with high scores on letter knowledge at pre-intervention were excluded from this analysis of change scores. Participants pre-intervention scores of letter name knowledge were, however, significantly correlated with PPVT scores [$r = 0.71$, $p = 0.02$] but not with hearing thresholds [$r = -0.40$, $p = 0.24$] or chronological age [$r = -0.81$, $p = 0.82$].

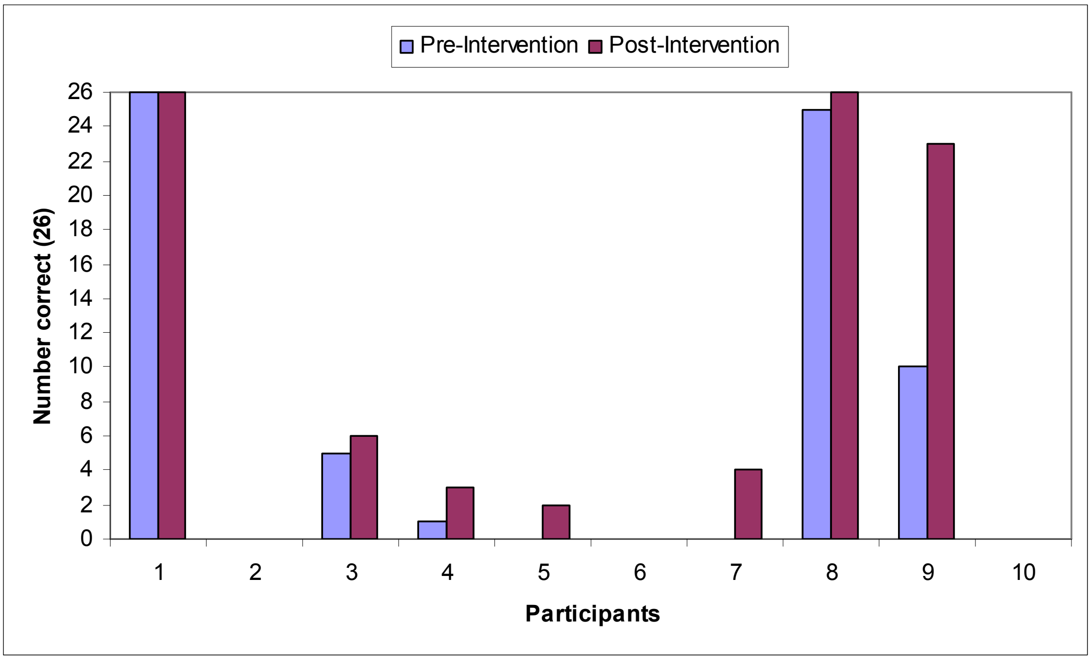


Figure 5.7. Letter-name knowledge pre- and post-intervention

Results of the pre-and post-intervention assessment of letter-sound knowledge are presented in Figure 5.8. At pre-intervention, two participants demonstrated high scores on the letter-sound knowledge task with one other participant able to identify 1 letter sound correctly. Post-intervention, two of these participants showed some increases in scores but no additional children were able to demonstrate any letter-sound knowledge. Five participants at pre-intervention and four participants at post-intervention were unable to complete the task and were assigned a score of zero.

Letter-name knowledge was more advanced than letter-sound knowledge at both testing times. Additionally, letter-sound knowledge depended on letter-name knowledge, with no children able to demonstrate knowledge of a letter's sound without knowledge of that letter's name. Participants pre-intervention scores of letter-sound knowledge was significantly correlated with PPVT scores [$r = 0.69$, $p = 0.02$]

but not with hearing thresholds [r = -0.47, p = 0.17] or chronological age [r = -0.18, p = 0.60].

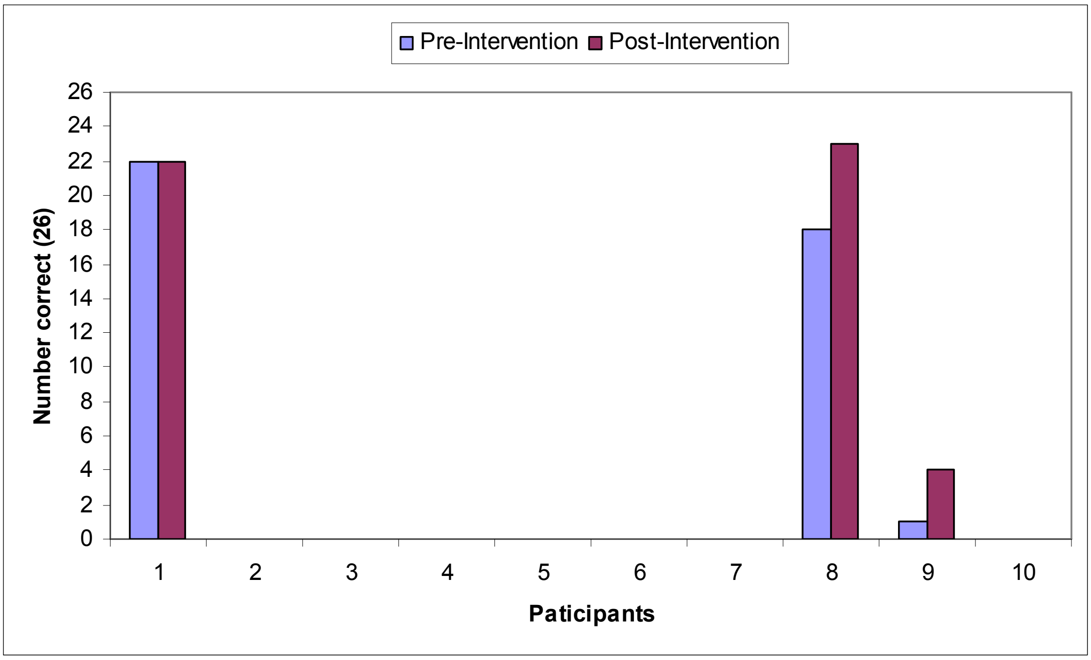


Figure 5.8. Letter-sound knowledge pre- and post-intervention

5.3.3 Phonological awareness

The data were then analysed to evaluate whether the intervention improved. phonological awareness skills on selected untrained phoneme level tasks.

Initial Phoneme Identity

Pre-and post-intervention assessment results of Initial Phoneme Identity (IPI) are presented in Figure 5.9. Three participants at pre-intervention and nine participants at post-intervention achieved scores on the IPI task, however all scores were below chance level as determined by the binomial test (Portney and Watkins 2009), with a score of 7/10 or higher required for a statistically significant result ($p < 0.05$). Three participants at pre-intervention and one participant at post-intervention were unable to complete the task and were assigned a score of zero. Participant's IPI scores were significantly correlated with PPVT scores pre- [*r* = 0.67, *p* = 0.03] and post-intervention [*r* = 0.67, *p* = 0.03] but not with hearing thresholds pre- [*r* = -0.52, *p* = 0.11] and post-intervention [*r* = -0.002, *p* = 0.99] or chronological age pre- [*r* = -0.29, *p* = 0.40] and post-intervention [*r* = -0.34, *p* = 0.32]. However, no significant relationships were found between IPI gain scores and pre-intervention measures of PPVT [*r* = -0.13, *p* = 0.74], hearing thresholds [*r* = 0.45, *p* = 0.18] or chronological age [*r* = 0.026, *p* = 0.94]. A linear regression analysis also found a significant relationship between participant's IPI scores and letter sound knowledge (*p* = 0.003), with 63.7% of IPI scores predicted by letter-sound knowledge.

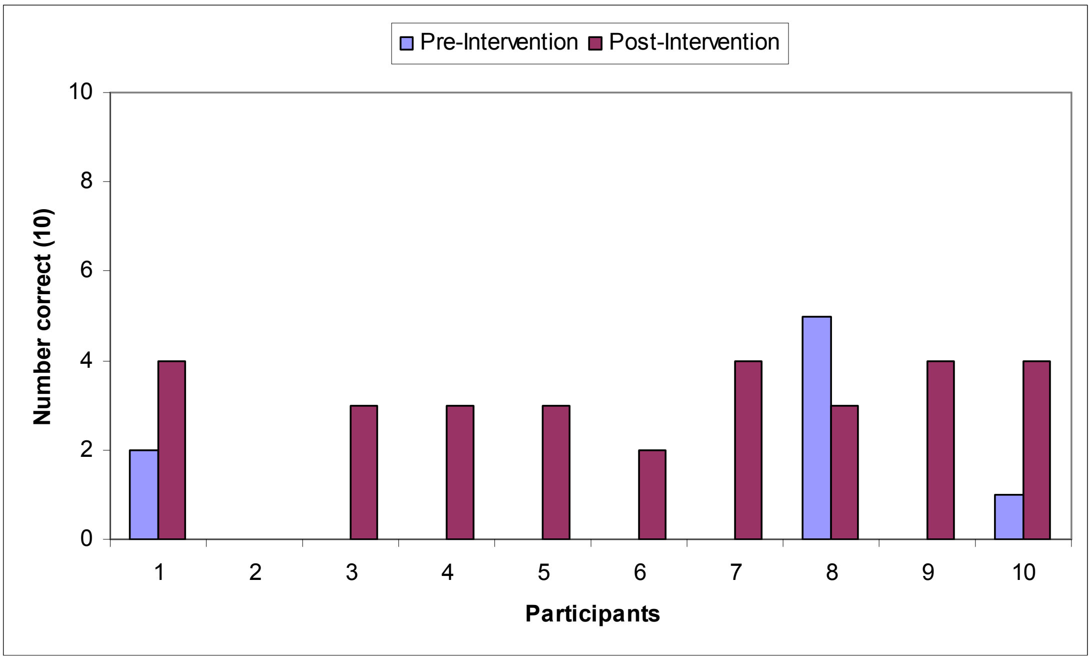


Figure 5.9. Initial Phoneme Identity pre- and post-intervention

<u>Initial Phoneme Identity with Words</u>

Pre-and post-intervention assessment results are presented in Figure 5.10. Four participants at pre-intervention and eight participants at post-intervention achieved scores on the Initial Phoneme Identity with Words (IPIW) task, however all scores were below chance level as determined by the binomial test (Portney and Watkins

2009), with a score of 8/12 or higher required for a statistically significant result ($p < 0.05$). Four participants at pre-intervention and two participants at post-intervention intervention were unable to complete the task and were assigned a score of zero. No significant relationships were found between participants' IPIW scores and PPVT pre- [$r = 0.06$, $p = 0.86$] or post-intervention [$r = 0.42$, $p = 0.2$], hearing thresholds pre- [$r = 0.24$, $p = 0.50$] or post-intervention [$r = -0.23$, $p = 0.50$], or chronological age pre- [$r = -0.38$, $p = 0.26$] or post-intervention [$r = -0.30$, $p = 0.38$]. No significant relationships were found between IPIW gain scores and PPVT [$r = 0.45$, $p = 0.18$], hearing thresholds [$r = 0.39$, $p = 0.32$], or chronological age [$r = -0.20$, $p = 0.56$].

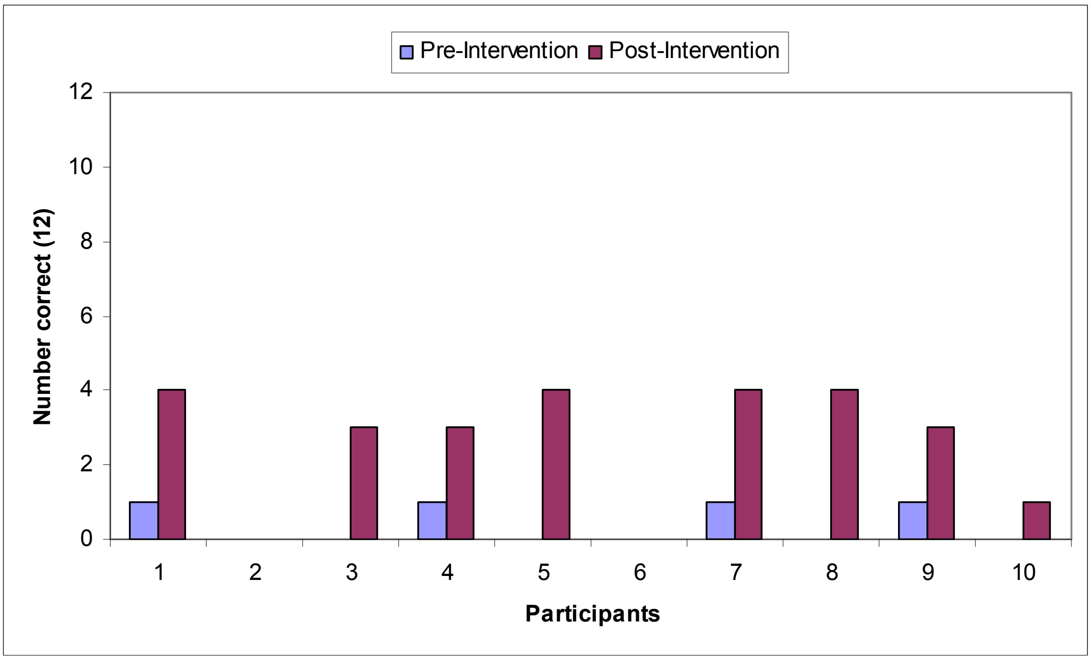


Figure 5.10. Initial Phoneme with Words pre- and post-intervention

Rhyme matching

For the Rhyme Matching task, both pre-and post-intervention scores were below chance level. Above chance was calculated using the binomial test (Portney & Watkins, 2009), which calculates the cumulative probability of achieving the score or a greater score by chance. For a statistically significant result ($p < 0.05$) a score of

10/12 or higher was required. Results of the pre-and post-intervention assessment of rhyme matching are presented in Figure 5.11. None of the participants were able to demonstrate any understanding of the requirements of the task or of the concepts which underpinned it. Six participants pre-intervention and seven participants post-intervention did not attempt, or would not attempt the task and were assigned a score of zero. Further data analysis evidenced widespread position pattern responses which were apparent for all participants who completed the task, with all of these children choosing a "yes" response for all items. Thus, the rhyme matching data were not included in any further analysis.

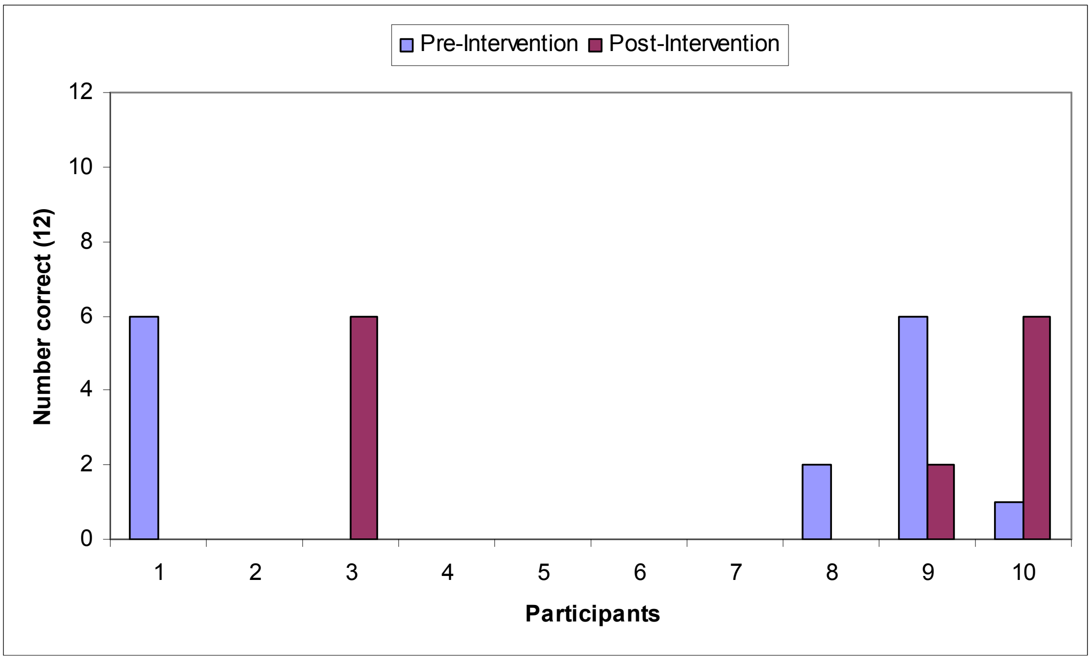


Figure 5.11. Rhyme matching pre- and post-intervention

Widespread position pattern responses, most commonly a final position pattern, were also apparent for all participants on phoneme level tasks at pre-intervention assessment. At post-intervention, a position pattern response was demonstrated by one participant for one of the phoneme level phonological awareness tasks.

5.4 Discussion

This study used a multiple single subject design to investigate the effectiveness of an integrated phonological awareness intervention for 10 children with DS aged 4 and 5 years. The intervention aimed to facilitate the development of speech production, letter-name and letter-sound knowledge and phonological awareness. The intervention included the following three components;

1. parent implemented print referencing during joint story reading,
2. letter knowledge and phoneme awareness activities conducted by the SLT in a play based format, and
3. letter knowledge and phoneme awareness activities conducted by the computer specialist (CS) adapted for presentation on a computer.

The intervention was implemented by the SLT and CS at an early intervention centre during two 20 minute sessions per week, in two 6 week therapy blocks separated by a 6 week break (i.e. 8 hours total). The parents implemented the print referencing component in four 10 minute sessions per week across the 18 week intervention period (approximately 12 hours total).

5.4.1 Speech

The first hypothesis stated that the research intervention would improve speech production accuracy in the trained and untrained words featuring the target speech sounds. This hypothesis was supported, with all ten participants demonstrating statistically significant improvement in production accuracy on both trained and untrained words.

There was, however, considerable variability between the speech production skills of the participants at pre- and post-intervention and in individual’s response to intervention, although this variability could not be accounted for by participant's receptive language scores, chronological age or hearing thresholds. The intervention appeared to be effective irrespective of the targeted error pattern i.e. both earlier and later resolving error patterns. As in the Parsons and Iacono (1992) study, many of the participants used multiple error patterns at once which severely impacted their intelligibility and made phonological pattern analysis difficult.

The study findings indicated that significant change in speech performance can be achieved after a short intervention i.e. approximately 20 hours over 18 weeks (intervention time M= 18hrs 8m, SD= 1 hr 13m) in children whose rate of speech development is slow and whose performance has remained stable over the preceding two months. The improvement in the speech production by the children with DS is consistent with the findings of Cholmain (1994) and Dodd et al., (1994) who reported participants made considerable speech gains over a relatively short period of time, despite stable performance pre-intervention.

Grunwell (1990) described four different types of generalisation of speech skills: *Lexical*; *Socioenvironmental; Syntactic; and Phonological.* Lexical generalisation refers to use of the remediated pattern in untrained words and was observed in all participants with children performing equally well on the trained and untrained words. Phonological generalisation is observed when the remediated pattern is demonstrated with other phonemes in the same sound class.

An example of phonological generalisation and use of multiple patterns is provided by Participant 4. Targeted patterns for Participant 4 included voiced/voiceless contrasts presented in words with initial /t/, many of which were of CVC structure. Final consonant deletion was also a targeted pattern for participant 4. A number of words presented to target final consonant deletion included initial /k/, and these were typically voiced to /g/ or /d/. Analysis across time demonstrated remediation of the final consonant deletion pattern *and* the establishment of voicing contrasts within the same word e.g. for the target word /kæp/ addressing deletion of final stops, Participant 4's production progressed as follows; /dɒ/ →/dʌp/→ /kʌp/ and for the target word /tæp/ addressing voicing contrasts the progression was similar /dæ/→ /tæ/→ /dæp/→ /tæp/. Other improvements in participants' speech that were not the focus of a targeted pattern, such as velar fronting in the example above, are evidenced by increased PCC-R and PVC scores from all sounds in target words.

5.4.2 Letter knowledge

The second hypothesis tested in this study was that the research intervention would improve participants' letter-name and letter-sound knowledge. This hypothesis was partially supported. Letter-sound knowledge proved difficult for most participants. The intervention appeared to only further stimulate letter-sound knowledge in 2 participants who entered the study already able to demonstrate some letter sound knowledge. The intervention had more effect on teaching participants letter names. Six of the 10 participants demonstrated that they knew more letter names at the end of the intervention compared to pre-intervention.

Participants with the strongest letter knowledge at post-intervention were 3 of the 4 participants who had language ages of at least 3 years, suggesting a stronger language foundation may facilitate the acquisition of alphabet knowledge. A pattern of learning letter names before letter sounds is consistent with findings for children without DS (Arrow, 2007; McBride-Chang, 1999; Worden & Boettcher, 1990).

Analysis of the videotaped intervention sessions showed many of the participants were able to correctly identify one or two of the letter names and sounds that were the focus of their intervention session. However, these skills were evident in therapy sessions only and did not generalise to the assessment session when the activity was presented in a different context. Difficulty in transferring improved skills from a therapy context to an assessment context is common in children with high learning needs, and may suggest the knowledge has not yet consolidated or further scaffolding and increased therapy time is required (Roberts, Chapman et al., 2008). The short duration of the therapy sessions and the considerable behavioural and motivational challenges experienced by the participants in response to the intervention meant the administration of assessment probes during the therapy sessions was deemed inappropriate.

5.4.3 Phonological awareness

The third hypothesis in this study examined whether the research intervention would improve phonological awareness skills on untrained phoneme level tasks. The data partially supported this hypothesis. For most participants, performance improved post-intervention compared to pre- intervention but their improved performance did not meet the conservative binomial level of 70% correct at post-intervention, when untrained phonological awareness items were introduced. This suggests phonological awareness was being stimulated during the intervention period, but participants had not reached mastery of identifying initial sounds in words and therefore could not demonstrate the transference of knowledge to novel items.

Phonological awareness in young children typically proceeds along a developmental continuum of increasing ability and stability (Lonigan et al., 1998) throughout the preschool years. Lonigan et al. (1998) reported some measurable, though inconsistent, phonological awareness skills in children as young as 2 or 3 years of age and more consolidated phonological awareness skills in children aged 4 years and over. Participants' receptive language abilities, as determined by their PPVT scores, were associated with both pre- and post-intervention measures of letter-name and letter-sound knowledge and IPI, but not with change scores. Consistent with the findings of Lonigan et al. (1998) it is plausible that some participants in the current study did demonstrate a pattern of emerging but unstable phonological awareness. Follow-up assessment of letter knowledge and phonological awareness skills is necessary to investigate any potential longer term influence of the intervention on these skills. Follow-up assessment of speech measures is also required to determine whether treatment gains were maintained.

5.4.4 Clinical Implications

Speech production errors are common in children with DS and these errors often persist into adulthood. However, empirically based interventions to improve speech production in this population are rare. Children with DS also exhibit weakness in the underlying skills of phonological awareness and letter knowledge tasks that are critical for early reading success. The findings of this study suggest an intervention approach which integrates speech, letter knowledge, and phonological awareness targets, was effective in remediating speech error patterns for pre-school children with DS. Additionally, the intervention introduced children to letter knowledge and phonological awareness activities and may potentially stimulate these skills in the future. Thus, dedicating some intervention time to facilitating the participants' letter knowledge and phonological awareness was not at the expense of speech gains. In light of the persistent nature of speech difficulties in individuals with DS and the superior language abilities associated with reading in this population, evidence based interventions which can combine several treatment goals may provide a valuable alternative to conventional therapy techniques which aim to improve only one language domain.

CHAPTER 6

THE LONGER TERM EFFECTS OF AN INTEGRATED PHONOLOGICAL AWARENESS INTERVENTION FOR CHILDREN WITH DOWN SYNDROME

6.1 Introduction

Longitudinal studies describing the development of speech, language, reading and memory in children with Down syndrome (DS) are reported in the literature (Boudreau, 2002; A. Byrne et al., 2002; Conners et al., 2008; Cupples & Iacono, 2000; Jarrold et al., 2009; Laws & Gunn, 2002), however, far fewer studies report longer-term effects of intervention on these abilities. Cologon, Cupples, and Wyver (2007) reported significant gains in literacy measures in 15 children with DS, six months after they had received a phonological awareness or reading comprehension intervention. More modest follow-up results were reported by Goetz and colleagues (2008). The researchers reassessed the literacy skills of 15 children with DS five months after they had completed a phonics-based reading intervention, and reported the majority of the children were able to at least maintain the progress made during the intervention. Although both groups of researchers (Cologon et al., 2007; Goetz et al., 2008), reported positive outcomes overall, considerable individual variation in post-intervention performance was reported in both studies. Buckley (2008) drew attention to the need for research not only to investigate intervention effectiveness in this population, but also to routinely follow up post-intervention to investigate intervention effects over time.

The study reported in this chapter evaluated the phonological awareness, letter knowledge, decoding, and spelling development in children with DS who had previously participated in an integrated phonological awareness intervention (see Chapter 5), after they had subsequently received two terms (approximately 20 weeks) of formal schooling. The following hypotheses were tested:

1. Participants will exhibit higher scores on speech and phonological measures at the follow-up assessment than those achieved at pre- and post-intervention assessment.
2. Participants will be able to transfer improved phonological awareness and letter knowledge to decoding and spelling performance.

6.2 Method

6.2.1 Participants

While school attendance in New Zealand is not compulsory until age six (New Zealand. Ministry of Education, 2006c), children with typical development generally start school on their fifth birthday. School commencement was delayed for the children with DS in this study, who ranged in age from 5;05 to 6;0 (M = 5;09, S.D. = 2.5 months) when they started school. Nine of the ten participants attended mainstream schools and one participant was schooled at home with support from the New Zealand correspondence school.

6.2.2 Follow-up assessment period

Follow-up assessment was undertaken after participants had received two terms of formal schooling (approximately 20 weeks). As well as allowing enough time for the impact of formal literacy instruction to be manifest, this period of attendance was appropriate as it provided children with sufficient time to settle into school and become familiar with the teacher, teacher-aide, classmates and the school routine. All children were available for reassessment which occurred between 8 and 16 months from the completion of the intervention (M = 12.4 months, SD = 3.2) (see Table 6.1). Three children (Participants 2, 4 and 6) whose school attendance was part-time, due to serious health issues or a change of school, were reassessed after the equivalent of two full school terms.

Table 6.1. Participants' age and post-intervention interval at follow-up assessment.

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Child's age	6;0	6;10	6;6	6;5	6;6	7;0	6;1	6;0	6;6	6;4
Gender	F	M	F	F	M	F	F	M	M	M
PII	8	17	8	14	11	14	16	10	11	15

Note: P = Participant; age reported in years; months; PII = post intervention interval reported in months.

All the children received speech-language therapy in the time between the end of the intervention and the follow-up reassessment. The number and nature of speech-language therapy sessions for the two school terms immediately prior to follow-up reassessment varied considerably between participants (see Table 6.2). The number of therapy sessions received ranged from 1 to 20, with four of the participants receiving 4 or fewer sessions during the two term (20 week) period. Five of the participants experienced interrupted and restricted speech-language therapy service, due to the unavailability of therapists, long travel distances and large caseloads. Participant 8 continued attending the early intervention centre until his 6^{th} birthday and receiving speech-language therapy input from that service, however attendance was interrupted by family health issues. He received two school terms of home schooling instruction prior to leaving the early intervention centre. For participant 7, no publicly funded service was available for the entire two terms of schooling prior to follow-up assessment, with parents privately funding sessions to be provided at their child's school. Participant 5 received additional private service due to his parent's dissatisfaction with the publicly funded service he received.

Table 6.2. Speech- language therapy in the two school terms prior to follow-up reassessment

P	Number of sessions	Frequency	Duration in minutes	Service delivery model	Service provider	Teacher/ Teacher-aide/ home programme	Goals
1	1	1/ term	20 – 30	consultative	GSE	No	RL: following instructions
2	4	2-3/ term	20 - 30	consultative and collaborative	GSE	No	RL: routines
3	1	1/ term	20 – 30	consultative	GSE	TAP	RL: following directions and social engagement in the classroom,
4	6	fortnightly	20 – 30	collaborative and 1:1	GSE	TAP	RL: prepositions Literacy: letters of her name
5	3	1-2/ term	30	collaborative	GSE	TP, TAP	EL: extension, visual supports
	9	fortnightly	30	1:1	private	No	EL: verbs, greetings, colours, size RL: size, gender, objects by use
6	9	fortnightly	30	1:1	private	No	RL: prepositions EL: adjectives, negatives
7	8	fortnightly	45	1:1	private	TAP	Speech: increase diadokokinetic rate, oro-motor exercises, auditory discrimination EL: enrichment, sign language (Makaton)

8	10	weekly	20	consultative and 1:1	EIC	HP	Fluency: Lidcome programme
9	6	2-3 / term	20	collaborative and 1:1	GSE	TAP	EL: present tense Speech: decrease rate, /r/ blends
10	2	1 - 2/ term	20 - 30	consultative	GSE	No	RL: following instructions EL: extension

Note: P = Participant, GSE = Ministry of Education, Special Education; EIC = Early Intervention Centre; TP = Teacher; TAP = Teacher-Aide programme; HP = home programme; RL = Receptive Language; EL = Expressive Language

<u>Follow-up assessment measures</u>

The following measures were readministered at the follow-up assessment.

Speech production measures

- Assessment of participants' 48 speech sound targets and 12 control sound targets.

Speech sound samples were elicited using the following assessment measures collected from a possible total of 119 words:

- Hodson Assessment of Phonological Patterns- Third Edition (HAPP-3) (Hodson, 2004),
- The Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1986),
- Diagnostic Evaluation of Articulation and Phonology (DEAP) single trial of the inconsistency subtest (Dodd et al., 2006).

Where a spontaneous response could not be elicited by the picture or stimulus item, a response was elicited following delayed imitation. Speech data were recorded using a high-quality digital voice recording device (Belkin F8E462). All responses were transcribed via broad transcription. These samples were analysed using Computerised Profiling (PROPH, Long & Fey, 2005).

Letter Knowledge and Phonological Awareness experimental measures

Letter-name and letter-sound knowledge was reassessed using the Gillon Preschool Phonology and Letter Knowledge probes (Gillon, 2005). These tasks were administered according to the protocol described in the pre-intervention assessment schedule (in Chapter 5).

- Letter-name and letter-sound knowledge tasks (Gillon, 2005)
- Initial Phoneme Identity (IPI) (Gillon, 2005)

- Initial Phoneme Identity with Words (IPIW) (Gillon & McNeill, 2007)
- Rhyme matching task

Additionally the following measures of reading, spelling and early literacy development were assessed at follow-up only:

Word decoding measures

- The Burt Word Reading Test-New Zealand Revision (Gilmore et al., 1981) was administered to all ten participants. This real word decoding test provides age equivalence bands for children aged over six, which represent achievement within the expected range. Raw scores were also gathered for data analysis.

Spelling tasks

- Single word spelling task. This experimental measure consisted of five coloured pictures each presented separately on a page. All pictures were familiar to the participants and included the following items: *cat, chips, sun, dinosaur and train*. Participants were required to write the name of the picture on a line under the picture. The pages were spread out on the desk and children selected the order to complete them, either by picking the order as they preferred or by throwing a counter and selecting the page it landed on. Some children were unable to or declined to select; in these cases the order was selected by the lead researcher. Participants were instructed to "write the name of the picture on the line". No other instructions or cues were given. Participants received a point for each correct phoneme- grapheme match. Position of the correct phoneme was also noted. Spelling attempts were also analysed according to a stage theory of spelling development (Ehri, 2000).

Early literacy measures

- Pre-Literacy Rating Scale (Supplementary Measure) from the Clinical Evaluation of Language Fundamentals Preschool- Second Edition (CELF-P:2) (Wiig et al., 2004). This scale includes questions about print concepts, letter knowledge and word recognition. The scale is designed to be completed by the child's teacher, parent or clinician, and is presented in two parts; Emergent Reading Skills and Emergent Writing Skills. Scores are summed to provide a Total score which is compared against criterion scores for age.
- Story writing task. Examples of typical recent story writing attempts were gathered from children's completed worksheets or exercise books where possible. These story writing attempts were completed under a variety of conditions and with different levels of instruction and support, therefore, the salient features are described, however, they are not scored.

6.2.3 Data reliability methods

An independent reviewer rescored a randomly selected 20% of the assessment measures and speech sound results and checked reliability of data entry with scores recorded by the lead researcher. Any errors noted were corrected before data analysis. Additionally, a randomly selected 20% of all speech sound data were retranscribed using broad transcription, by a speech-language therapist experienced in phonetic transcription. Point-by-point analysis showed inter-rater agreement between 83.3% and 100% (M = 99.0%). Any differences were resolved by consensus after repeated listenings.

An independent reviewer analyzed all spelling samples and provided a score for each phoneme-grapheme match with a mean inter-rater agreement of 100%. The reviewer also completed descriptive analysis of the spelling stage (Ehri, 2000) with mean inter-rater agreement of 94.7%. Any differences were resolved by consensus.

6.3 Results

Scoring

Where the assessment was unable to be completed due to non-compliance or non-response by the participant, a score of zero was given for that item and the next item was presented, as in Cupples and Iacono (2000) and in line with the pre- and post-intervention assessment protocol. Where participants did not respond during the speech sound assessment, stimulus cards were placed on the bottom of the pile and re-presented later in the assessment. A further non- response resulted in a zero score for that item.

6.3.1 Speech

Standardised speech measures

Standardised speech assessments were administered at pre-intervention and at follow-up, but not at post-intervention. Analyses of follow-up assessment on standardised speech measures are presented in Tables 6.3 to 6.5.

Table 6.3. The percentage of each sound class produced correctly at follow-up assessment

Sound Class	Participants									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Stops	98.3	85.0	93.7	24.4	66.7	83.8	63.6	100	96.2	98.3
Nasals	90.6	90.0	100	22.2	86.4	86.7	64.0	100	93.5	94.1
Fricatives	67.8	31.7	73.9	16.7	12.7	52.6	19.4	87.5	66.7	69.8
Affricates	46.2	28.6	0.0	0.0	0.0	33.3	0.0	25.0	0.0	30.8
Glides	100	80.0	72.7	33.3	16.7	50.0	36.4	83.3	70.0	88.9
Liquids	11.8	11.1	55.0	21.4	0.0	40.0	23.5	66.7	33.3	33.3
Clusters	29.0	23.7	52.2	7.3	9.1	54.8	9.5	64.6	42.9	43.9
Vowels	91.2	78.1	96.7	78.6	71.2	86.8	72.5	100	91.5	90.5
Sample information										
Unin. wds	0	1	0	0	11	0	1	0	0	0
Total wds	111	74	119	79[1]	108	68[1]	108	73[1]	116	111

Note. P = Participant; Unin. wds = number of unintelligible words in sample not included in total words analysed; Total wds = total number of words analysed in sample, analysis from Computerized Profiling (PROPH, Long & Fey, 2005); [1]denotes unwillingness to participate in the full assessment

Results of a paired t-test comparing participants' grouped pre-intervention and follow-up PCC-R scores from the standardised speech assessments, revealed that children evidenced significant growth in their speech development during that period [t (9) = -4.04, p = 0.003]. However, consistent with the speech of children in the in-depth assessment study reported in Chapter 2, age was not correlated with PCC-R scores at either pre-intervention [r = 0.39, p = 0.26] or at follow-up [r = -0.1, p = 0.76] for children in the current study.

Table 6.4. The percent consonants correct (PCC) for the early 8 sounds, middle 8 sounds, late 8 sounds, and percent consonants correct-revised (PCC-R) for total consonants from participants' follow-up assessment data

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Early 8	91.3	83.1	90.0	37.7	60.0	80.6	51.0	87.5	88.4	88.6
Middle 8	79.8	53.5	75.2	17.3	38.6	60.4	34.6	91.5	67.8	77.0
Late 8	36.6	22.4	60.3	11.7	6.9	46.3	16.2	68.8	47.2	48.3
Total	68.3	52.7	74.7	21.7	36.6	62.6	35.1	83.9	67.3	71.4

Note. P = Participant; Early 8 = early developing sounds; Middle 8 = middle developing sounds; Late 8 = late developing sounds (Shriberg, 1993); Total = total percent consonants correct-revised; analysis from Computerized Profiling (PROPH, Long & Fey, 2005)

Analysis of the PCC for the early, middle and late 8 sounds revealed that participants made gains on all three categories during the period between pre-intervention and follow-up. Gains on early 8 sounds were not significant [t (9) = -0.9, p = 0.3], however gains on middle 8 sounds were significant [Wilcoxon W = 55.0, p = 0.006] and on late 8 approached significance [t (9) = -2.21, p = 0.056].

Table 6.5. Error breakdown from follow-up assessment data

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
Sub	61.8	54.4	72.2	42.5	46.4	71.2	36.0	78.8	63.1	57.8
Omission	38.2	43.1	25.4	54.1	41.2	27.2	53.5	6.1	28.5	32.5
Other	0.0	2.5	2.5	3.4	12.4	1.7	10.5	15.1	8.3	9.6

Note. P = participant; sub = substitution error; omission = omission error analysis; other = total other errors including distortions and additions; from Computerized Profiling (PROPH, Long & Fey, 2005)

Analysis of the error breakdown data revealed that participants made slightly more substitution errors and slightly fewer omission and other errors at follow-up compared to pre-intervention, however, none of the differences were significant (all $p > 0.1$).

Speech sound targets

Individual results are presented on measures of speech sound targets. Analysis revealed eight of the ten participants improved their performance on the speech production measure (number of phonemes correct score). Further visual analysis was undertaken whereby each participant's results were graphed to reflect performance on individual speech targets at post-intervention and at follow-up. Participants received a number of phonemes correct score for each of their four target sounds and one control sound, each with a possible score of 12. Participant 7's performance on individual speech sound targets is presented in Figure 6.1. The graphs demonstrating overall speech production changes and performance on individual speech sound targets for all remaining participants are presented in Appendix E.

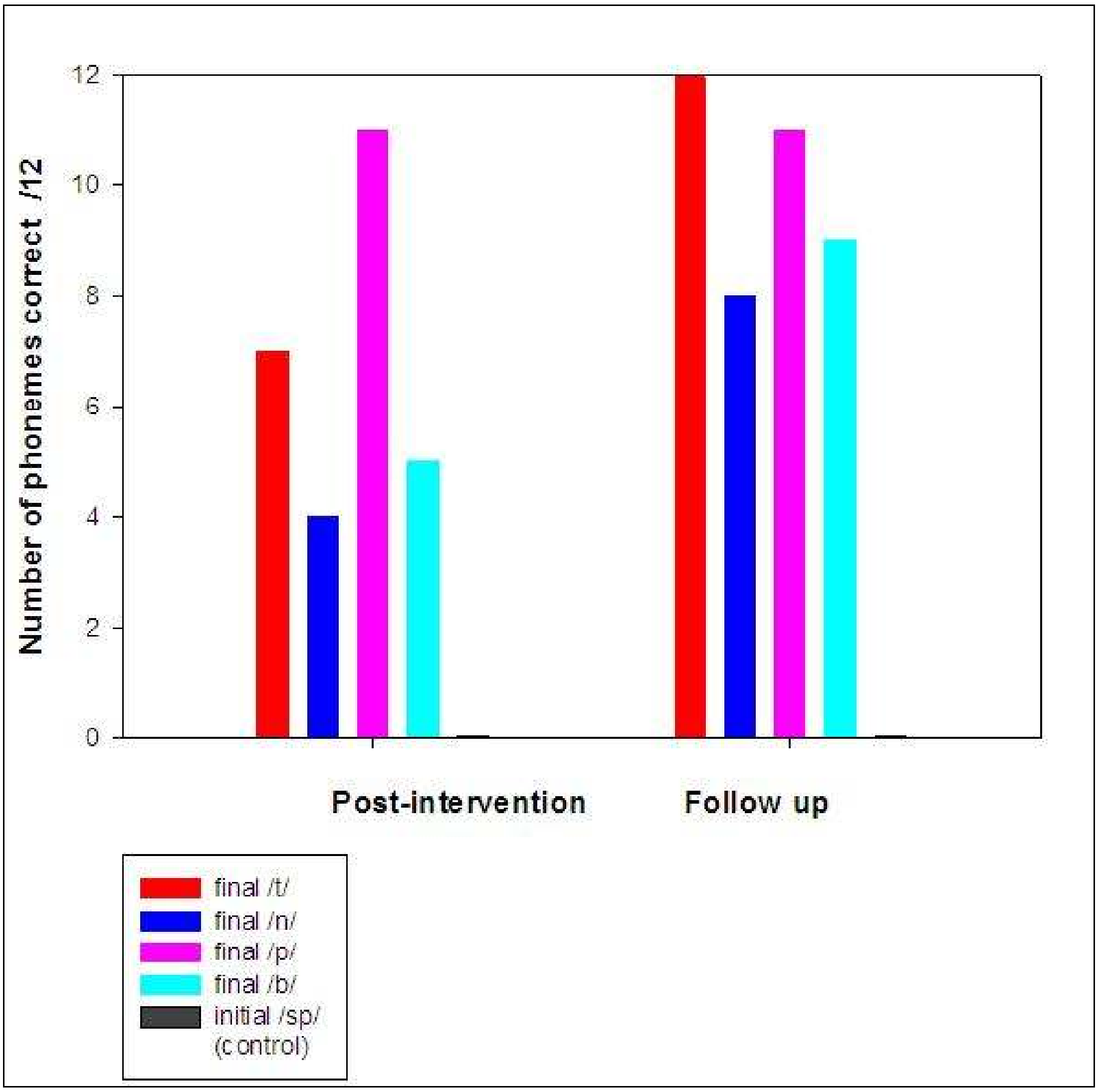


Figure 6.1. Post-intervention and follow-up performance for target speech sound measures for Participant 7.

The data were subsequently grouped, with a paired t-test conducted to determine whether a statistically significant difference existed between performance immediately post-intervention and performance at follow-up assessment. Significant differences was observed between post-intervention and follow-up assessment scores for the speech production measure for the group [Wilcoxon W = 283.0, p = 0.009]. One child (Participant 4) was identified as an outlier, with her speech performance dropping to well below post-intervention performance. When these data were removed from the analysis, post-intervention and follow-up differences were even more apparent [Wilcoxon W = 243.0, $p < 0.001$]

As was observed in Chapter 5, and is demonstrated again in Figure 6.2, participants' response to the intervention was extremely variable. Development of the target sounds in the period between post-intervention and follow-up assessment also showed extreme variability across participants. Analysis of individual's results at follow-up (see Appendix E) revealed that seven of the participants maintained or made gains on all four targets. One participant evidenced a small reduction in score on one target but gained on the other three, resulting in a gain in total score. One participant evidenced gains on one target and small reductions in scores on the other three targets, with her total score dropping from 31 to 30 at follow-up. The final participant, identified as an outlier, maintained gains on one target, but evidenced a reduction on the other three targets, all of which were targeting the phonological process of final consonant deletion. Her total score fell from 31 at post-intervention to 15 at follow-up. Two participants made gains on the control sounds during the period between post-intervention and follow-up assessment. Grouped data for total number of target phonemes correct at pre- and post-intervention and at follow-up are presented in Figure 6.2.

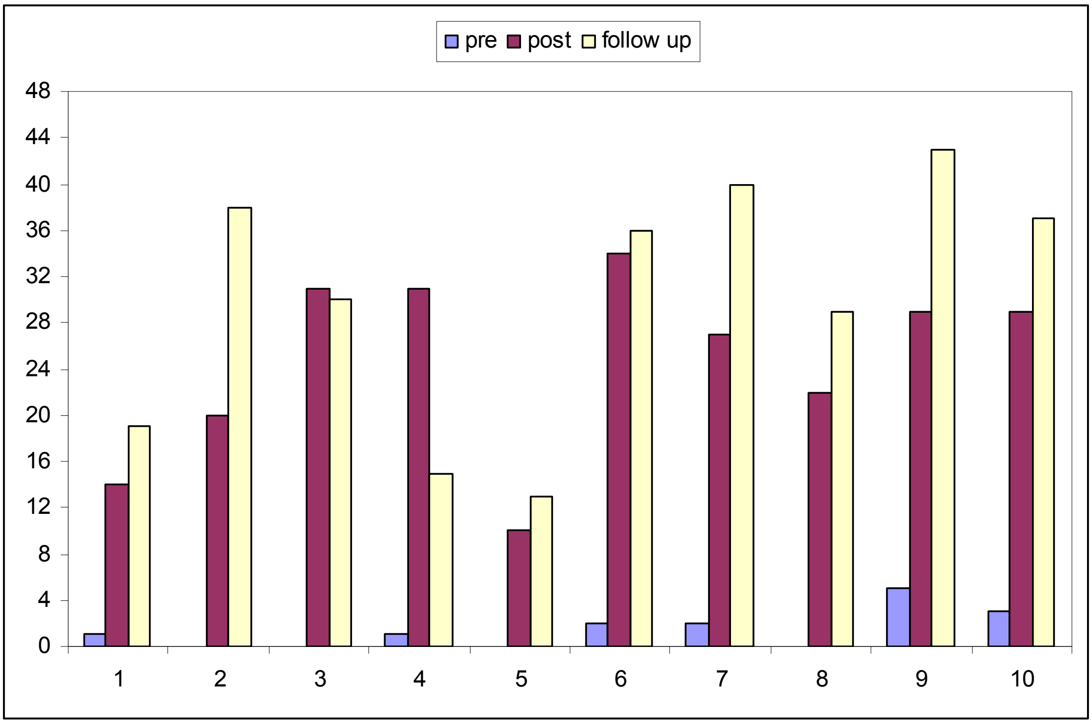


Figure 6.2. Participants' number of target phonemes correct, at pre- and post-intervention and follow-up

Note: Scores are out of a possible 48

6.3.2 Letter Knowledge

<u>Letter-name knowledge</u>

Individual scores were grouped, and a paired t-test was conducted to determine whether a statistically significant difference existed between performance immediately post-intervention and performance at follow-up on the measure of letter-name knowledge. Analysis revealed group scores were significantly greater at follow-up [t (7) = -3.76, *p* = 0.007]. This analysis excluded the two participants who had reached ceiling at post-intervention. Nine of the ten participants were able to demonstrate some letter-name knowledge at follow-up with scores ranging from 8 to 26 letters correct. Three participants post-intervention and one participant at follow-up did not attempt, refused to attempt or did not understand the task and were assigned a score of zero. Letter-name knowledge at the three assessment times (pre- and post-intervention and follow-up) is presented in Figure 6.3.

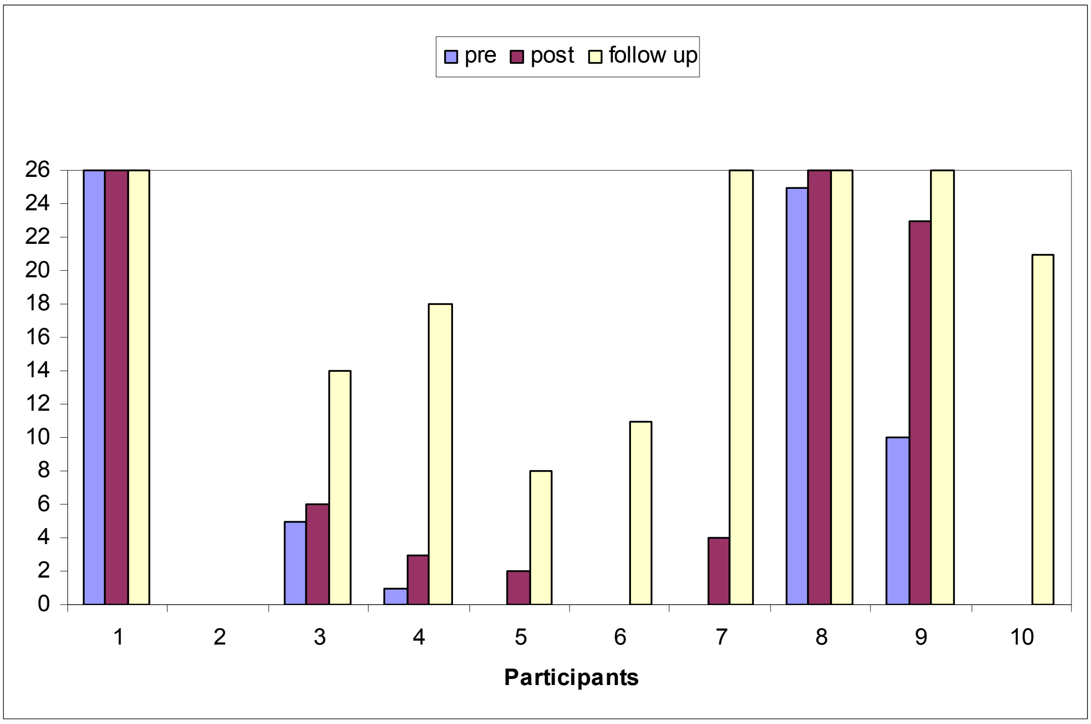


Figure 6.3. Letter-name knowledge at pre- and post-intervention and follow-up

<u>Letter-sound knowledge</u>

A paired t-test revealed group scores were significantly greater at follow-up than post-intervention on the measure of letter-sound knowledge [t (9) =-4.23, *p*= 0.002]. This analysis included all participants, although two participants demonstrated near ceiling scores post-intervention. Nine of the ten participants were able to demonstrate some letter-sound knowledge at follow-up with scores ranging from 5 to 26 letters correct. Four participants post-intervention and one participant at follow-up did not attempt, refused to attempt or did not understand the task and were assigned a score of zero. Letter-sound knowledge at the three assessment times is presented in Figure 6.4.

As at pre- and post-intervention, letter-name and letter-sound knowledge were strongly and significantly correlated (see Table 6). At follow-up, participants knew more letter names (M = 17.6, SD = 9.1) than letter sounds (M = 12.5, SD = 9.4), although a t-test revealed differences were not significant [t (9) = 1.22, p = 0.23].

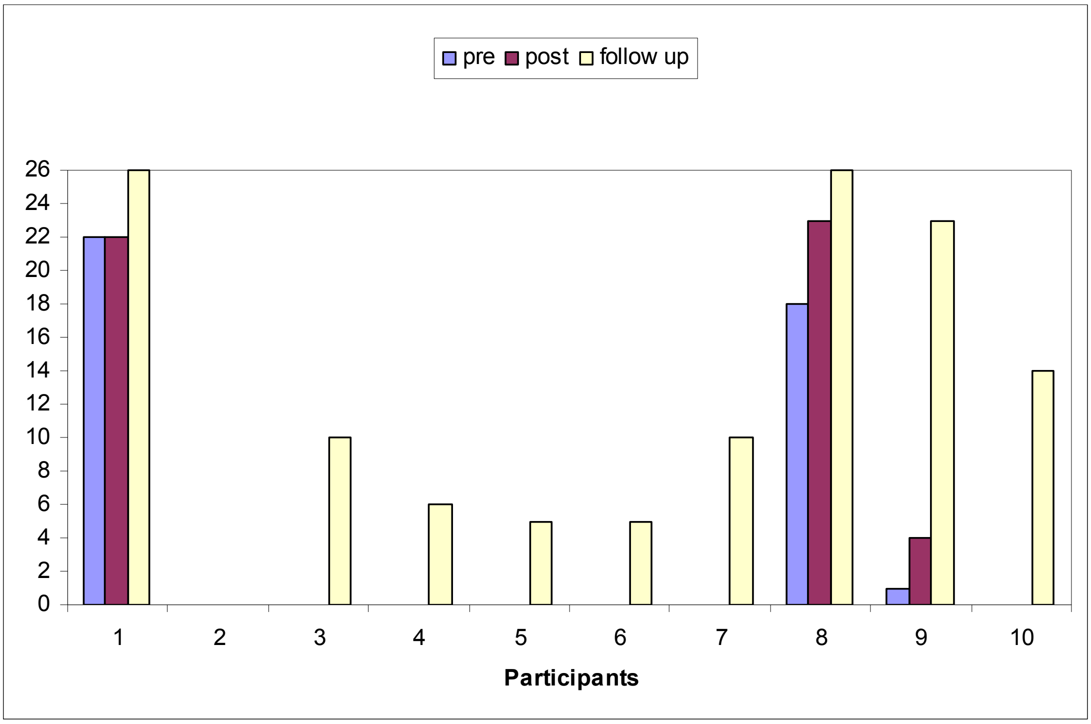


Figure 6.4. Letter-sound knowledge at pre- and post-intervention and follow-up

Phonological awareness

Individual results on measures of phonological awareness were grouped, with a series of paired t-tests conducted to determine whether a statistically significant difference existed between performance immediately post-intervention and performance at follow-up assessment on these measures.

Initial Phoneme Identity

Results of a paired t-test revealed differences between post-intervention and follow-up scores of IPI were close to significant [t (9) = -2.13, p = 0.06]. At follow-up, nine of the ten children were able to achieve scores on the task, with one of participants achieving a score above chance level and achieving a maximum score. One participant at post-intervention and follow-up did not attempt, would not attempt or did not understand the task and was assigned a score of zero. Above chance was calculated using the binomial test (Portney & Watkins, 2009), which calculates the probability of achieving the score or a greater score by chance. For a statistically significant result ($p < 0.05$) a score of 7/12 or higher was required. Results of the post-intervention and follow-up assessment of the IPI task are presented in Figure 6.5.

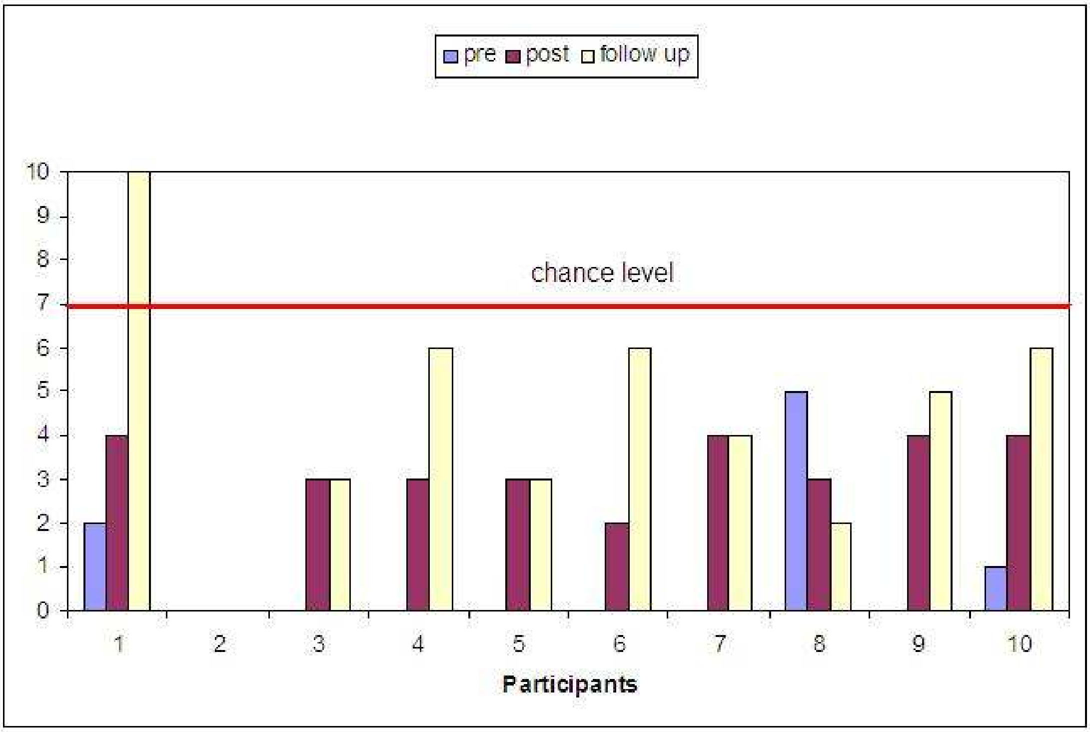


Figure 6.5. Initial Phoneme Identity scores at pre- and post-intervention and follow-up

Post hoc analysis of participants' scores on the IPI task and their letter-name and letter-sound scores found no examples where children were able to identify the first sound in a word without having letter-name and or letter-sound knowledge of the particular phoneme.

Initial Phoneme Identity with Words

Post-intervention and follow-up scores of IPIW were compared, with analysis revealing group scores were significantly greater at follow-up [t (9) = -4.59, p = 0.001]. At follow-up, all of the children were able to achieve scores on the task with five of the ten participants achieving scores above chance level, four of these achieving maximum scores. Two participants post-intervention did not attempt, would not attempt or did not understand the task and were assigned a score of zero. Above chance was calculated using the binomial test (Portney & Watkins, 2009), which calculates the cumulative probability of achieving the score or a greater score by chance. For a statistically significant result ($p < 0.05$) a score of 8/12 or higher was required. Results of the pre- and post-intervention and follow-up assessment of the IPIW task are presented in Figure 6.6. Post-hoc analysis of scores on the IPIW task revealed all children who scored above chance for this task had letter- name or letter-sound knowledge of the target letter and knew at least 14 letter-names or letter-sounds. One child with high scores on the letter-name knowledge tasks achieved a below chance score of 7 on the IPIW task. Eight of the ten children improved in both phoneme identity performance and speech production.

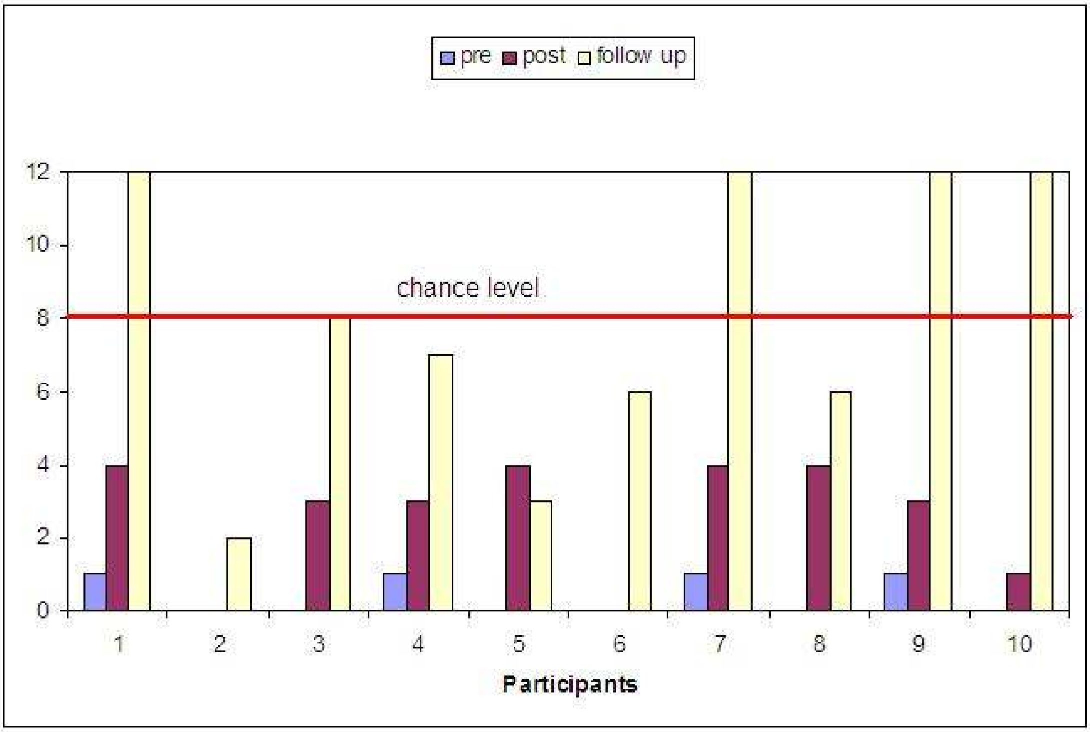


Figure 6.6. Phoneme Identity with Words scores at pre- and post-intervention and follow-up

Rhyme matching

For the Rhyme Matching task, both post-intervention and follow-up scores were below chance level for all participants. Above chance was calculated using the binomial test (Portney & Watkins, 2009), which calculates the cumulative probability of achieving the score or a greater score by chance. For a statistically significant result ($p < 0.05$) a score of 10/12 or higher was required. A Wilcoxon Rank Sum test revealed no significant differences between post-intervention and follow-up measures of Rhyme Matching [Wilcoxon W = 13.0, p = 0.12] Seven participants post-intervention and four participants at follow-up did not attempt, would not attempt or did not understand the task and were assigned a score of zero. Only one child completed all items of the task, choosing a “yes” response for all items. Results of the post-intervention and follow-up assessment of rhyme matching are presented in Figure 6.7. In common with the assessment of this task during the intervention (see Chapter 5), none of the participants were able to demonstrate any understanding of the requirements of the task, nor of the concepts which underpinned it.

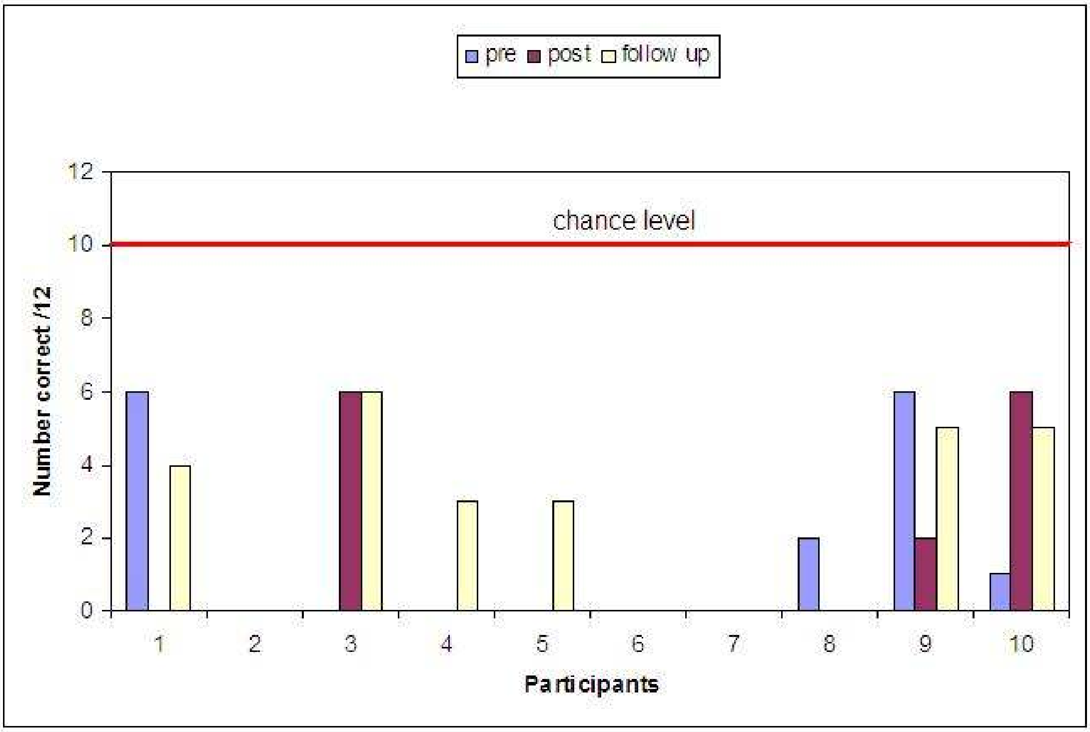


Figure 6.7. Rhyme Matching scores at pre- and post-intervention and follow-up.

Given the relationships between receptive measures, letter knowledge and phonological awareness skills reported in the literature (Anthony & Lonigan, 2004; Boudreau, 2002; Bradley & Bryant, 1983; Lemons, 2008; Murray et al., 1996) and in Chapters 2 and 5, the relationships between these variables were investigated in the current study. Individual results on measures of PPVT at pre-intervention and letter knowledge, phonological awareness, and age at follow-up were grouped, with a series of Pearson Product Moment Correlations performed to examine the strength of the relationships.

Age was found to be negatively correlated with all other measures, with strong significant negative correlations apparent between age and PPVT and both letter knowledge measures. Participants' PPVT scores (receptive vocabulary) were strongly and significantly correlated with letter-name and letter-sound knowledge and with decoding (BWRT) scores. As might be expected from the nature of the tasks, IPIW scores were highly correlated with letter-name knowledge, and IPI scores were highly correlated with spelling. No significant relationships were found between scores on the rhyme matching task and any other measures. Table 6.6 reports a correlational matrix of the variables.

Table 6.6. Pearson's *r* values for correlations between performance on PPVT at pre-intervention, and letter knowledge, phonological awareness, decoding, spelling and age at follow-up

	LS	RM	IPI	IPIW	BWRT	SWST	PPVT	Age
LN[1]	**0.834	0.219	0.529	**0.831	0.625	0.481	*0.758	**-0.790
LS[2]		0.278	0.425	0.608	***0.889	0.613	**0.831	*-0.710
RM[3]			0.384	0.453	0.235	0.255	0.248	-0.127
IPI[4]				*0.658	0.432	*0.706	0.464	-0.292
IPIW[5]					0.445	0.542	0.627	-0.540
BWRT[6]						**0.811	*0.695	-0.604
SWST[7]							0.470	-0.465

PPVT[8]	*-0.697

*p < 0.05, **p < 0.01, ***p < 0.001

Note. Age calculated in months; [1]LN = letter-name knowledge; [2]LS = Letter-sound knowledge; [3]RM = Rhyme matching; [4]IPI = Initial phoneme identity; [5]IPIW = Initial phoneme identity with words; [6]Burt Word Reading Test (Gilmore et al., 1981); [7]Single word spelling task; [8]Peabody Picture Vocabulary Test– III (Dunn & Dunn, 1997) assessed at pre-intervention

6.3.3 Literacy performance

Pre-Literacy Measures

The Pre-Literacy Rating Scale (CELF-P:2) (Wiig et al, 2004) was completed by participants' teachers. Raw scores were obtained for Emergent Reading Skills and Emergent Writing Skills, with these scores summed to provide a total score which was compared to a Criterion Score for Age. Emergent Reading scores were higher than Emergent Writing scores for nine of the participants. None of the children demonstrated criterion scores for their age; however two children achieved scores within 6 months of criterion. Results are presented in Table 6.7.

Table 6.7. Pre-Literacy Rating Scale Scores

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
ERS	36	17	30	30	21	24	35	47	34	36
EWS	40	15	30	32	18	18	24	24	31	17
Total	76[a]	32	60	66	39	42	59	71[a]	65	53
CSA	≥86	≥91	≥91	≥86	≥91	>91	≥86	≥86	≥91	≥86
ACM	5;6-5;11	<3;0	4;6-4;11	5;0-5;5	3;0-3;5	3;6-3;11	4;6-4;11	5;6-5;11	5;6-5;11	4;0-4;5

Note. P = Participant; ER = Emergent Reading Skills raw score; EWS = Emergent Writing Skills raw score; Total = total raw score; CSA = Criterion Score for Age; ACM = Age Criterion Met; [a]scores within 6 months of criterion

Real word decoding

At age 6 to 7 years, five children showed evidence of real word decoding skills, reading between 2 and 18 words on the Burt Word Reading Test (see Figure 6.8). Criterion scores for New Zealand children aged 6; 00 – 6; 05 are depicted (M = 21.33, SD = 13.8), with the shaded area representing one standard deviation above and below the mean (i.e. normal limits). New Zealand children typically start school when they turn five. All children in the current study started school at least 5 months later than this, nonetheless, two children were able to achieve decoding scores within one standard deviation of the mean for their age. The three participants who would not attempt the real word decoding task including one participant, who achieved a letter-sound knowledge score of 14, were assigned scores of zero.

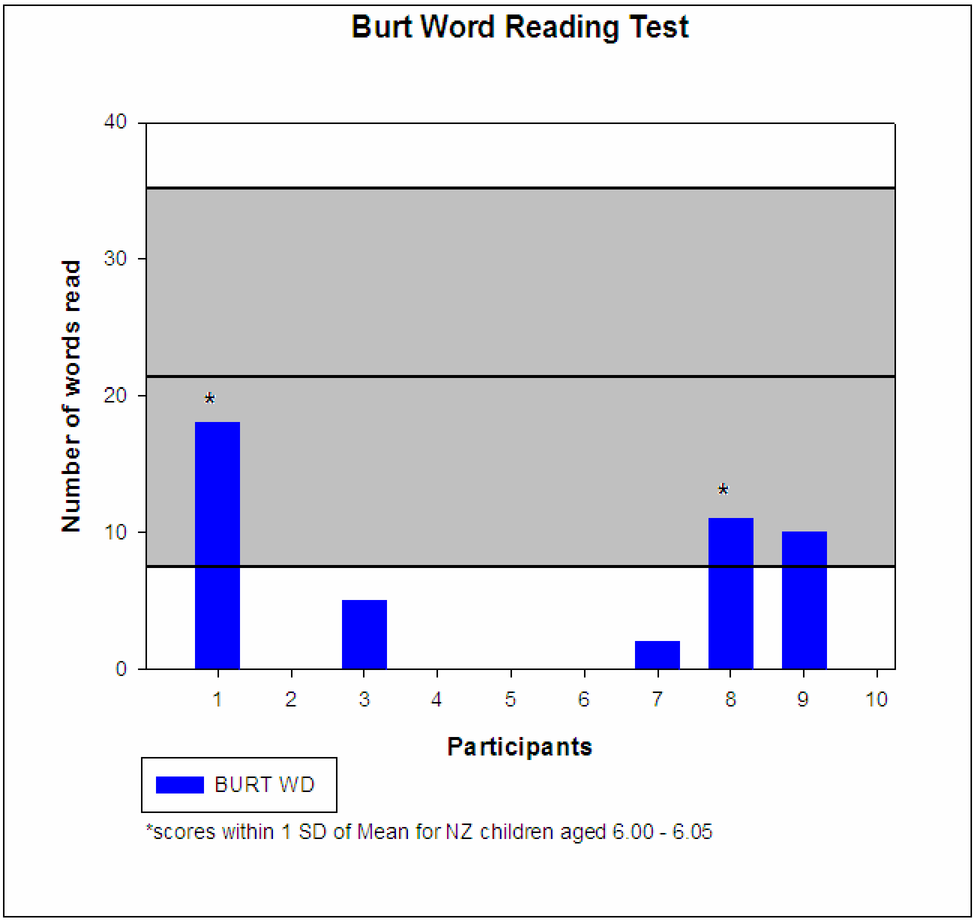


Figure 6.8. Participants' scores at follow-up for the Burt Word Reading Test.

Note: Scores for New Zealand children aged 6; 00 – 6; 05 are represented (M = 21.33, SD = 13.8). The shaded area represents one standard deviation above and below the mean.

Real word spelling

The spelling task was particularly difficult for the participants and the spelling challenges appeared to be further impacted by the physical demands of the task. Although participants were provided with a thick pencil or a pencil with an extra grip, all participants experienced difficulty holding the pencil. No child demonstrated a traditional "pencil" grip and several dropped the pencil or changed the pencil to the other hand during the assessment. The spelling assessment was conducted at the child's desk to provide a work surface at an appropriate height, nevertheless, body positioning also appeared difficult for participants. Discussion with participant's teachers also revealed that half the children rarely or never took part in written activities in the classroom.

Three of the five children who were able to decode some words, also showed evidence of real word spelling skills, representing between 1 and 6 phonemes correctly in the independent spelling task. Real word reading and spelling scores were found to be strongly and significantly correlated (see Table 6). Nine participants attempted the spelling task, with results demonstrating participant's spelling development is emergent. The spelling samples from 6 participants were at the pre-communicative stage for all words. Two of these children demonstrated they knew some letters, with their spelling samples consisting of the letters that occurred in their name, and were unrelated to the sounds in the target words. Two children were able to represent one or two initial phonemes correctly, however the spelling samples also included multiple repetitions of the same sets of letters. One child was able to demonstrate some initial phonemes and other salient phonemes. The spelling attempts of nine participants are presented in Figures 6.9 to 6.17.

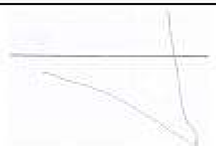
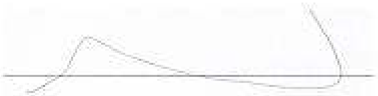
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Pre-communicative
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.9. Spelling performance for Participant 10.

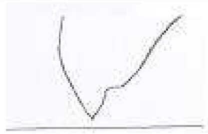
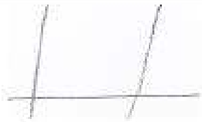
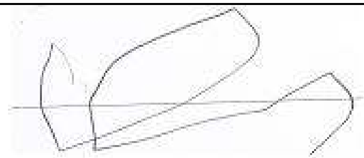
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Pre-communicative
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.10. Spelling performance for Participant 6.

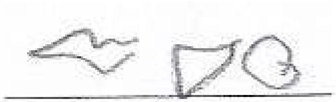
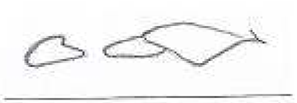
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Pre-communicative
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.11. Spelling performance for Participant 5.

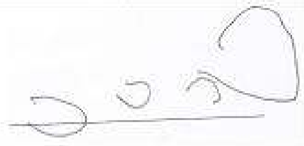
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Pre-communicative
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.12. Spelling performance for Participant 8.

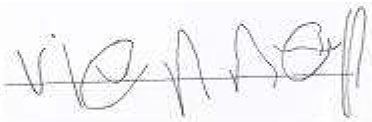
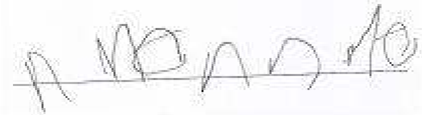
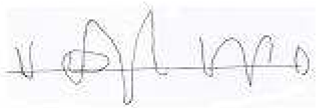
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Pre-communicative
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.13. Spelling performance for Participant 4.

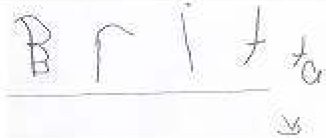
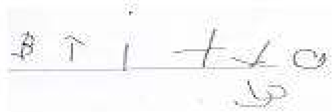
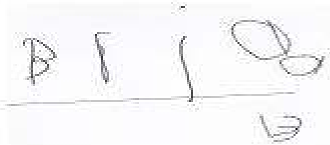
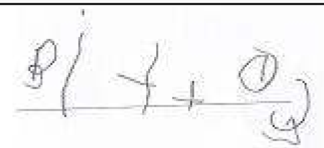
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Pre-communicative
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.14. Spelling performance for Participant 3.

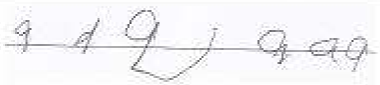
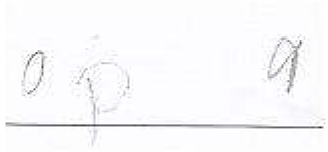
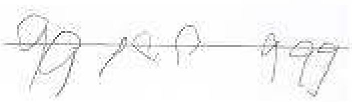
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Partial-alphabetic
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.15. Spelling performance for Participant 7.

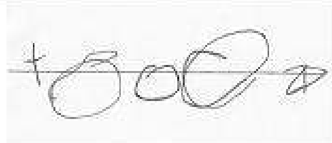
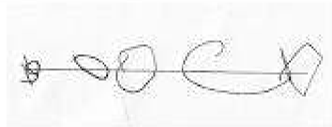
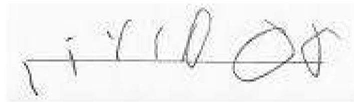
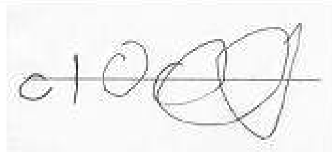
Target		Spelling stage
Train		Partial-alphabetic
Chips		Pre-communicative
Sun		Partial-alphabetic
Cat		Pre-communicative
Dinosaur		Pre-communicative

Figure 6.16. Spelling performance for Participant 9.

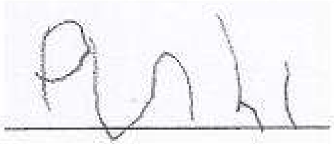
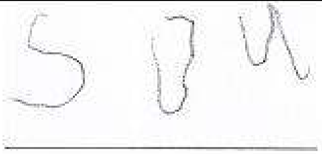
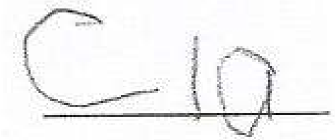
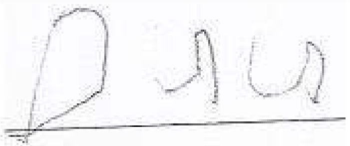
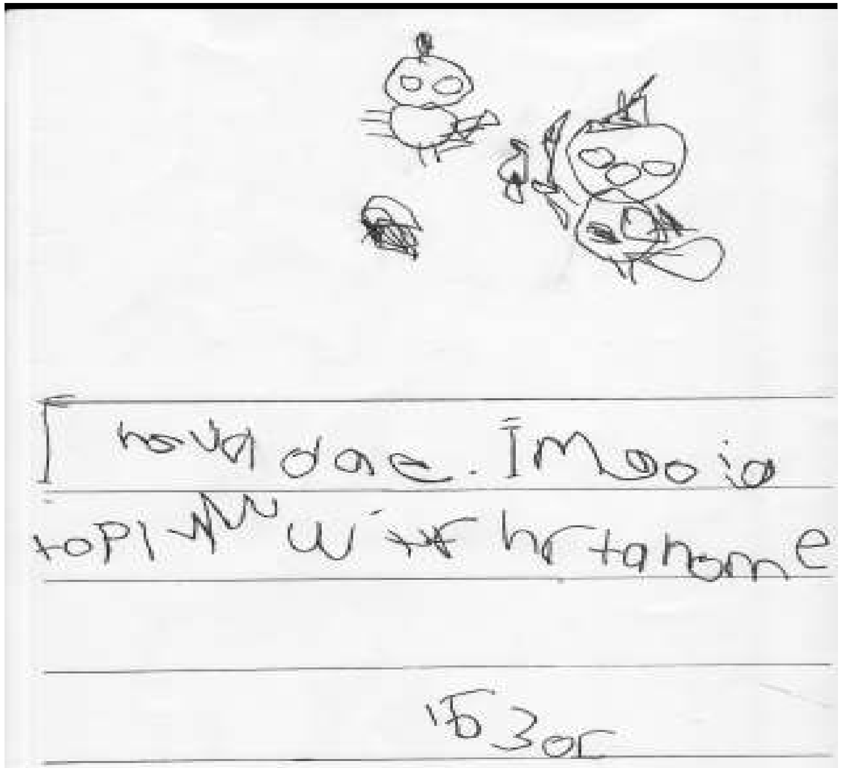
Target		Spelling stage
Train		Pre-communicative
Chips		Pre-communicative
Sun		Alphabetic
Cat		Partial-alphabetic
Dinosaur		Partial-alphabetic

Figure 6.17. Spelling performance for Participant 1.



I have a baby. I'm going to play with her at home.

19/3/07

Figure 6.18. Scaffolded story writing sample at follow-up for Participant 1.

Story writing samples were collected from 4 participants. Three of the stories consisted of tracing over a sentence written by the teacher or teacher-aide. The only example of a story where the writing was generated by the child, Participant 1, is presented in Figure 6.18. This scaffolded writing attempt demonstrates spelling attempts at the semi-phonetic and phonetic stages of spelling development. Analysis of the videotaped session during which this story was produced, revealed the teacher asked the child about letter-name and letter-sound and grapheme correspondences, although she did not provide answers nor correct when the child was in error. For example, when Participant 1 was asked to hear and write the last sound in “with”, the child said /wɪf/ and wrote “f”.

Regressions analysis was used to further investigate the relationship between letter knowledge and phonological awareness scores and the transfer of these skills to real word reading and spelling tasks. A Best Subsets Regression was used to determine which combination (subsets) of the dependent variables (letter knowledge, PA skills, PPVT, and age) best contributed to the prediction of the dependent variables (real word decoding and real word spelling). Letter-sound knowledge alone at follow-up was found to predict 76% of the Burt Word Reading Test scores, with spelling skills contributing a further 11%. Table 6.8 presents the best three models where all *p* values are at the level of significance ($p < 0.05$). Figure 6.19 presents regression, confidence and prediction intervals for Model 1 (from Table 6.8).

Table 6.8. Best Subsets Regression Analyses for Burt Word Reading Test

Variables	R^2	R^{2adj}	*p*
Model 1			
Letter-sound knowledge at follow-up	0.791	0.765	<0.001
Model 2			
Letter-sound knowledge at follow-up	0.904	0.877	0.004
Spelling at follow-up			0.024
Model 3			
Letter-sound knowledge at follow-up	0.953	0.929	<0.001
IPIW at follow-up			0.048
Spelling at follow-up			0.005

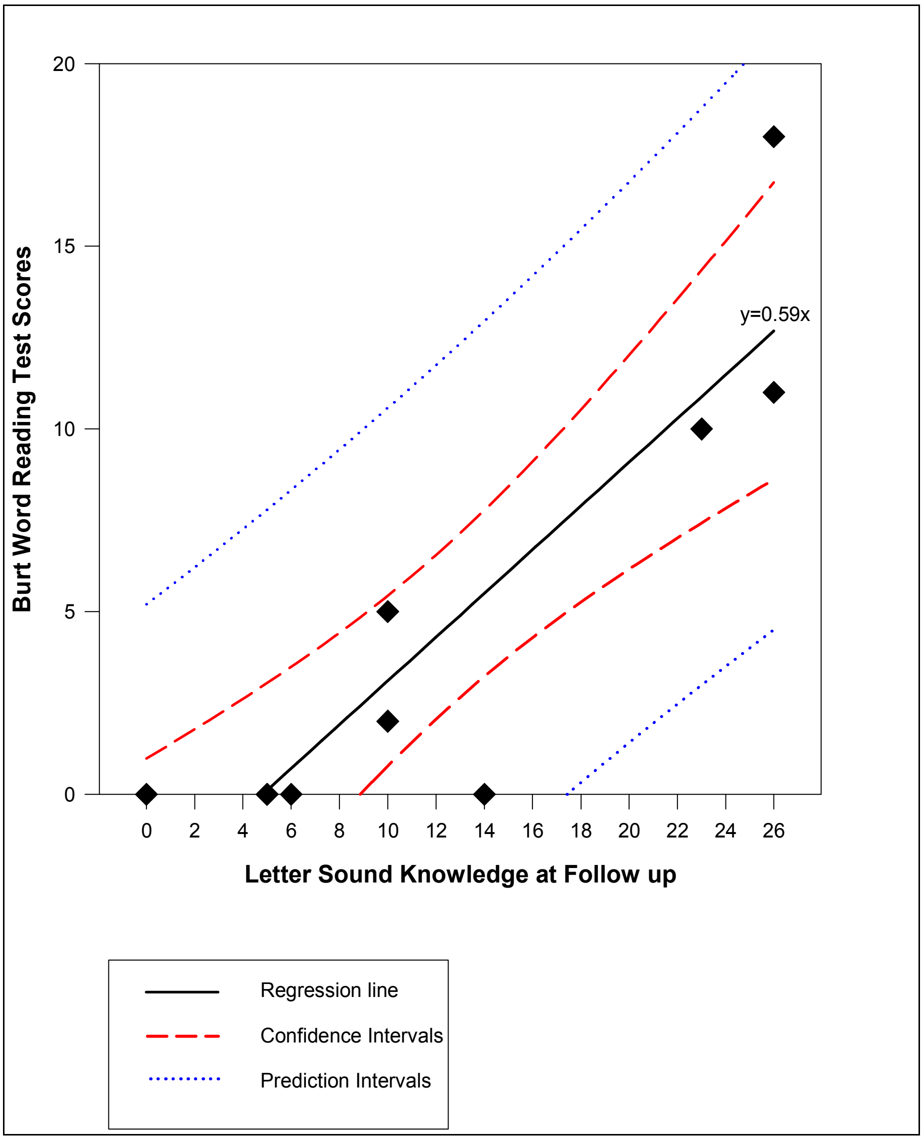


Figure 6.19. Regression, confidence and prediction intervals for Model 1 with the Burt Word Reading Test as the dependent variable.

Burt Word Reading Test scores at follow-up were found to predict 61% of the spelling skills scores with IPI scores contributing a further 15%. Table 6.9 presents the best two models where all *p* values are at the level of significance ($p<0.05$). Figure 6.20 presents regression, confidence and prediction intervals for Model 1 (Table 6.9).

Table 6.9. Best Subsets Regression Analyses for Single word spelling task

Variables	R^2	R^{2adj}	*p*
Model 1			
Burt Word Reading Test scores at follow-up	0.658	0.616	0.004
Model 2			
Initial Phoneme Identity scores at follow-up	0.814	0.760	0.046
Burt Word Reading Test scores at follow-up			0.011

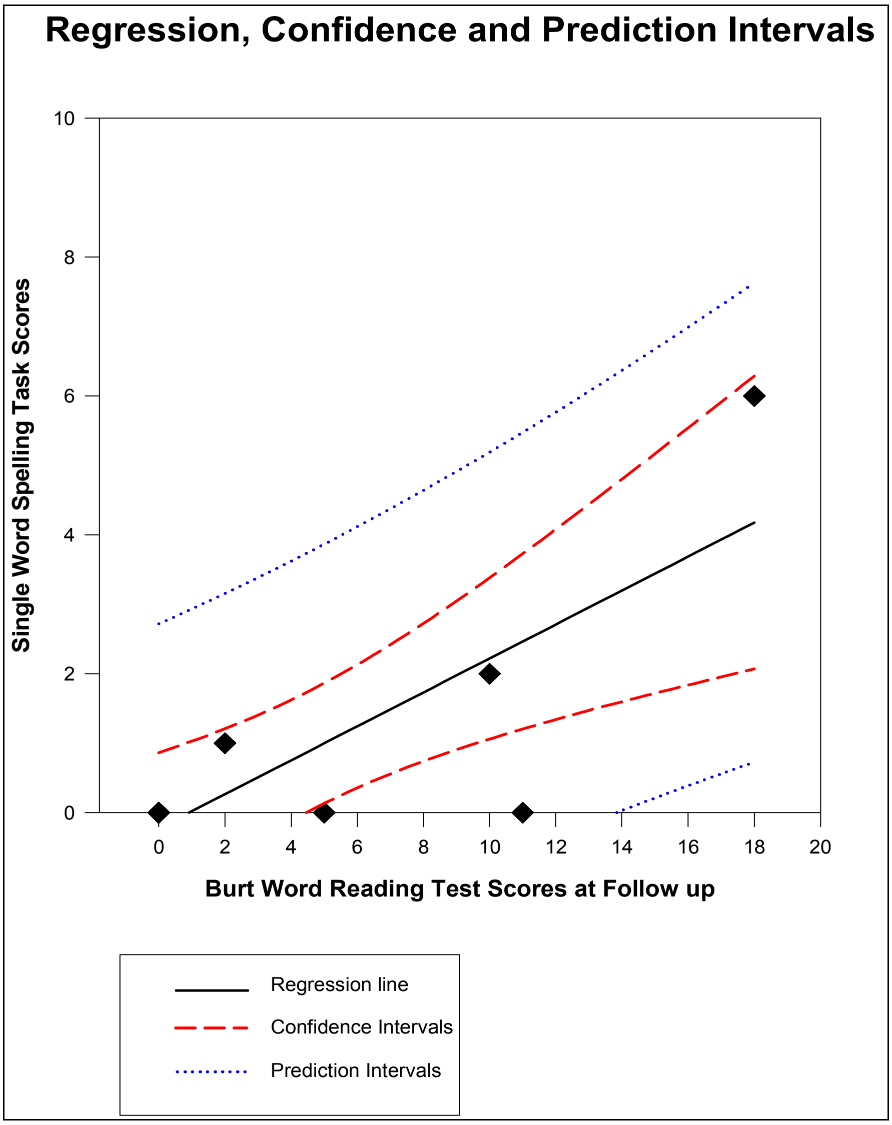


Figure 6.20. Regression, confidence and prediction intervals for Model 1 with the Single Word Spelling Task as the dependent variable.

6.4 Discussion

The study reported in this chapter evaluated the phonological awareness, letter knowledge, decoding, and spelling development in children with DS after they had received two terms (approximately 20 weeks) of formal schooling. The children had participated in an integrated phonological awareness intervention before they started school.

6.4.1 Speech

The first hypothesis tested was that children would exhibit higher scores on speech, letter knowledge and phonological awareness measures at the follow-up assessment than those achieved at pre- and post-intervention assessment. This hypothesis was confirmed at a group level on speech measures. As a group, participants' PCC-R scores on standardised speech assessment measures were significantly higher at follow-up than at pre-intervention. Speech targets scores were also higher at follow-up than at post-intervention for the group as a whole, with eight of the ten participants demonstrating increased scores on their individual speech targets. One participant had a slightly reduced score and one participant scored significantly below post-intervention scores, although still above pre-intervention performance.

6.4.2 Letter knowledge

The hypothesis that letter knowledge scores at follow-up would exceed those at pre- and post-intervention was confirmed at a group level. Group scores on both letter-name and letter-sound knowledge tasks were significantly higher at follow-up, with nine of the ten participants demonstrating growth or achieving ceiling on both letter knowledge tasks. Participants knew more letter names than letter sounds. This is consistent with the letter knowledge profile of children with typical development (Arrow, 2007; McBride-Chang, 1999; Worden & Boettcher, 1990), and is consistent with the performance of the children with DS reported in Chapter 2. In addition to demonstrating a similar letter knowledge profile, the children in the current study had higher mean letter-name and letter-sound knowledge than the Group 1 children in Chapter 2, who were aged 5 to 8 years.

6.4.3 Phonological awareness

The majority of participants exhibited higher phonological awareness scores at follow-up on both the phoneme level assessments, confirming the hypothesis that these scores would exceed pre-and post-intervention scores. However, scores on the rhyme matching task demonstrated no evidence of growth across the intervention and follow-up period. Researchers have demonstrated strong relationships amongst phonological awareness skills (Lonigan et al., 1998; Stahl & Murray, 1994), however other researchers (e.g. Muter et al., 1997) have suggested rhyming and phoneme level skills may draw on different underlying abilities. Although rhyme matching is an early developing skill in children with typical development (Anthony et al., 2002; Cardoso-Martins, Michalick, & Pollo, 2002) the children with DS in the current study were unable to complete this task. These findings are consistent with those reported in Chapters 2 and 5 of this thesis, and with the findings of other researchers (Cardoso-Martins et al., 2002; Gombert, 2002; Snowling et al., 2002), who reported the children with DS in their studies evidenced poorer rhyme level skills relative to some phoneme level skills.

An examination of the association between the phoneme awareness tasks and participants' letter knowledge confirmed the strong relationships reported in the literature (Murray et al., 1996; Oudeans, 2003). Although some researchers have reported children were able to demonstrate phoneme awareness in the absence of letter knowledge (Hulme et al., 2005; Muter et al., 2004), others have suggested letter knowledge is a prerequisite for phoneme awareness. The relationship between these skills demonstrated in the current study appeared to support the view that letter knowledge may be prerequisite but not sufficient to achieve phoneme awareness in young children with DS (van Bysterveldt et al., 2006).

6.4.4 Transfer to reading and spelling

The second hypothesis tested was that participants would be able to transfer improved phonological awareness and letter knowledge to decoding and spelling performance. The data partially supported this hypothesis for reading, with five children able to demonstrate some decoding ability and two of these children achieved word decoding scores within one standard deviation of the mean for their age. The analysis also revealed a strong relationship between participants' letter-sound knowledge and their ability to decode. Qualitative analysis of the decoding errors revealed some partial phonological cues were being used when reading. The errors from four of the five children who were able to decode some words showed they were using initial phoneme cues to decode and therefore were able to apply their phonological knowledge, albeit in a limited way. These findings are encouraging in light of Share's self-teaching hypothesis (Share, 1995) which theorises the ability to achieve independent reading through 'self teaching' is predicated on successful phonological recoding experiences. Unfortunately, the refusal to take part in the assessment by three participants, including one with comparatively strong letter knowledge, meant that any transfer of improved phonological awareness and letter knowledge to reading for these children could not be determined.

The hypothesis that improved phonological awareness and letter knowledge would transfer to spelling performance was also partially supported by the data, for three of the children. Only those children who could read could also spell, but not all children who could read could also spell. Spelling skill also appeared to be related to explicit teaching, with the child who was a ‘reader’ but not a ‘speller’ being schooled at home with an instructional programme that did not yet include any written tasks. Two children wrote their name or letters of their name for all or most of the five spelling words. This suggests children have memorised these frequently occurring words which may also have been explicitly taught. Although the findings confirm the underlying commonality of understanding the alphabetic principle (Adams, 1990; Ehri, 2000; Treiman & Bourassa, 2000), the fact that not all the ‘readers’ were also ‘spellers’ suggests the ability to mobilise knowledge about phoneme-grapheme correspondences needs to be taught explicitly for children with DS.

The strong relationship demonstrated between participants’ decoding and spelling skills confirms the relationship reported between these skills (Ehri, 2000; Treiman & Bourassa, 2000), and is in line with the suggestion that spelling is largely commensurate with decoding in this population (A. Byrne et al., 2002; Cardoso-Martins et al., 2008).

6.4.5 Clinical implications

The results of the intervention at post-intervention and at follow-up support the claim that an integrated phonological awareness intervention which simultaneously targets speech, phonological awareness and letter knowledge is effective in facilitating development in these skills for young children with DS. The lack of a relationship between outcomes and age at intervention suggests that the intervention may be appropriately delivered to young children with DS, well before they begin school. Other studies have demonstrated pre-school children with DS are capable of acquiring these emergent literacy skills (Groen et al., 2006; van Bysterveldt et al., 2006) and that reading is associated with superior language abilities (Cardoso-Martins et al., 2008; Laws et al., 1995; Laws et al., 2000; Laws & Gunn, 2002). Therefore, the early provision of an intervention which combines speech and literacy goals may be an effective and efficient way to maximise the speech and literacy development of children with DS. However, this is a subject which requires further investigation. The following chapter provides some insight into this issue via a longitudinal case study of a boy with DS who was aged 5;02 at pre-intervention and followed at three subsequent assessment points 1., after 2 terms of schooling, 2., after one year of schooling and 3. following two years of formal schooling.

CHAPTER 7

A PHONOLOGICAL AWARENESS INTERVENTION CASE STUDY OF A CHILD WITH DOWN SYNDROME

7.1 Introduction

The findings of the investigations reported in Chapters 5 and 6 provide evidence for the effectiveness of an integrated phonological awareness intervention for pre-school children with Down syndrome (DS). Significant gains in speech accuracy were apparent at post-intervention for all participants and continued gains in speech accuracy, letter knowledge, phonological awareness and early reading and spelling skills for most participants were evident at follow-up, at which time participants had received two terms of formal schooling.

The study described in this chapter provides a case study evaluation of a boy with DS (pseudonym Ben, aged 5y; 2m at the start of the study) who was one of the participants in the pre-school integrated phonological awareness intervention (described in Chapter 5). Ben's speech and literacy development were monitored up to the age of 8;0 (34 months post pre-school intervention) which included two years of formal schooling. The following hypotheses were tested:

1. That Ben's speech accuracy (as measured by PCC-R and percentage phonemes correct) will demonstrate continued improvement over the course of the investigation.

2. That Ben's letter knowledge and phonological awareness skills will continue to improve over the course of the investigation.

3. That Ben will demonstrate the use of letter-sound and phonological awareness knowledge in reading and spelling, resulting in improved reading and spelling performance over time.

7.2 Case history

Ben was born at 40 weeks gestation weighing 2940g. The onset of labour was spontaneous, with the birth assisted by ventouse and forceps. Examination of Ben's physical features on delivery raised the question of Down syndrome. Subsequent chromosomal testing confirmed a diagnosis of Trisomy 21 (Down syndrome).

An echocardiogram at age 4 days revealed an atrial septal defect (ASD) and a patent ductus arteriosus. A repeat echocardiogram at 5 months of age measured the ASD at 6-7mm, with a flattened septal motion and enlarged right heart. Ongoing monitoring of his cardiac status was recommended, however no interventions have been necessary at the time of writing.

Ben was jaundiced and sleepy for the first weeks of life. Ben's mother attempted breastfeeding but Ben was unable to latch on. He was naso-gastric tube fed from day 10. He experienced gagging and vomiting even on small volumes and had a weak and uncoordinated non-nutritive suck. Ben was sent home from hospital at age 14 days feeding via a Haberman feeder, however he fatigued easily. His non-nutritive suck was stronger and more coordinated however his feeding was still uncoordinated, with anterior leakage evident. Ben experienced numerous bouts of vomiting during his first six months of life and was admitted to hospital with dehydration. At age 7 months he had a duodenal web resected, which alleviated his acute symptoms, however feeding problems including vomiting, nasal regurgitation and food aversion remained issues for several years. Ben attended a feeding clinic at the hospital and a feeding experiences clinic at the early intervention centre throughout his pre-school years.

Ben experienced frequent episodes of otitis media with effusion, with concerns also raised about his hearing. Results from behavioural condition orientation response audiometry were not reliable, therefore at aged 13 months Ben's hearing was tested via auditory brainstem response audiometry completed under sedation. Results revealed mild to moderate hearing loss at least partly conductive. Audiological assessment during the intervention period (described in Chapter 5) also revealed mild-moderate conductive loss binaurally with type B typanograms consistent with otitis media with effusion bilaterally. Ben had ongoing problems with ear, nose and throat infections and obstructive sleep apnoea requiring a tonsillectomy at age 4 years and the insertion of 3 sets of pressure equalisation (PE) tubes. However, middle ear infections and discharge have remained a problem, with symptoms evident at all five assessment times.

Ben began attending the early intervention centre at age 1 month. A review of the Speech-Language Therapist's notes indicated Ben was cooing and gurgling at age 2 months, becoming more vocal over the next few months, with babbling reported from age 9 months. At age 14 months Ben was reported to be able to turn the page in a book, and clap and wave on request. Ben's vocalisations became more purposeful and at age 17 months Ben used /ʌ/ to indicate he wanted to be picked up. Ben was also reported to be able to understand one-step instructions and to indicate a choice from two objects. However, gains in expressive language were reported to be slow. At age 2;08, Ben was reported to have several single words, mostly nouns. Ben continued to add single words to his vocabulary throughout his third year which he used to label common objects and was reported to begin to use verbs during this time including "eat" and "go". Ben was also reported to use some signs to indicate something he wanted.

Ben's mother completed the MacArthur Communicative Development Inventory: Words and Sentences (CDI:WS) (Fenson et al., 1993) when Ben was aged 4;4. Ben's mother reported Ben was able to use 294 words listed in the vocabulary checklist which comprises Part 1 of the CDI:WS. Fenson et al. (2007) reported mean and median CDI:WS scores for children with typical development of 256.6 and 263.5 (SD = 166.9) words at 22 months, and 307.3 and 306.0 (SD = 171.0) at 24 months. Results from Part 2 of the CDI:WS revealed Ben was able to use two of the listed plural nouns (feet and teeth) and two of the past tense verbs (fell and lost). Ben's mother indicated he was sometimes able to combine two words (e.g. daddy car) and very occasionally three words.

Ben attended the early intervention centre on a weekly basis from age one month until aged 2;0, and on a fortnightly basis for the next two years. At age 4;03, Ben entered the transition-to-school clinic which he attended weekly until he started school at age 5;10. During the speech-language therapy sessions at the centre, the therapist works largely with the parent in a consultative way, and discussion includes the child's social interaction, sleeping, feeding and communication. As part of his speech-language therapy programme at the early intervention centre, Ben's mother participated in It Takes Two to Talk™ - The Hanen Program® for parents, (Girolametto & Weitzman, 2006; Girolametto, Weitzman, & Clements-Baartman, 1998) when Ben was aged 3;04 to 3;10. Ben participated in an integrated phonological awareness intervention (described in detail in Chapter 5) when he was aged 5;02 – 5;07.

7.3 Method

7.3.1 Procedure

Ben was assessed on five occasions of differing intervals during the study; at pre-intervention, at post-intervention, and after two terms, one year, and two years of formal schooling. Monitoring was completed approximately 29 months after the conclusion of the intervention programme. The assessment schedule and between assessment intervals are presented in Table 7.1.

Table 7.1. Study assessment schedule for Ben

	Age	**Assessment Interval (months)**
Pre-intervention assessment	5;02	NA
Post-intervention assessment	5;07	5
Follow up assessment 1	6;06	11
Follow up assessment 2	7;0	12
Follow up assessment 3	8;0	12

Note: age = years; months

During the time Ben has been at school he has received funding for special education services though the Ongoing and Renewable Resourcing Scheme (ORRS) (Ministry of Education, 2008d). Ben received 20 hours per week teacher-aide support in the classroom and 0.1 full time equivalent specialist teacher support per week. Ben also received speech-language therapy services provided by the Ministry of

Education-Special Education (GSE) (Ministry of Education, 2008e), via a consultative model 2-3 times per term. None of the speech or literacy targets included in the integrated phonological awareness intervention have been part of Ben's subsequent speech-language therapy.

During the longitudinal study, Ben was assessed on the following measures (see Chapter 5 for a more detailed description of the assessment measures)

Language

- Peabody Picture Vocabulary Test - III (PPVT-III) (Dunn & Dunn, 1997). Raw scores and standard scores are reported.
- Pre-School Language Scale – Fourth Edition (Australian Language Adaptation) (PLS-4) (Zimmerman et al., 2002). Standard scores for the Auditory Comprehension and Expressive Communication are reported. A Total Language Score (TLS) presented as a language age score is also reported.

Speech

- Hodson Assessment of Phonological Patterns-Third Edition (HAPP-3) (Hodson, 2004).
- The Goldman Fristoe Test of Articulation (Goldman & Fristoe, 1986).
- Diagnostic Evaluation of Articulation and Phonology (DEAP) single trial of the inconsistency subtest (Dodd et al., 2006). All speech data were recorded using a high-quality digital voice recording device (Belkin F8E462). All responses were transcribed via broad transcription. These samples were analysed using Computerised Profiling (PROPH, Long & Fey, 2005).
- Intervention speech targets. Assessment of Ben's 48 speech sound targets and 12 control sound targets.

Audiological assessment

- Hearing screening, tympanography and otoscopy

Letter knowledge

- Letter name and sound knowledge was assessed using the Gillon Preschool Phonology and Letter Knowledge probes (Gillon, 2005). Raw scores out of 26 are presented.

Phonological Awareness

- Initial Phoneme Identity (IPI) (Gillon, 2005). Raw scores out of 10 are presented.
- Initial Phoneme Identity with Words (IPIW) (Gillon & McNeill, 2007) Raw scores out of 12 are presented.
- Rhyme Matching. Raw scores out of 12 are presented.
- Blending (Gillon & Tyler, 2007). This experimental task assesses the child's ability to blend CV, CVC and CCVC words. The examiner introduces the task by showing the child a puppet which the examiner pretends to make talk, and says:

  "Here is my friend Charlie (puppet of bird). Charlie is trying to learn to talk. He says words very slowly. See if you can guess what words he says.

The child is shown three pictures with text underneath and the examiner says:

  "Look at these picture: (names the pictures for the child) "boy boat cup"

  Show me the picture Charlie is trying to say. /b - ɔi/"

The test comprises 1 practice item and 5 test items.

- Segmentation (Gillon & Tyler, 2007). This experimental task assesses the child's ability to segment CV, CVC and CCVC words. The child is given a picture with text underneath. Using the puppet from the blending task, the examiner says to the child:

> "Now see if you can say some words bit by bit to help Charlie hear the sounds in the word. This word says me (picture of "me" speech card). Let's say it bit by bit to help Charlie /m – i/".

The test comprises 3 practice items and 5 test items.

- Phoneme Detection without Pictorial Cues (Long & Gillon, 2007). This experimental task requires the child to identify the phoneme produced by the examiner as the first sound in a word, from a choice of three. The three words are presented as text only. The test comprises 1 practise item and 13 test items.
- Preschool and Primary Inventory of Phonological Awareness (PIPA) (Dodd, Crosbie, MacIntosh, Teitzel, & Ozanne, 2000) alliteration awareness, phoneme isolation, phoneme segmentation and letter knowledge subtests. As Ben was older than the norms provided, raw scores are reported. An adaptation of the alliteration awareness task was also administered, where the target was presented from a choice of three instead of the four choices in the original version. The adaptation excluded the first picture from test items 1-5 and 11 and 12, and the final picture from test items 6-10.

Reading

- Burt Word Reading Test-New Zealand Revision (BWRT) (Gilmore et al., 1981). The number of words read and age equivalent scores are reported.
- Neale Analysis of Reading Ability-Third Edition (NARA) (Neale, 1999). Both the accuracy and comprehension sections were administered. Age equivalent scores are reported.
- Non-word reading subtest. This experimental task (adapted from Calder, 1992) requires the child to read words which are not real but adhere to English spelling and pronunciation rules, and consists of three sets of ten non-words. Only the first

set was presented (*vab, kos, sim, dup, mov, tob, zug, hud, tiz, and sep*.) Ben received a point for each phoneme produced correctly.

Spelling

- Short spelling task. This experimental task consists of five coloured pictures each presented separately on a page. All pictures were familiar to Ben and included the following items: *cat, chips, sun, dinosaur and train*. Ben was required to write the name of the picture on a line under the picture. Ben received a point for each correct phoneme- grapheme match. Spelling attempts were also analysed according to a stage theory of spelling development (Ehri, 2000).
- Long spelling task. This experimental task consists of ten common words taken from the inconsistency subtest of the DEAP (Dodd et al., 2006). Ben was required to write the name of each picture on an answer sheet. Ben received a point for each correct phoneme- grapheme match. Spelling attempts were also analysed according to a stage theory of spelling development (Ehri, 2000).
- Queensland University Inventory of Literacy (QUIL) (Dodd, Holm, Oerlemans, & McCormick, 1996) non-word spelling subtest. This subtest requires the child to spell words which are not real but adhere to English spelling rules. Ben was assessed on the first 6 words (*dorf, lont, sheve, wump, suts and craid*) which included words of CVC, CVCC and CCVC structure. Ben received a point for each correct phoneme-grapheme match.

Intervention

Ben participated in an integrated phonological awareness intervention over a period of 18 weeks. The intervention included three key components

1. A parent implemented home programme to facilitate letter and sound knowledge via print referencing techniques during joint story reading.
2. Speech-language therapy sessions which integrated speech goals with phonological awareness and letter knowledge goals during weekly individual sessions.
3. Learning Through Computer individual weekly sessions which comprised phonological awareness and letter knowledge tasks adapted for presentation on a computer to pre-school children with DS.

The intervention assessments, procedures and outcomes are presented in detail in Chapter 5. Ben's performance on speech assessment measures can be viewed in Appendices D and E. (Participant 9).

7.4 Reliability

Speech data

All standardised speech assessment data were re-transcribed by an independent SLT. Point-by-point analysis showed 95.4% agreement, ranging from 92.7% to 98.5% agreement. All speech targets were also re-transcribed. Point-by-point analysis showed mean agreement of 99.1%, ranging from 91.6% to 100% agreement. Any differences were resolved by consensus after repeated listenings.

Non-word reading

Ben's non-word reading attempts were retranscribed by an independent reviewer. Inter-rater agreement was 92.5%. Any differences were resolved by consensus.

Spelling

All real and non-word spelling samples were reviewed by an independent reviewer. Point by point agreement was 97%. Any differences were resolved by consensus. Inter-rater agreement for spelling stage was 100%.

7.5 Results

At pre-intervention Ben achieved a raw score of 28 and a standard score of 62 on the PPVT-III (Dunn & Dunn, 1997). Assessment on the PLS-4 (Zimmerman et al., 2002) yielded standard scores of 51 for Auditory Comprehension and 52 for Expressive Communication, which equated to a Total Language Score age equivalent of 3;0. See Chapter 5 for detailed audiological assessment results. Ben's performance on the remaining assessment measures and the time of assessment is presented in Table 7.2.

Table 7.2. Ben's performance on assessment measures at the five assessment times

Assessment	Pre-	Post-	FU 1	FU 2	FU3
Age	5;02	5;07	6;06	7;0	8;0
Speech analysis					
Early 8 sounds (PCC)	86.8		88.4		86.0
Middle 8 sounds (PCC)	46.2		67.8		83.2
Late 8 sounds (PCC)	22.4		47.2		61.5
Total PCC-R	53.2		67.3		76.5
Percent vowels correct (PVC)	85.2		91.5		98.8
Substitutions	52.1		63.1		84.6
Omissions	36.6		28.5		13.8
Other errors	11.3		8.3		1.5
Speech targets (% correct)	10.41	60.4	89.5	93.75	75.0
Letter knowledge					
Letter-name	10	23	26		
Letter-sound	1	4	23		
Phonological awareness					
Initial Phoneme Identity/10	0	4	5	10	
Initial Phoneme Identity with Words/12	1	3	12	12	
Rhyme Matching	6	2	5	6	6
Segmentation/12				8	9
Blending/5				4	5
Phoneme Detection without Pictorial				13	

cues/13			
PIPA[1] (raw scores)			
Alliteration awareness /12		2	4
Alliteration awareness (3 choices)/12		6	9
Phoneme isolation/12		9	12
Phoneme Segmentation		0	2
Letter knowledge/32		20	29
BWRT[2]**-**number of words read	10	13	28
-age equivalent (boys norms)	<6;10	<6;10	6;09-
	-6;04	-6;04	7;03
Non-word reading[3] -words /4		0	0
-phonemes/12		4	7
NARA-3rd Ed[4] Accuracy			6;5
Comprehension			6;2
Spelling Short - words	0	1	2
- phonemes	2/20	6/20	12/20
Long - words		0	1
-phonemes		8/39	12/16
QUIL[5] Non-word spelling - words		0/5	0/6
- phonemes		8/18	12/22

Note. Pre- = pre-intervention; post- = post-intervention; FU1 = follow up 1; FU2 = follow up 2; FU 3 = follow up 3; PCC = Percent consonants correct; PCC-R = Percent consonants correct- revised; PVC = Percent vowels correct; [1]Preschool and Primary Inventory of Phonological Awareness (PIPA) (Dodd et al., 2000); [2]Burt Word Reading Test-New Zealand Revision (BWRT) (Gilmore et al., 1981); [3]Non-word reading test (Calder, 1992); [4]Neale Analysis of Reading Ability-Third Edition (NARA) (Neale, 1999); age equivalent scores presented; [5]Queensland University Inventory of Literacy (QUIL) (Dodd et al., 1996).

7.5.1 Speech results

Detailed speech analysis of the speech samples elicited through standardised speech measures are presented in Table 7.3.

Table 7.3. The percentage of each sound class produced correctly by Ben at each assessment time using samples from the standardised speech assessments

Sound Class	Assessment time		
	Pre-intervention	**Follow-up 1**	**Follow-up 3**
Stops	83.3	96.2	100
Nasals	76.5	93.5	100
Fricatives	28.6	66.7	50.7
Affricates	0.0	0.0	85.7
Glides	33.3	70.0	44.4
Liquids	28.6	33.3	100
Clusters	27.6	42.9	56.1
Vowels	91.3	91.5	98.8
Sample information			
Unin. Wds	30	0	0
Total wds	70	116	106

Note. Unin. wds = number of unintelligible words in sample not included in total words analysed; Total wds = total number of words analysed in sample; analysis from Computerized Profiling (Long & Fey, 2005).

Ben's speech was assessed using standardised measures on three occasions during the intervention at approximately one and a half year intervals. Results indicated Ben made continued gains on all sound classes across the assessment times, with the exception of fricatives and glides at follow up 3. Ben's production of alveolar (/s/ and /z/), and labio-dental fricatives (/f/ and /v/) at follow up 3 was affected by structural changes, as he had recently lost both top and bottom front (deciduous) teeth and his permanent teeth had not fully erupted. These sounds were typically substituted to /θ/ and /ð/. Despite this inability to produce some sounds at follow-up 3, Ben's overall PCC-R score increased.

Speech analysis revealed stable production of early 8 sounds and large gains in the production of middle and late 8 sounds (Shriberg, 1993). As well as increases in total PCC-R and PVC across the assessment times, changes in the type of errors Ben produced were also evident. Error analysis revealed an increase in the proportion of substitution errors and large reductions in the proportion of both omission and other errors. At pre-intervention, Ben's speech included atypical processes such as initial consonant deletion (e.g. /ʤʌmpɪŋ/ → /ʌmpɪŋ/) and he frequently used multiple phonological processes such as cluster reduction or simplification and final consonant deletion which severely impacted his intelligibility (e.g. smoʊk/ →/ moʊ/, and /fɔk/ → /pwɔ/). At pre-intervention, 30% of the words Ben produced during the standardised speech assessments could not be transcribed due to unintelligibility, however, all words were sufficiently intelligible to be transcribed at both other assessment occasions.

Syllable structure simplification was also a feature of Ben's speech at pre-intervention (e.g. /skrudraivə/ → /kwuwʌ/), however this was no longer as prevalent at follow-up 1 (/ʃwuʃwavə/) and no longer apparent at follow-up 3 (/θkrudraivə/). Relational analysis reporting the percentage of word shape targets achieved indicated Ben's ability to produce multisyllabic word shapes increased from 69% of targets at pre-intervention to 80.4 % at follow-up 1 and 97.9% at follow-up 3. Glottal substitutions were present in Ben's speech at follow-up 1 and appeared to be a process which facilitated this development, as glottal substitutions were only produced at the end of the first syllable in multisyllabic words (e.g. kæŋgəru/ → /kæʔwəwu/, /mætʃəz/ → /mæʔsəz/, /pensʊz/ → /peʔʃʊz/). This process had resolved by the follow-up 3 assessment.

Gains in the production of the sounds targeted in the intervention were also apparent across the testing times, with the exception of initial /v/ and initial /sn/ and /sm/ at follow up 3, where articulation was affected by missing dentition. The pattern of suppression of the phonological processes present in Ben's speech followed a largely typical (though delayed) developmental order (Grunwell, 1982), with the production of final /k/ targeting final consonant deletion resolving first, gliding of /l/ and stopping of /v/ resolving next and the consistent production of initial /tʃ/ not achieved until follow-up 3. Graphic analysis of Ben's performance on targeted speech sounds is presented in Figure 7.1.

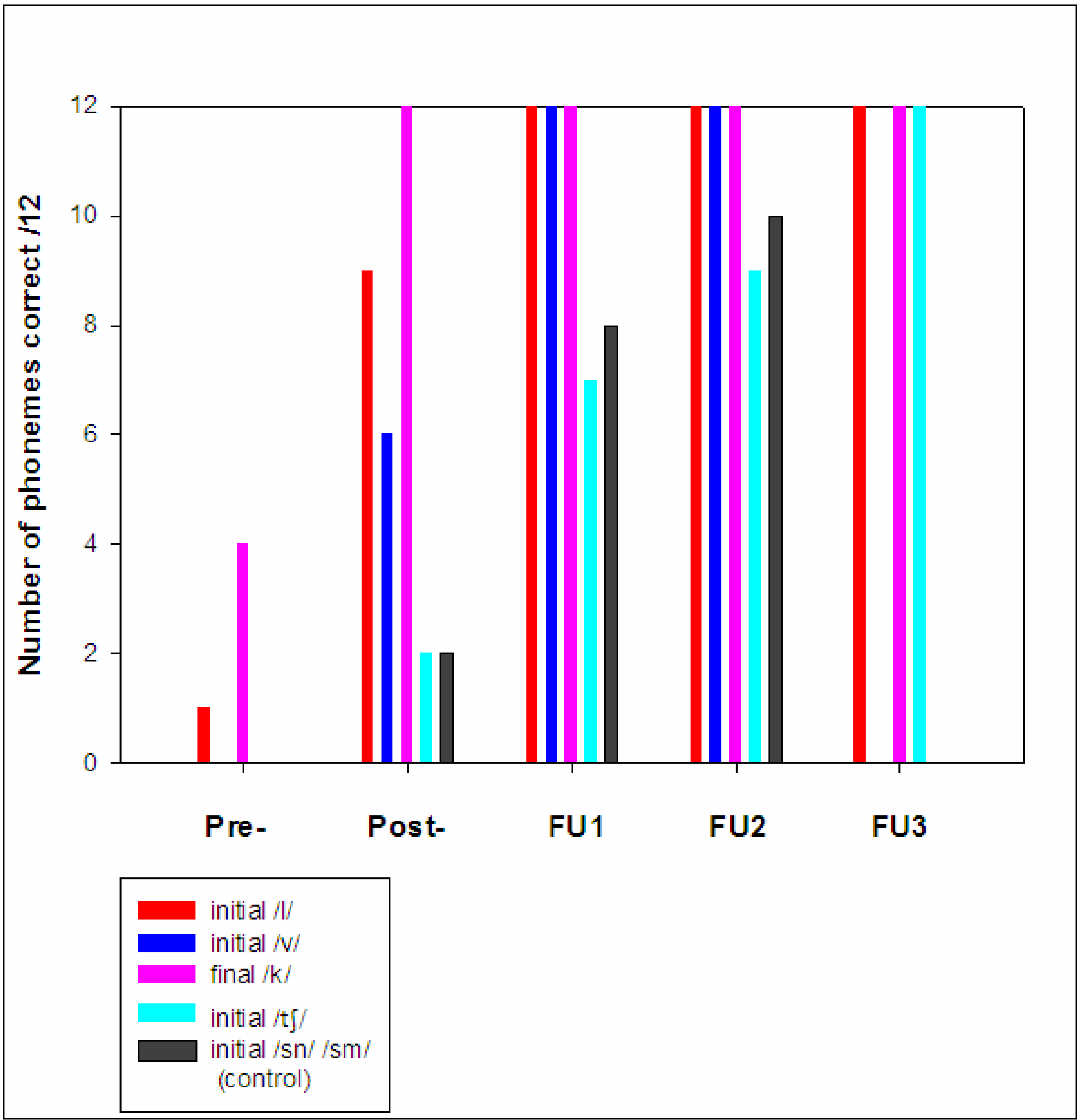


Figure 7.1. Ben's performance on target speech sounds on the five assessment occasions

7.5.2 Letter knowledge

Ben demonstrated a large increase in letter-name knowledge during the integrated phonological awareness intervention. The large increase in letter-sound knowledge between post-intervention and follow-up 1 coincided with the onset of formal schooling. Letter-name knowledge exceeded letter-sound knowledge at all assessment times, although scores at follow-up 1 were close to ceiling. The use of the

PIPA (Dodd et al., 2000) letter knowledge subtest allowed the assessment of letter-sound knowledge of digraphs and consonant clusters in addition to single graphemes. Additionally, the PIPA task is a confrontational naming task as compared to a letter identification measure (Gillon, 2005) and therefore requires the child to generate rather than recognise the correct response. Lower initial scores on the PIPA letter knowledge task may reflect this additional complexity. At follow-up 3, although Ben produced /ð/ as the sound made by the letter ‘v’, further clarification revealed this was an articulation error present in his speech at the time, and his answer was credited as correct.

7.5.3 Phonological awareness

Reassessment of phonological awareness measures presented during the intervention revealed Ben achieved ceiling scores on the IPIW task (Gillon, 2005) at follow-up 1 and on the IPI task at follow-up 2. Ben also achieved a ceiling score on the phoneme detection without pictorial cues task at follow-up 2, therefore a more advanced assessment of phonological awareness, the PIPA (Dodd et al., 2000), was used for subsequent assessment. All PIPA subtests scores were higher at follow-up 3 than follow-up 2 with a ceiling score achieved on the phoneme isolation task at follow-up 3. No evidence of any development in rhyme abilities was evident throughout the 34 month period of the study. Ben was unable to demonstrate any understanding of the concept of rhyme with scores below chance level (10/12) on all assessment occasions.

7.5.4 Reading

Ben’s reading abilities were assessed at the three follow-up assessments times. Although Ben’s decoding ability as assessed by the BWRT (Gilmore et al., 1981) improved across the assessment times, the improvement between follow-up 1 and 2 was minimal, with scores on both occasions falling below the lowest age norms provided by the test. Ben's decoding scores at follow-up 3 revealed he had made considerable gains in the year since the last assessment.

Ben attempted the first 30 words on the test on all three occasions, however differences in reading behaviour was evident across the study. At follow-up 1 and 2, errors were largely associated with word shape (e.g. he → she, said → sad, his → this) as well as some errors which bore no relationship to the target (e.g. that → of, big → up). At follow-up 3, Ben read aloud 28 of the first 30 words correctly, using his finger to point to the words as he did so. He continued to point to the next five words in the test, but said "don't know" after looking at each word and did not attempt to read them aloud.

Assessment of Ben's connected reading and reading comprehension using the NARA (Neale, 1999) showed at Level 1 Ben was able to read all but one word (kitten) correctly and answer three of the four comprehension questions. His 14 errors at Level 2 were all refusals, with the word supplied by the examiner. Ben was able to answer one comprehension question correctly, and the test was subsequently discontinued.

Ben's performance on the non-word reading test (Calder, 1992) revealed he was unable to read any of the non-words (e.g. vab, kos) correctly. Ben attempted four words, beginning with the correct sound for three of them and ending with the correct sound for the remaining word.

7.5.5 Spelling

Real word spelling ability was assessed at the three follow-up assessment times. Results revealed continued development across the assessment times both at the word and phoneme level. Spelling attempts were at the pre-communicative and partial-alphabetic stage at follow-up 1, and included some examples of alphabetic spelling at follow-up 2, and partial alphabetic and alphabetic at follow-up 3. At follow-up 3 Ben was able to demonstrate some understanding of orthographic rules and conventions including the 'magic e' in cake, as well as correctly writing the digraphs 'ch' in chips, 'sh' in fish and 'th' in teeth. Spelling samples also illustrated development in mechanical writing skills including letter formation, letter sequencing and positioning. Spelling performance on the short real word spelling task is presented in Figure 7.2.

Non-word spelling was assessed at follow-up 2 and 3 only. Ben was able to represent sounds in initial, medial and final positions at both testing occasions but was unable to spell any of the non-words correctly. At follow-up 3 he was able to represent the digraph 'sh' in 'sheve' and the consonant cluster 'cr' in 'craid'.

Samples of Ben's early writing attempts are presented in Figures 7.3 and 7.4. Figure 7.3 is an example of written work completed at follow-up 2. The sample depicts a story dictated by Ben, with text provided by the teacher-aide for him to copy. Although many of the letters represented are recognisable, no independent spelling is evident. Figure 7.4 is an example of an original story completed by Ben at follow up 3. Ben was provided with the spelling of the word "birthday". Ben's teacher-aide also added grammatical words and supplied the word "bowling" for Ben to copy over during the composition. Spelling attempts are predominantly alphabetic, however Ben's teacher-aide reported many of the words used in this story are words

Ben commonly uses in story writing and it is likely he has memorised them. This writing sample also illustrates grammatical and morphological errors present in Ben's language including omitted words, possessive s, and verbs. Difficulties with 'b' and 'd' confusion is also evident in the words 'today', 'birthday' and 'Dad'.

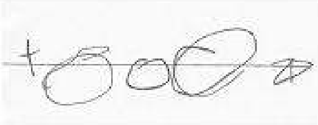
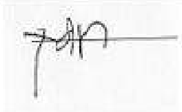
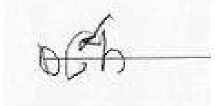
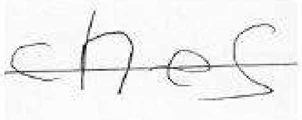
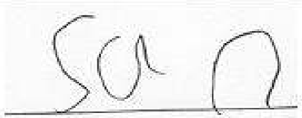
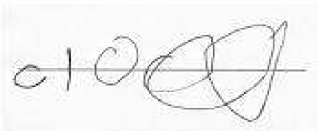
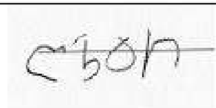
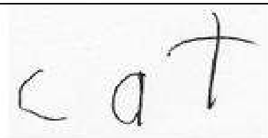
Target		Spelling stage		Spelling stage		Spelling stage
Train		Partial-alphabetic		Partial-alphabetic		Partial-alphabetic
Chips		Pre-communicative		Pre-communicative		Partial-alphabetic
Sun		Pre-communicative		Alphabetic		Alphabetic
Cat		Partial-alphabetic		Partial-alphabetic		Alphabetic
Dinosaur		Pre-communicative		Pre-communicative		Partial-alphabetic

Figure 7.2. Spelling performance on short spelling task for Ben at follow up assessment times 1, 2 and 3, presented left to right.

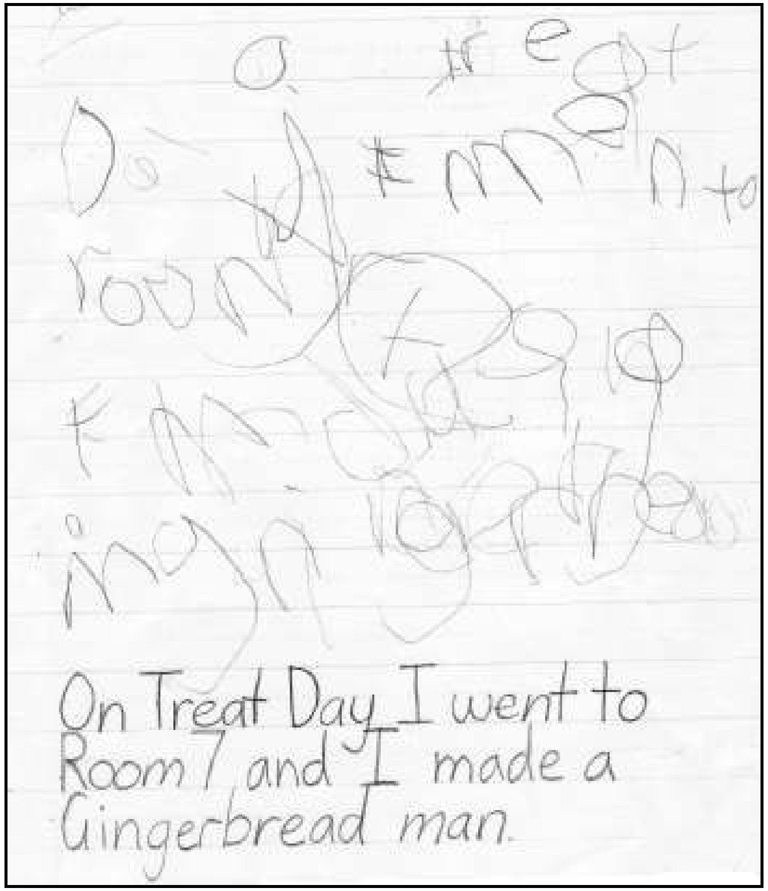
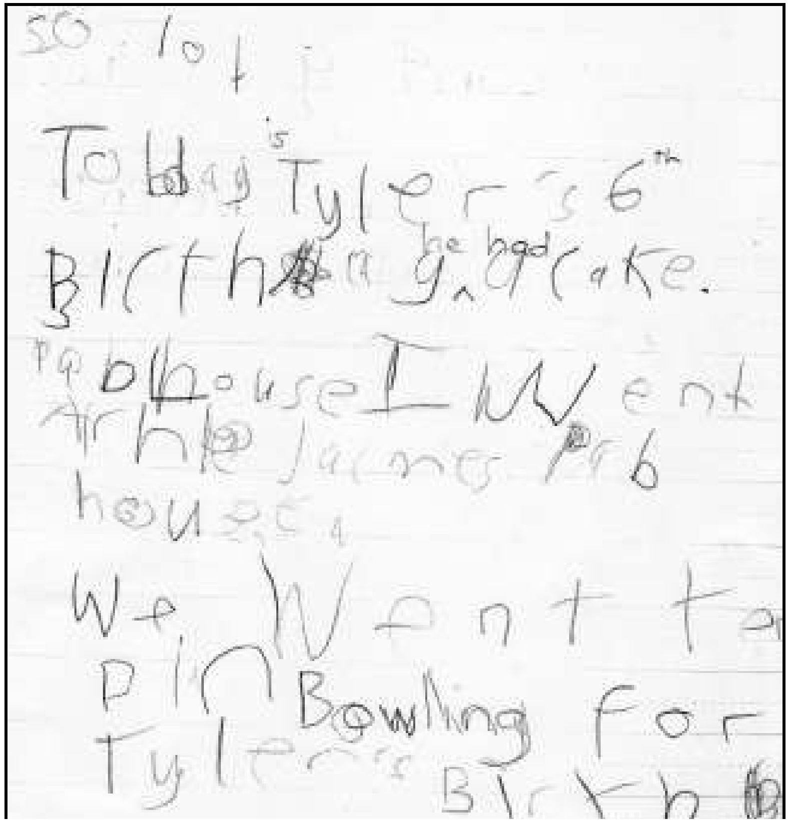


Figure 7.3. Ben's copy of dictated story



Today **is** Tyler**'s** 6^{th} birthday. **He had** a cake. Dad house I went Archie James Dad house. We went ten pin **bowling** for Tyler**'s** birthday.

Figure 7.4. Ben's original story.
Underlined bold text added by teacher-aide

7.6 Discussion

This study evaluated the ongoing development of speech, letter knowledge and phonological awareness and the transfer of these skills to reading and spelling, in a boy with DS who had previously participated in an integrated phonological awareness intervention. The integrated intervention simultaneously targeted speech, letter knowledge and phonological awareness goals. Ben was aged 5;02 at the start of the study and assessments were conducted immediately post-intervention (aged 5;07), after two terms of formal schooling (aged 6;06), after one year of schooling (7;0) and after two years of schooling (8;0).

7.6.1 Speech production

The first hypothesis tested was that Ben's speech accuracy would demonstrate continued improvement over the course of the 34 month investigation. This hypothesis was confirmed by the data. Results of the standardised speech measures indicated increased accuracy of all sound classes across the assessment times, with the exception of fricatives and glides at follow-up 3. Analysis of speech errors at follow-up 3 revealed that fricative errors present in Ben's speech were articulation errors which resulted from missing dentition, and not part of a phonological process.

Improvements in PCC-R were attributable to increases in both 'middle' and 'late 8' sounds (Shriberg, 1993) which showed similar and substantial gains across the assessment periods, and are reflective of Ben's improved production of the sounds targeted in the intervention. In light of the persistent nature of speech difficulties characteristic of this population (Kumin, 1994; Miller & Leddy, 1999; Roberts, Stoel-Gammon et al., 2008), this rate of speech development is noteworthy.

As well as an increase in total PCC-R, the reduction in omissions and other errors and the corresponding increase in substitution errors are likely to have had a positive influence on the intelligibility of Ben's speech. Hodson and Paden (1991) suggested high numbers of omission errors are associated with increased severity of speech disorder. Increased accuracy of multisyllabic words is also likely to have positively affected intelligibility. These trends allude to the development of stronger underlying phonological representations, which in turn, may promote more accurate phonological assembly (Griffiths & Stackhouse, 2002). An increase in phonological awareness may contribute to the ability to access these representations and further facilitate improved speech production accuracy (Gillon, 2004).

Increased accuracy on production of Ben's intervention speech targets as measured by percentage phonemes correct was also apparent during the course of the study, again with the exception of those sounds affected by his missing dentition. These affected sounds were not omitted but were substituted by sounds consistent in voice and manner and minimally different in place. Although vowel errors were not directly targeted during the intervention, repeated presentation and modelling of correct vowel production occurred in the context of the target words used in the intervention. Development of vowels was apparent across the course of the investigation.

Throughout the follow-up period (follow-up 1, 2 and 3) Ben's speech-language therapy goals did not include any of the speech targets included in the intervention, however, accurate production of 's blends' (intervention control) was recommended as a goal by the lead researcher at the completion of the post-intervention assessments, and was included in the speech-therapy goals when Ben started school.

7.6.2 Letter knowledge and phonological awareness

The second hypothesis tested was that Ben's letter knowledge and phonological awareness would continue to improve over the course of the investigation. This hypothesis was supported by the data with the exception of the phonological awareness measure of rhyme. Ben achieved high scores for both letter-name and letter-sound knowledge measures. Ben's strong letter knowledge is reflected in his scores on the IPIW task (and later on the phoneme detection without pictorial cues task), which was in advance of his ability to identify the first sound when it presented aurally only. This illustrates the importance of providing visual and tangible supports for children with DS, to supplement the transitory nature of the speech signal. The identification of an isolated deficit in rhyme awareness compared to phoneme awareness is compatible with the findings of Gombert (2002) and Snowling et al., (2002) who demonstrated poorer rhyme level skills than would be predicted from other phonological awareness abilities in this population.

The co-occurrence of high IPI scores and high letter knowledge demonstrated by Ben was in common with the children with DS in the national study reported in Chapter 2. Consistent with the findings reported in Chapter 5 and 6 and those reported by Gillon (2005) and McNeill, Gillon and Dodd, (in press), gains in letter knowledge and phonological awareness achieved through an integrated phonological awareness intervention were not at the expense of gains in speech accuracy. These findings provide ample support for the inclusion of explicit letter knowledge and phonological awareness instruction in interventions to improve speech production for children with DS.

Although the Alliteration Awareness (AA) subtest of the PIPA (Dodd et al., 2000) requires the child to identify initial sounds in words, in common with both the

IPI and IPIW tasks, the AA task is cognitively more complex, as it requires the child to identity the one that *is not* the same, rather than the one that *is* the same. Further difficulty is added by the presence of four rather than three choices. The impact of these additional demands on the child's ability must be considered as they have the potential to mask or reduce the child's ability to demonstrate their phonological awareness skills. Verbal working memory has been reported to be compromised in individuals with DS (Bower & Hayes, 1994; Jarrold et al., 2000; Jarrold, Baddeley, & Phillips, 1999; Kay-Raining Bird & Chapman, 1994). Deficits in verbal working memory limit an individual's ability to store, manipulate and recall sounds in words. Children with DS are reported to typically have a digit span of 2-3 (Conners et al., 2008; Laws & Gunn, 2004), therefore, phonological awareness tasks which exceed this digit span can no longer claim to be solely measuring phonological awareness. Ben's response to an adaptation of the AA task where only three choices were presented supports this position. Scores on the adapted AA task were substantially higher than the original version at both assessment times.

7.6.3 Transfer to reading and spelling

The third hypothesis tested was that Ben would demonstrate further transfer of letter knowledge and phonological awareness skills to reading and spelling, resulting in improved performance of these skills. The data supported this hypothesis. Although gains on the BWRT (Gilmore et al., 1981) were minimal during the six months between follow-up 1 and 2, considerable growth in letter-sound knowledge occurred during this time. The substantial gains evident in decoding skills assessed the following year, suggests Ben's letter-sound knowledge, which is reported to be associated with reading success in this population (Lemons, 2008) was sufficiently consolidated to support the development of his decoding skills. New Zealand children typically start school at their 5th birthday, however Ben started 10 months after this. After just over two years of schooling Ben's decoding ability as determined by BWRT scores was not substantially different from those reported for typically developing children who have been at school for a similar period. Ben's emerging ability to read some of the sounds in non-words further illustrates his utilisation of letter-sound knowledge to decode.

Results on the NARA (Neale, 1999) revealed Ben was able to transfer his real word decoding skills to connected text, with sufficient accuracy to support his comprehension of the text. Consistent with the reading profile reported by other researchers (Byrne et al., 1995; Byrne et al., 2002; Carr, 1988; Fletcher & Buckley, 2002; Groen et al., 2006), and with the investigation reported in Chapter 2, Ben's reading accuracy was in advance of his reading comprehension.

Spelling appeared to be very difficult for Ben. The changes apparent in the spelling samples suggest, as with the children reported in Chapter 6, the physical demands of the spelling task also had a significant influence on Ben's ability to represent the sounds in words. Although few words were spelled correctly at any of the assessment times, ongoing increases in the number of phoneme-grapheme matches supports the hypothesis that Ben would be able to further transfer his letter knowledge and phonological awareness skills to achieve improved spelling scores. Spelling stage analysis also confirmed that by assessment at follow-up 3, the predominant spelling stage Ben used was predicated on a growing understanding of the alphabetic principle. Ben's growing ability to spell sounds in non-words further illustrates his transfer of letter-sound knowledge and phoneme-grapheme correspondences to the spelling process. Consistent with Ehri's (2000) stage theory of spelling, at follow-up 3 Ben was able to demonstrate an emerging knowledge of orthographic patterns and conventions present in written English.

The longitudinal study reported in this chapter demonstrated the positive speech, phonological awareness, and early literacy development of a young boy with DS who participated in an 18 week integrated phonological awareness intervention before he started school. In light of the persistent speech difficulties, compromised verbal working memory and language disorder in addition to cognitive impairment that are all characteristic of individuals with DS, an intervention which is provided early and which simultaneously targets speech, letter knowledge and phonological awareness goals provides a promising alternative to conventional therapy. It is vital that monitoring of Ben's speech and literacy development is ongoing and that the positive gains resulting from this intervention are maximised.

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CHAPTER 8

GENERAL DISCUSSION

8.1 Introduction

This thesis investigated spoken and written language development in New Zealand children with Down syndrome (DS). Variables that influence written language development such as the home and school literacy environment and specific interventions to facilitate speech and reading development were also examined. Specifically, three broad questions were addressed in this thesis:

1. What are the phonological awareness, speech, language and literacy skills of New Zealand children with DS?
2. What are the home and school literacy environments of New Zealand children with DS and how do they support written language development?
3. What are the immediate and longer term effects of an integrated phonological awareness intervention on enhancing aspects of spoken and written language development in young children with DS?

A series of six experiments was conducted to answer these research questions. The following section describes the research methodology employed in these experiments, followed by a discussion of the results and how these relate to the research questions.

8.2 Research Methodology

8.2.1 Experiment 1: Exploring aspects of spoken and written language profiles of New Zealand children with Down syndrome

This descriptive study was conducted in two parts. Part one investigated the phonological awareness, letter knowledge and decoding skills of 77 school aged children with DS (aged between 5;08 and 14;11), via screening assessments administered by the children's teachers. Children who were able to read more than ten words on the decoding task were eligible for inclusion in Part 2 of the experiment. Thirty two children met this criterion, with results of in-depth assessment of 27 children included in the analysis. The in-depth assessment battery was administered by qualified speech-language therapists and assessed speech production, phonological awareness reading accuracy and comprehension, and narrative language skills. The data provided descriptive information detailing aspects of the spoken and written language abilities of the children and enabled the relationships between the skills to be explored.

8.2.2 Experiment 2: Literacy environments for children with Down syndrome: What's happening at home?

This descriptive study investigated the home literacy environment of 85 primary school-aged children with DS from throughout New Zealand. Participants were identified through their schools and survey data gathered via questionnaire was collected from their parents. The questionnaire was modelled on and adapted from the Early Literacy Parent Questionnaire by Boudreau (2005). The questionnaire included questions relating to parent's priorities regarding literacy for their child with DS, how literacy was supported at home and the ways in which the children with DS participated in literacy activities.

8.2.3 Experiment 3: Literacy environments for children with Down syndrome: What's happening at school?

This descriptive study investigated the school literacy environment of 87 children with DS, identified through their schools, as reported in Chapter 3. Survey data gathered via questionnaire was collected from the children's teachers using a parallel questionnaire to that completed by children's parents. The questionnaire included questions relating to literacy interactions and the ways in which literacy was supported in the classroom, the role of the child with DS during literacy activities and the literacy skills they displayed.

8.2.4 Experiment 4: The effectiveness of an integrated phonological awareness intervention for children with Down syndrome

This study investigated the effectiveness of an integrated phonological awareness intervention approach on the speech, letter knowledge and phonological awareness development of ten pre-school children with DS aged 4;04 – 5;05 at the start of the intervention. A multiple single-subject design with repeated measures was employed to evaluate the effectiveness of the intervention on trained and untrained speech measures. The intervention was conducted over an 18 week period and included three key components: 1. Parent implemented print referencing to teach letter knowledge during joint story reading 2., speech goals integrated with letter knowledge and phoneme awareness activities conducted by the speech-language therapist (SLT) in a play based format, and 3. letter knowledge and phoneme awareness activities conducted by the computer specialist (CS) adapted for presentation on a computer. Changes in speech accuracy, letter knowledge and phonological awareness were analysed at an individual level and the relationships between these variables were analysed for the children as a group.

8.2.5 Experiment 5: The longer term effects of an integrated phonological awareness intervention for children with Down syndrome

This study re-evaluated the speech, letter knowledge and phonological awareness of children with DS after they had received two terms of formal schooling. Children's decoding and spelling skills were also assessed at this time. The study aimed to determine whether the children were able to maintain or improve on pre- and post-intervention measures of speech, letter knowledge and phonological awareness and whether they were able to transfer their improved letter knowledge and phonological awareness to decoding and spelling performance.

8.2.6 Experiment 6: A case study of phonological awareness development in a child with Down syndrome

This study evaluated the long term effects of an integrated phonological awareness intervention on the speech, letter knowledge, phonological awareness, reading and spelling skills of one boy with DS, who had participated in the intervention when he was aged 5;02. Questions regarding the longer term effects of the research intervention on the children's speech, letter knowledge and phonological awareness were successfully addressed in Chapter 6. However, the emergent decoding and spelling skills demonstrated by the children revealed a longer term investigation was required to investigate any transfer of improved letter knowledge and phonological awareness to these skills. Thus, this case study monitored Ben's speech and literacy development up to the age of 8;0 (34 months post pre-school intervention).

8.3 Spoken and written language in New Zealand children with Down syndrome: A pattern of delay and disorder.

The first question the experiments addressed was to describe the phonological awareness, speech, language and literacy skills of New Zealand children with DS, with evidence provided by both the descriptive study conducted in Experiment 1 and the intervention and follow-up studies conducted in Experiments 4, 5 and 6.

8.3.1 Speech deficits

Analysis of the speech sound data revealed many similarities between the speech of the children with DS who participated in Experiment 1 and that of younger children with typically developing speech. These similarities included lower levels of accuracy (PCC-R), incomplete phonetic inventories and the presence of early resolving phonological processes (Bernthal & Bankson, 2004; Grunwell, 1982; James, 2001; Smit, Hand, Frelinger, Bernthal, & Bird, 1990; Stoel-Gammon, 1987). Multiple speech errors were evident in the speech of all the children with DS whose speech was examined in this thesis, and entire sound classes were absent from the pre-intervention speech of seven of the ten children in the intervention study in Experiment 4. The children in Experiment 1 were all school aged, thus they were at an age at which phonological acquisition in typically developing speech is largely complete (Bernthal & Bankson, 2004; Hodson & Paden, 1981) and speech is fully intelligible (Gordon-Brannan & Hodson, 2000; Stoel-Gammon & Dunn, 1985). The children with DS demonstrated better accuracy with earlier than later developing sounds, however no significant relationship was found between chronological age and speech accuracy in either Experiment 1, 4 or 5, nor between chronological age and speech intelligibility in Experiment 1, confirming the persistent nature of speech deficits in this population.

Data analysis also revealed phonological characteristics of speech disorder in the speech of children in Experiments 1 and 5, including the presence of unusual and atypical phonological processes, as well as high proportions of distortion and addition errors (Dodd, 1976). Many children also demonstrated vowel errors in their speech, which are not commonly found in typically developing speech (James, van Doorn, & McLeod, 2001; Selby, Robb, & Gilbert, 2000) and have been described as a hallmark of speech disorder (Lewis, Freebairn, Hansen, Iyengar, & Taylor, 2004; Stackhouse, 1992).

8.3.2 Phonological awareness deficits

Measurable though inconsistent phonological awareness skills have been reported in children as young as 2 or 3 years of age and more consolidated skills reportedly present in children aged 4 years (Lonigan et al., 1998). However, significant delay in the acquisition of phonological awareness skills was evident in the children with DS. Above chance scores were achieved by fewer than half the children in Experiment 1 on the initial phoneme identity task and by fewer than one fifth on the rhyme oddity task. The children who participated in Experiments 4, 5 and 6 presented a similar picture of delay.

The results also revealed an atypical pattern of phonological awareness emergence in the children with DS compared to children with typical development. Although rhyme awareness is reported to be an earlier developing skill in children with typical development, with young children able to achieve higher scores on rhyme oddity than phoneme identity tasks (Bryant, MacLean, Bradley, & Crossland, 1990; Byrne & Fielding-Barnsley, 1991; Lonigan et al., 1998; Maclean, Bryant, & Bradley, 1987), the reverse was true for the children with DS. Very few of the children in Experiment 1 achieved above chance scores on a rhyme oddity task and none of the children in Experiments 4, 5 and 6 were able to achieve above chance scores on the rhyme matching task. This atypical pattern of phonological awareness development in DS is consistent with the findings of other researchers (Gombert, 2002; Snowling et al., 2002), who reported poorer rhyme awareness than would be expected given other phonological awareness abilities.

8.3.3 Literacy measures

As would be expected given increased exposure to formal literacy instruction and reading opportunity, increased chronological age was associated with better reading accuracy and comprehension in the children in Experiment 1. Reading achievement in DS is reported to be extremely variable (Cardoso-Martins et al., 2008; Sloper et al., 1990), including reports of age appropriate reading accuracy (Groen et al., 2006). Variability in reading abilities was also demonstrated between the children in Experiment 1. Nearly one quarter of the children were unable to read any words correctly, 6.6% could decode at a 7 - 8 year level and one child aged 6;11 achieved a decoding score within her equivalent age band. Reading comprehension scores were consistently poorer than reading accuracy for all children, although scores were again variable as was the gap between accuracy and comprehension scores.

Results from Experiments 5 and 6 revealed spelling tasks were extremely difficult for all ten participants. At post-intervention, the majority of all responses were at the pre-communicative stage (Ehri, 2000), with only three of the five children who could decode, able to demonstrate any spelling skills. The increasing ability to read and represent some sounds in real and non-words demonstrated by Ben, in Experiment 6, typified the strong relationships that were evident in Experiments 1 and 5, between the children's letter-sound knowledge and their literacy abilities. These findings confirmed the need for children to understand the alphabetic principle which underlies literacy development and therefore to be equipped with the knowledge which allows them to do so. According to Share's (1995) self-teaching hypothesis, the ability to "self-teach" is based on repeated successful phonological decoding experiences, experiences which are themselves conditional on knowledge about phoneme-grapheme relationships. The children with DS who were able to apply their strong phoneme-grapheme knowledge to successful phonological decoding were on the way to becoming independent readers. Although historically the need for learning print-to-sound relationships was not been seen as important for children with DS (Buckley, 1985), the results from Experiments 1 and 6 corroborates more recent research which confirm readers with DS use letter knowledge and knowledge of phoneme-grapheme correspondences to read both real (decodable) and nonsense words (Groen et al., 2006; Lemons, 2008).

8.3.4 Language

Although results of the intervention study in Experiment 5 demonstrated no relationship between participants' language scores and response to the intervention (on speech, letter knowledge or phonological awareness measures), pre-intervention receptive language and total language scores were however predictive of pre-intervention scores on the letter knowledge, with the highest scores achieved by children who had language ages of at least 3 years. Thus, it appears a stronger language foundation may facilitate the acquisition of alphabet knowledge in children with DS.

The results of the narrative language assessment in Experiment 1 revealed differences in both microstructure and macrostructure measures between the group of older children with DS who were better readers, and their younger peers with poorer reading skills. Better readers produced more advanced narrative structures in which they used longer sentences and a greater number of different words. The more advanced narratives structures produced by the better readers confirmed a relationship between reading and narrative measures reported by Kay-Raining Bird et al., (2008), and provided further evidence of continued syntactic development with age (Chapman et al., 1998; Thordardottir et al., 2002), contrary to the findings of Fowler (1990) who hypothesised the existence of a syntactic ceiling.

It is also possible that the quality of the narratives was influenced by the expressive language deficits of the participants, rather than an inability to mentally represent the event, as suggested by Boudreau and Chapman (2000). However, the absence of a semantic language assessment from the assessment battery meant this hypothesis could not be confirmed. Years of schooling and explicit teaching may also have contributed to the better narratives produced the Group B children, as children's experiences with writing can help develop their narrative skills and their abilities to represent place and time (Hughes, McGillivray et al., 1997).

Interpretation of the relationship between participants' reading skills and their other language abilities is confounded by the significant age difference between the two groups. However, these results do attest to the continuing development in both spoken and written language abilities in this population, and provide support for McDuffie, Chapman, and Abbeduto's (2008) recommendation that individuals with DS receive "ongoing language intervention and literacy instruction" (p. 124) throughout adolescence.

8.4 Home and school literacy environments are supportive and facilitative of literacy development

The second question examined the home and school literacy environments of children with DS and the ways in which they supported and facilitated the children's literacy development. Experiments 2 and 3 provide evidence to address this question.

In general, New Zealand home environments are rated very favourably in terms of facilitating children's early literacy development and New Zealand parents are more likely to engage their child as a pre-schooler in literacy related activities compared to parents from other countries in the Progress in International Reading Literacy Study (PIRLS, 2005/2006) (Mullis et al., 2007). The study also revealed the mean number of hours per week of reading instruction that New Zealand Year 5 children receive is above the international mean on this measure. A comparison of the data reported by parents and teachers indicated that the children with DS spend a similar amount of time engaged in joint reading with their parents as they do in reading instruction at school. Teachers' reported allocation of reading and writing home practice and the child's receipt of this work reported by parents was entirely consistent, although far fewer children were allocated writing home practice compared to reading home practice. Thus it appears, when homework is assigned, teachers can be confident that it is received and completed.

Although reported drawing frequency was similar at home and at school, many more children were involved in the more complex written activities at school than at home. The significant correlations between the assignment of homework and parental provision of help with both reading and writing identified in Experiment 2, highlights the important opportunity that exists for teachers and parents to work together to enhance literacy outcomes for children with DS, and points to regular allocation of reading and writing homework as one way this can be achieved.

Similarities in the strategies parents and teachers used to help children with reading, writing and spelling were identified. Approximately one quarter of teachers and parents reported using an alphabet, phonics based or sounding out approach to support the development of literacy skills, however more teachers reported using a sight word strategy than was reported by parents. Although similar numbers of parents and teachers reported their child/pupil was able to demonstrate at least some independent reading, many more Group 2 (older) children were reported to be regular independent readers by their teachers than by their parents. These findings confirm the need for shared goals and expectations regarding literacy acquisition and development for children with DS as well as the consistent use of reading instructions strategies which equip children with the skills to become independent readers.

Given the association between phonological awareness and letter knowledge and better reading outcomes in children with DS (Cupples & Iacono, 2000, 2002; Goetz et al., 2008; Gombert, 2002; Roch & Jarrold, 2008; Snowling et al., 2002), coupled with the reported associations between reading and spelling skills (A. Byrne et al., 2002; Cardoso-Martins et al., 2008), the limited connection between children's reading, writing and spelling activities reported in Experiments 2 and 3 is a matter for concern. Commonalities in the way teachers and parents included letter knowledge instruction into reading and other activities also emerged, which is encouraging in light of research findings confirming the benefits of an HLE which provides both regular joint reading and formal instruction of letter knowledge (Sénéchal & LeFevre, 2002; Sénéchal et al., 1998). However, the majority of children did not have the prerequisite letter knowledge or phoneme level skills to facilitate independent reading

(Share, 1995), which suggests children with DS may require an instructional approach in which the links between spoken and written language are more explicit and integrated than they currently appear to receive. Print referencing techniques have been shown to be an appropriate and effective way of facilitating print concepts, alphabet knowledge, phoneme awareness and name writing ability in young children, including pre-school children with DS, children with communication impairment and children who are socially or economically disadvantaged (Ezell, Justice, & Parsons, 2000; Justice & Ezell, 2000; Justice & Kaderavek, 2002; Justice et al., 2009; van Bysterveldt et al., 2006). The suitability of these techniques for school-aged children with DS with emergent literacy skills is an area which clearly requires further investigation.

Teachers and parents both reported on their child/pupil's engagement with the pictures or text during joint story reading. A comparison of these data confirmed that many more children were commenting and asking about the pictures, text and characters during reading with their parent than when reading at school. However, despite the higher levels of engagement reported in the home environment, a large number of children were not yet demonstrating these behaviours in either context. These findings reinforce the need for targeted interventions to identify strategies that maximise engagement and learning during joint reading activities for children with DS.

Parents and teachers acknowledged there were challenges providing literacy instruction for children with DS. Both groups of respondents identified ways they had found to manage these challenges, including ways to manage the physical and physiological challenges the activity presented as well as focusing on positive methods to enhance the child's behaviour and motivation to participate in the activity.

The information reported by the parents and teachers of the children with DS who took part in these studies present a very similar and predominantly positive picture. Although both studies involved reports rather than independent assessment data, the compatibility of these reports provides some reassurance as to the validity and accuracy of the data. The perspectives provided by the large number of parents and teachers in these parallel studies offer valuable insights into the environments in which New Zealand children with DS become literate and contribute to the understanding about the ways these environments shape literacy acquisition and development.

8.5 Integrated phonological awareness intervention effectiveness

The final question examined the children's response to intervention. It was hypothesised that children with DS would respond positively to an integrated phonological awareness intervention which included direct instruction in letter knowledge and phonological awareness to improve their speech and literacy, and that these improvements would be sustained over time. Evidence to support this hypothesis is provided by Experiments 4, 5 and 6.

8.5.1 Speech

All ten children who participated in the intervention demonstrated statistically significant gains in production accuracy on both trained and untrained words. Examples of phonological generalisation (Grunwell, 1990) were also evident in the speech of some children, who demonstrated generalisation of the remediated pattern to other phonemes in the same sound class. Phonologically based approaches to remediating speech errors focus on the phonological system and target phonological error patterns apparent in the child's speech to effect reorganisation of the child's phonological system (Holm et al., 2005; Strattman, 2007). The increased accuracy post-intervention on non-targeted consonants and vowels in the trained and untrained words (22.5% – 52.7% in PCC-R and 5.3% and 66.4% in PVC) suggests the intervention was successful in effecting reorganisation of the children's phonological systems. Further evidence of phonological reorganisation is provided by the improved accuracy across all sound classes between pre-intervention and follow-up. Sustained or continuous gains on speech target scores at follow-up were demonstrated by all but two children, although their follow-up scores were still in advance of pre-intervention performance. Ben's performance on sound classes and on speech targets reported in the case study in Experiment 6, also showed continued improvement, with missing dentition rather than phonological processes preventing accurate production of some target sounds.

8.5.2 Letter Knowledge

The impact of the intervention on facilitating participant's letter knowledge was mixed, and exemplifies the variability of the DS phenotype, with letter knowledge strongly and significantly correlated with receptive language measures and negatively correlated with chronological age. Six children learnt some letter names during the intervention with one demonstrating substantial gains, however there was little evidence of any change in letter-sound knowledge, with any development restricted to those three children who already knew some letter sounds. Letter-name knowledge typically precedes letter-sound knowledge (Arrow, 2007; McBride-Chang, 1999; Worden & Boettcher, 1990), with the latter described as similar to a phoneme awareness task requiring access to phonological structure (McBride-Chang, 1999). Not only did letter-name knowledge appear to facilitate letter-sound knowledge for the children in these experiments, it appeared to be pre-requisite at a specific level, with no child able to demonstrate letter-sound knowledge of a letter name they did not know. Large gains in letter knowledge scores at follow-up showed children were able to take advantage of the formal literacy instruction they had received, with mean scores for the children as a group in advance of those reported for the children in Experiment 1, who were of a similar age.

8.5.3 Phonological Awareness

There was little evidence of any immediate effect of the intervention on participant's phonological awareness scores at post-intervention. These results are unsurprising in light of findings which suggest that while early developing but inconsistent phonological awareness can be demonstrated in children with language ages of 2 and 3, more consolidated phonological awareness is apparent after aged 4 (Lonigan et al., 1998). None of the children with DS were yet able to demonstrate language ages at this level at post-intervention. Therefore, while it is conceivable that phonological awareness was being stimulated during the intervention period and that participants had some emergent phonological awareness skill, they had not yet reached mastery of identifying initial sounds in words which limited their transference of knowledge to novel items. There was however, considerable development in phonological awareness evident at follow-up, with half the children achieving above chance scores on the initial phoneme identity with words task. Continued phonological awareness development was demonstrated by Ben, who showed an increasing awareness of the sounds in words, initially with the support of print and latterly through information presented verbally only.

Throughout Experiments 4, 5 and 6, and consistent with the reported literature (Cardoso-Martins et al., 2002; Gombert, 2002; Snowling et al., 2002), rhyme awareness was poor and despite some ceiling scores on some phoneme awareness measures, no child in these experiments was able to demonstrate any awareness of the concepts at any of the assessment times.

8.5.4 Literacy measures

The immediate effect of the intervention on participant's literacy skills was limited. Although five children could decode and three could spell some sounds in words at follow-up, the overall trajectory of change was slow, indicating the follow-up period of two terms provided insufficient time for children to be able to demonstrate transfer of their improved phonological awareness and letter knowledge skills to reading and spelling. Results of the longitudinal study in Experiment 6 reflect a similar pattern, with the greater gains in decoding Ben demonstrated after a full year of schooling providing evidence that his phonological awareness and letter knowledge skills were sufficiently consolidated to enable transfer to reading and spelling of real and non-words.

8.6 Summary of findings

This thesis investigated the spoken and written language development in New Zealand school aged children with DS and examined the home and school literacy environments and their influence on literacy development. The thesis also examined the impact of a specific intervention for pre-school children with DS to facilitate speech and reading development. It can be concluded from the experiments that:

1. Although considerable variability is evident, the spoken and written language profiles of the children contain elements of both delay and disorder, which are persistent throughout the primary school years.

2. Some children are able to demonstrate mastery of phonological awareness and letter knowledge tasks, however, many children are unable to demonstrate these skills and are therefore poorly equipped to become independent readers.
3. The home and school literacy environments of New Zealand children with DS are largely supportive and facilitative of literacy. Homes and schools are typically well resourced and parents and teachers engage in regular literacy activities with the children.
4. An explicit and integrated approach to literacy instruction which includes shared parent and teacher goals, expectations and instructional techniques and a strengthening of the links between home and school, may further enhance literacy development for these children.
5. An integrated phonological awareness intervention is effective in stimulating speech development in children with DS, and in facilitating letter knowledge and phonological awareness in most children.
6. Children with more consolidated phonological awareness and letter knowledge are able to transfer these skills to reading and spelling.
7. The effects of the integrated intervention are able to be maintained and continued over time.

8.7 Clinical Implications

The findings of this thesis have important implications for parents, teachers and speech-language therapists of children with DS. The phenotypic spoken and written language profiles exhibited by the participants in this thesis are well documented in the literature. Nevertheless, language deficits are notoriously persistent and interventions to remediate these deficits are typically domain specific. The findings of the intervention study demonstrate an integrated phonological awareness intervention can be effective in targeting several speech and early literacy related goals simultaneously. The findings, therefore, add to and extend the literature demonstrating the benefits of simultaneously targeting speech, phonological awareness and letter knowledge skills, and making explicit links between spoken and written language domains (Gillon, 2000; 2002; 2005; McNeill et al., in press).

In contrast to a domain specific approach, an intervention which integrates spoken and written language goals provides an effective and efficient alternative to conventional therapy approaches. It is important to note that the intervention benefits on early literacy skills were not at the expense of gains in speech accuracy, with children not only demonstrating enhanced performance on their speech targets, but also showing a reorganisation of their phonological systems, demonstrated by generalisation of improved accuracy to untargeted sounds.

The strong and significant relationships evident between letter knowledge, phoneme awareness and reading reinforces the importance of equipping children with the requisite alphabet and phonological awareness skills that will allow successful decoding experiences, and will ultimately lead to independent reading. Although the children with DS demonstrated the rhyme deficits that have been identified in this population (Gombert, 2002; Snowling et al., 2002), phoneme rather than rhyme skills are associated with improved reading outcomes (Muter et al., 1997; Muter et al., 2004). Therefore, efforts should be dedicated to improving phoneme level awareness skills rather than attempting to remediate this rhyme deficit.

The impact of verbal working memory deficits on phonological awareness in this population, as well as the accuracy with which this awareness is assessed is also clinically important. Ben’s superior scores on the adapted Alliteration Awareness subtest of the PIPA (Dodd et al., 2000) illustrate that assessors must be cognisant of the linguistic and verbal memory demands inherent in standardised phonological awareness assessments, and how these demands may influence a child’s ability to demonstrate their phonological awareness skills.

The examination of the home and school literacy environments of the children with DS revealed that although these environments are predominantly positive, children’s literacy outcomes would be further enhanced by a strengthening of the relationship between the two. The findings also highlighted the need for further research into specific interventions to enhance children’s engagement with literacy and in finding positive and effective ways to address the challenges parents and teachers identified with providing literacy instruction to children with DS.

8.8 Limitations of the current research

The study reported in Experiment 1 aimed to investigate the spoken and written language profiles of New Zealand school-aged children with DS. However, not all aspects of language were investigated. The study would have benefited from further in-depth assessment of children’s semantic and syntactic abilities and their receptive language. The inclusion of non-verbal mental age assessment measures would have contributed to the understanding of the specific language impairment reported in this population (Chapman et al., 1998). Although the relationships between expressive language, phonological awareness, and selected literacy abilities were investigated, the lack of non-word reading and spelling measures limited the extent to which these relationships could be explored.

The major limitation of the studies reported in Experiment 2 and 3, is that the data are based on parental and teacher report. Parents' and teachers' answers may portray a more socially desirable response and as such they may have overstated the measures of literacy engagement in the home and school, and their priorities regarding literacy for their child. Additionally children's reported skills and interests are estimates only and may not be an accurate representation. To address the potential bias, the parent and teacher questionnaire contained a similar set of questions and therefore provided two data sources for each child. However, it may still be that the schools and parents who agreed to participate in the study were those for whom literacy was a higher priority. Finally, although the decile of the schools that participants attended is known, no direct information was gathered on families' socio-economic status or on maternal education.

The use of a multiple single-subject and case-study design in the intervention and follow-up studies allowed for the individualisation of speech targets for the participants, and the inclusion in the study of children with very different receptive and expressive language skills. However, such designs limit the generalisation of the findings, as a single child cannot be claimed to be representative of all children (Portney & Watkins, 2009). Therefore, the external validity of the studies was demonstrated through the replication of the study across ten participants and the inclusion of follow-up assessment.

8.9 Directions for Future Research

There is a need for longitudinal studies which follow children's developing spoken and written language skills from early childhood through to their later primary school years. The results of the follow-up assessment and case-study report identified that intervention effectiveness may not be immediately apparent. Longitudinal investigations would allow for the evaluation of specific early interventions provided within a preventative framework, and given the slower trajectory of development in children with DS, would allow recognition of development not apparent within a shorter time frame. Such studies would necessitate the development of assessment and monitoring tools that were sufficiently sensitive to measure emergent literacy skills in this population and were able to accommodate the cognitive and verbal working memory deficits of the children without compromising the accuracy and validity of the measure.

The findings of this thesis also identified the need for evaluation of home and classroom based interventions which explicitly target the phonological awareness and letter knowledge skills critical for early reading and spelling, with on-going monitoring of these skills essential. The lack of engagement during story reading demonstrated by many children also highlighted the need for interventions to enhance the child's literacy interactions and responsiveness and to maximise the learning and therapeutic outcomes from these interactions. Although the older children in Experiment 1 were typically in classrooms where the focus was on "reading to learn" as opposed to learning to read, few if any of the children had sufficiently advanced literacy skills for this to successfully occur. The benefit of explicit literacy instruction of a longer duration (i.e. earlier *and* later) for children with DS is clearly an area for further investigation.

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Appendix A

Parent Questionnaire

based on the Early Literacy Questionnaire by Boudreau (2005) (from Early Literacy Questionnaire by D.M. 1997, unpublished document, adapted with permission of the author) printed in Boudreau, D. (2005) Use of a parent questionnaire in emergent and early literacy assessment of preschool children. *Language Speech and Hearing Services in Schools, 36*, 1, 33 - 47

Child's Name:______________________________________

Date of Birth:______________________________________

Participant Number__________________________________

Person completing this form:_________________________

Relationship to child:_______________________________

Literacy development in children with Down syndrome

Developing Literacy Questionnaire

This questionnaire is divided into sections with each section containing questions about a different area of early literacy. Please answer as many questions as you can. Children are not expected to have all these skills and may demonstrate skills in some areas and not in others. Questions about earlier developing skills are typically towards the beginning of each section with questions about later developing skills towards the end of each section. Please answer the following questions by circling your response on the scale and filling in information.

Educational Setting

1. Does your child currently receive support in their school? Yes No (please circle one)

2. If yes, please describe the support they receive **and** who provides it. (e.g. CSW 3 hrs per week, teacher aide 4 mornings per week…)

____

____

3. Does your child currently receive speech and language therapy? Yes No (please circle one)

4. If yes, please describe the speech and language therapy they receive **and** who provides it.

____

____

____

Reading Books

5. How often do you read;

- **to** your child? (i.e. parent reads)

  1 2 3 4 5 6

- **with** your child? (i.e. child reads alone or with support)

  1 2 3 4 5 6

Never/rarely Occasionally Weekly Several times/week Daily Several times/day

On average, how many hours per week?___________(to)_____________(with)

Do you have a designated time for reading?______________________________

How many books do you typically read at one sitting?______________________

6. At what age did you begin reading to/with your child?_____(to)______(with)

7. How many books does your child own (approximately)? (please circle one)

0-10 10-25 25-50 50-75 75-100 over 100

8. How many books do you own (approximately)? (please circle one)

0-10 10-25 25-50 50-75 75-100 over 100

9. Does your child **independently** comment on pictures when you read stories together?

1 2 3 4 5 6

Not yet Has but rarely Occasionally A few times/story Often during story Usually

10. Does your child **independently** ask about pictures when you read stories together?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

11. Does your child read books independently?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, what are some of the books she/he reads______________________________

If no, does your child pretend to read the story in a book such as sitting with a book and producing speech that is similar to the actual story in the book?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

Are there specific books she/he will typically do this with? ______________________

12. What are some of your child's favourite books? ____________________________

13. When you read a book with your child he/she knows well, does he/she:

- **say** the next word or line before you read it?.

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

- **read** the next word or line before you read it?.

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

14. Does your child make up stories and tell them?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

15. Does your child bring reading books home from school for home practice?

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

If yes, what are some of the books he/she brings home?_________________________

16. Do you give your child help with his/her reading?

1	2	3	4	5	6
Never	Have but rarely	Occasionally	Weekly	Several times/week	Daily

If yes, what sort of help do you give him/her?_________________________________

17. Does your child ask questions about characters or events during story reading?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

18. In comparison to other activities, how would you rate your child's interest in books?

1	2	3	4	5	6
Least Favourite activity					Favourite activity

19. In comparison to other classroom activities, how important do you rate reading instruction for your child?

1	2	3	4	5	6
Not important activity					Most important activity

20.What do you enjoy most about reading with your child?_____________________

____

____

Response to Print

21. Do you point out signs and words such as restaurant names and street signs to your child (e.g. McDonalds, Main Street, Westfield etc)?

1	2	3	4	5	6
Never	Have but rarely	Occasionally	Weekly	Several times/week	Daily

22. Do you receive any published reading material at home such as newspaper, magazines etc?

If yes, which ones? ____

23. Does your child:

- **pretend to read** adult reading material (e.g. newspaper, TV guide, magazine etc.)?

1	2	3	4	5	6
Never	Have but rarely	Occasionally	Weekly	Several times/week	Daily

- **read or attempt to read** adult reading material (e.g. newspaper, TV guide, magazine etc.)?

1	2	3	4	5	6
Never	Have but rarely	Occasionally	Weekly	Several times/week	Daily

24. Does your child recognise his or her own name?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	Often	Usually	Always

25. Does your child identify words in the environment (such as WEETBIX, McDonalds, BNZ, etc.) in your environment **by him- or herself?**

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

When does this occur?____

What signs or words does your child know?_____________________________

____

26. Does your child ask what printed words say, such as signs on the street or words on food packets?

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

27. Does your child read any words by sight (or common words they have memorised and can identify, such as Mum, cat, etc.)?

1	2	3	4	5	6
Not yet	Has but rarely	Knows a words	A few words	Several words	Many words

Language Awareness

28. Do you play language games with your child such as rhyming games, e.g."I spy"?

1	2	3	4	5	6
Never	Have but rarely	Occasionally	Weekly	Several times/week	Daily

If yes, what sort of games do you play?______________________________________

____

Can your child rhyme with real or made up words?______________________________

29. Does your child try and play rhyming games with you or others?

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

30. Does your child tell rhymes such as nursery rhymes, skipping rhymes, or playground chants?

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

What are some of the rhymes he/she knows?____________________________________

31. Does your child sing simple or popular songs?

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

What are some of her/his favourites?______________________________________

Interest in Letters

32. Does your child recognise letters of the alphabet? (such as pointing to the letter "A" when you ask him/her to?)

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	Often	Usually	Always

If yes, which letter names does he/she know? _______________________________

33. Do you attempt to teach the names of letter in the alphabet and/or alphabet sounds:

- when reading?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

- during other activities?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

OR

- my child knows all the <u>letter names</u> and <u>letter sounds</u> (please circle)

34. Does your child recognise and/or attempt to make sounds for alphabet letters?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	Often during story	Usually	Always

If yes, which letter sounds does he/she know? ______________________________

Writing

35. Does your child draw?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week	Daily	Several times/day

36. Does your child attempt to write **letters** of the alphabet?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week	Daily	Several times/day

37. Does your child attempt to write **words** (such as their own name, sequences of letters)?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week	Daily	Several times/day

38. Does your child ask you to write for him/her?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week	Daily	Several times/day

39. Does your child write or attempt to write stories that have meaning for her/him?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week	Daily	Several times/day

If yes, what sort of stories does she/he write (e.g. sequences of letters, attempts at words, recognisable words)?____

What sort of topics does she/he write about?___________________________________

40. Does your child ask for help with his/her writing?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week	Daily	Several times/day

If yes, what sort of help do you give him/her? __________________________________

41. Does your child bring written tasks for homework?

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

If yes, what are some of the written tasks she/he brings home?__________________

____

42. What writing equipment does your child enjoy using (crayons, chalk, felt pens, pens, scrap book, etc)?____

____

Television/Computer

43. Does your child watch video/DVD stories on a VCR/DVD? (e.g. Lion King or other stories)

1	2	3	4	5	6
No	Occasionally	Weekly	Several times/week	Daily	Several times/day

How many hours per week does she/he watch them? ____________________________

Does your child own any stories on video/DVD, and if so, which ones?

____

____

44. Does your child watch TV? ____

1	2	3	4	5	6
No	Occasionally	Weekly	Several times/week	Daily	Several times/day

How many hours per day? ____

What is the show watched most frequently? __________________________________

45. Does your child go to the library to select books?

1	2	3	4	5	6
Never	Rarely	Every few months	Monthly	Fortnightly	Weekly

46. Do you have a computer at home? Yes No

If so, does your child use it? Yes No

Average number of hours per week? ______________________________________

What computer programmes does he/she enjoy? _____________________________

____

47. Do you discuss your child's reading and writing with his/her classroom teacher/teacher-aide?

1	2	3	4	5	6
Never	Rarely	Every few months	Monthly	Fortnightly	Weekly

48. Are there challenges to do with reading and writing for your child?

If yes, please describe what the challenges are, as well as ways you find to manage them.

____

____

____

49. What do you rate as the most important skill/s for your child to learn at school? (e.g. reading, writing, maths, social skills, physical education, arts and crafts, music…)

Please list them in order of importance ____________________________________

____

____

If you have any further comments you would like to make please do so here.

____

____

____

____

____

Thank you very much for completing this questionnaire.

Appendix B

Teacher Questionnaire

based on the Early Literacy Questionnaire by Boudreau (2005) (from Early Literacy Questionnaire by D.M. 1997, unpublished document, adapted with permission of the author) printed in Boudreau, D. (2005) Use of a parent questionnaire in emergent and early literacy assessment of preschool children. *Language Speech and Hearing Services in Schools, 36*, 1, 33 - 47

Child's Name:____________________________________

Date of Birth:____________________________________

Participant Number:______________________________

Person completing this form:________________________

Position:____

Name of School:____________________________________

Contact details:____________________________________

Literacy development in children with Down syndrome

Developing Literacy Teacher Questionnaire

This questionnaire is divided into sections with each section containing questions about a different area of early literacy. Please answer as many questions as you can. Children are not expected to have all these skills and may demonstrate skills in some areas and not in others. Questions about earlier developing skills are typically towards the beginning of each section with questions about later developing skills towards the end of each section. Please answer the following questions by circling your response on the scale and filling in information.

Educational Setting

1a) Does your pupil participate in a mainstream classroom /school setting? Yes No

If yes, approximately what proportion of the average school day does this occur

100% 80% 60% 40% 20% <20%

b) Does your pupil participate in a satellite classroom/ school setting? Yes No

If yes approximately what proportion of the average school day does this occur

100% 80% 60% 40% 20% <20%

c) Does your pupil attend a special school? Yes No

d) If none of these options appropriately apply to your pupil, **please describe** their situation here (e.g satellite class for maths, mainstream class for reading, finishes school at 2 pm)____

____

Towards Independent Reading (reading <u>by</u> the child)

2. Does your pupil participate in activities relating to reading instruction in the classroom?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, please describe what activities he/she participates in and the length of time he/she remains engaged. ____

____

____

If yes, on average, how many hours per week?__________________________________

If yes, what is the format of these activities relating to reading instruction? (circle all those that apply)

Individual small group large group

3. Are there activities related to reading instruction your pupil does not participate in?
Yes No

If yes, please list them here.____

____

4. Do you have a designated time for activities relating to reading instruction?

Yes No

If yes, please describe.____

5. Does your pupil read books independently?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, what are some of the books she/he reads?______________________________

____

If no, does your pupil pretend to read the story in a book, such as sitting with a book and producing speech that is similar to the actual story in the book?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

Are there specific books she/he will typically do this with?______________________

6. Does your pupil take reading books home from school for home practice?

1	2	3	4	5	6
Never	Has but rarely	Occasionally	Weekly	Several times/week	Daily

If yes, what are some of the books he/she takes home?_________________________

7. Does your pupil receive extra help with his/her reading at school?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, what sort of help does she/he receive?_________________________________

____

If yes, who provides this support?____

8. Are there challenges providing reading instruction for this pupil? Yes No

If yes, please describe what the challenges are, as well as ways you find to manage them.____

____

____

____

Shared Reading (reading <u>to/with</u> the child)

9. Does your pupil participate in activities relating to shared reading in the classroom?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

10. Does your pupil independently point to or ask about pictures during shared reading?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

11. Does your pupil ask questions about characters or events during shared reading?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	A few times/story	Often during story	Usually

12. Please describe any other ways your pupil participates in shared reading________

____

13. Do you have a designated time for shared reading activities in the classroom?
Yes No
If yes, please describe.____

14. How many books are typically read at one sitting? __________________________

15. Are there challenges related to shared reading in the class room with this pupil?
Yes No

If yes, please describe what the challenges are as well as ways you find to manage them.

____

____

____

Writing

16. Does your pupil recognise letters of the alphabet? (such as pointing to the letter "A" when you ask him/her to?)

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	Often	Usually	Always

If yes, which letter names does he/she know? ________________________________

17. Do you attempt to teach the names of letter in the alphabet and/or alphabet sounds:

- when reading?

1	2	3	4	5	6
Not yet	Have but rarely	Occasionally	A few times/story	Often during story	Usually

- during other activities?

1	2	3	4	5	6
Not yet	Have but rarely	Occasionally	Few times/story or activity	Often during story or activity	Usually

Please describe these activities____

____

____

18. Does your pupil recognise and/or attempt to make sounds for alphabet letters?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	Often	Usually	Always

If yes, which letter sounds does he/she know? _______________________________

19. Does your pupil participate in activities relating to writing activities in the classroom?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, please describe what activities he/she participates in and the length of time he/she remains engaged. ____

____

____

If yes, on average, how many hours per week?______________________________

20. Are there activities related to writing instruction your pupil does not participate in?

Yes No

If yes, please list them here.____

____

21. Does your pupil draw?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week.	Daily	Several times/day

22. Does your pupil attempt to write letters of the alphabet?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week.	Daily	Several times/day

23. Does your pupil attempt to write words (such as their own name, sequences of letters)?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week .	Daily	Several times/day

If yes, please describe____

24. Does your pupil ask you to write for her/him?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week.	Daily	Several times/day

25. Does your pupil write or attempt to write stories that have meaning for him/her?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, what sort of stories does he/she write (e.g. sequences of letters, attempts at words, recognisable words, sentences…?______________________________________

____

What sort of topics does he/she write about?___________________________________

____

26. Does your pupil receive extra help with her/his writing at school?

1	2	3	4	5	6
Not yet	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, what sort of help does she/he receive?__________________________________

____

If yes, who provides this support?____

27. Does your pupil take written tasks for homework?

1	2	3	4	5	6
Not yet	Has but rarely	Occasionally	Weekly	Several times/week	Daily

If yes, what are some of the written tasks he/she takes home?____________________

____

28. Are there challenges providing writing instruction for this pupil? Yes No

If yes, please describe what the challenges are as well as ways you find to manage them.____

____

____

____

____

Spelling

29. Does your pupil participate in activities relating to spelling instruction in the classroom?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

If yes, please describe what activities he/she participates in and the length of time she/he remains engaged. ____

____

____

If yes, on average, how many hours per week?________________________________

If yes, what is the format of these activities relating to spelling instruction? (circle all those that apply)

Individual small group large group

30. Are there activities related to spelling instruction your pupil does not participate in? Yes No
If yes, please list them here.____

____

31. Do you have a designated time for activities relating to spelling instruction?
Yes No
If yes, please describe.____

32. Does your pupil ask you how to spell words?

1	2	3	4	5	6
Never/rarely	Occasionally	Weekly	Several times/week.	Daily	Several times/day

33. Are there challenges providing spelling instruction for this pupil? Yes No
If yes, please describe what the challenges are as well as ways you find to manage them.____

____

____

____

34. Do you have a computer in the classroom? Yes No

If so, does your pupil use it? Yes No

Average number of hours per week? ______________________________________

What computer programmes does he/she enjoy? _____________________________

____

If you have any further comments you would like to make please do so here.

____

____

____

____

____

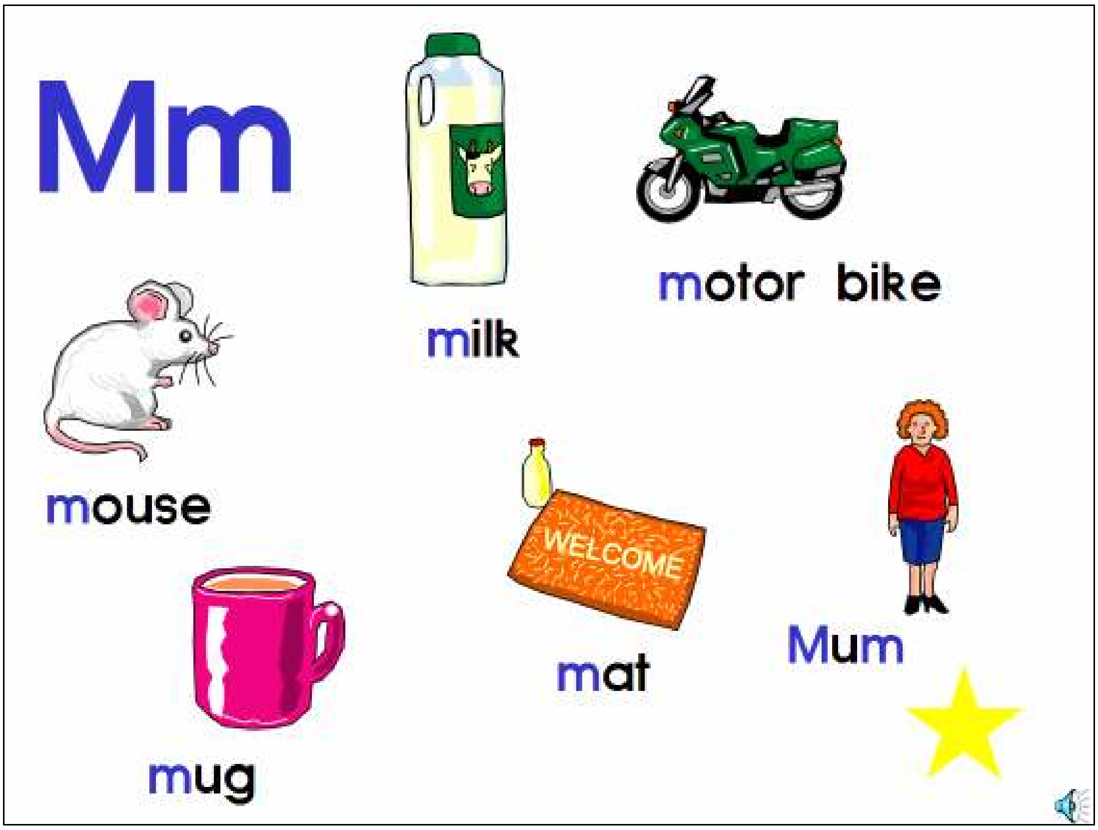
____

Thank you very much for completing this questionnaire.

Appendix C

Screen shot of intervention computer activity

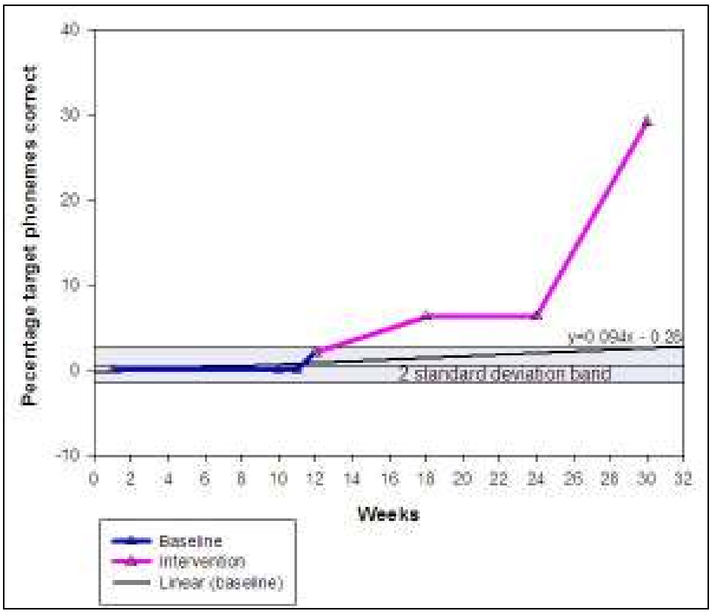
(described in Chapter 5)



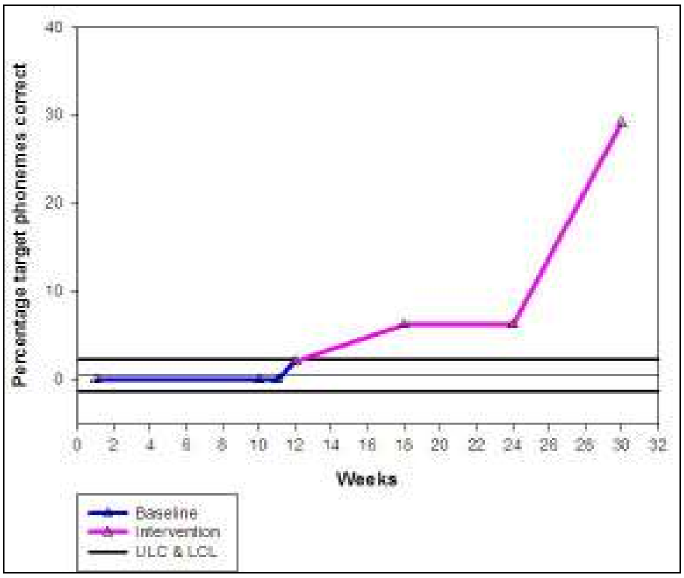
Appendix D

Participants' speech sound target results

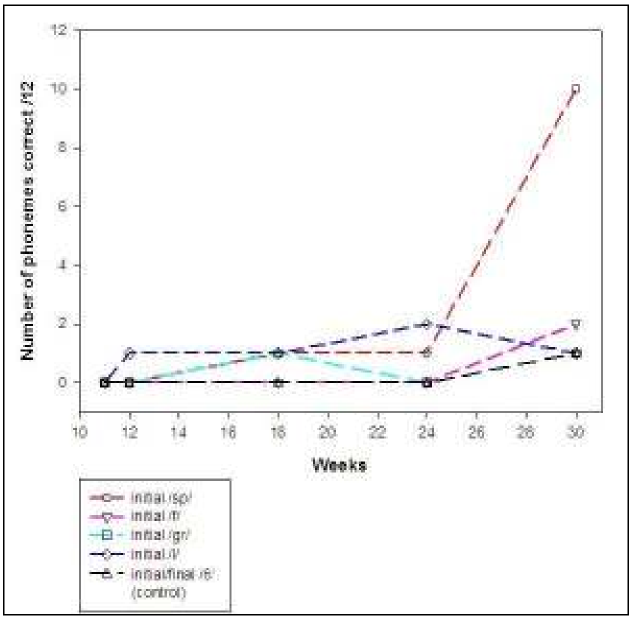
Two Standard Deviation Band, Statistical Process Control (where appropriate) and individual speech sound target graphs



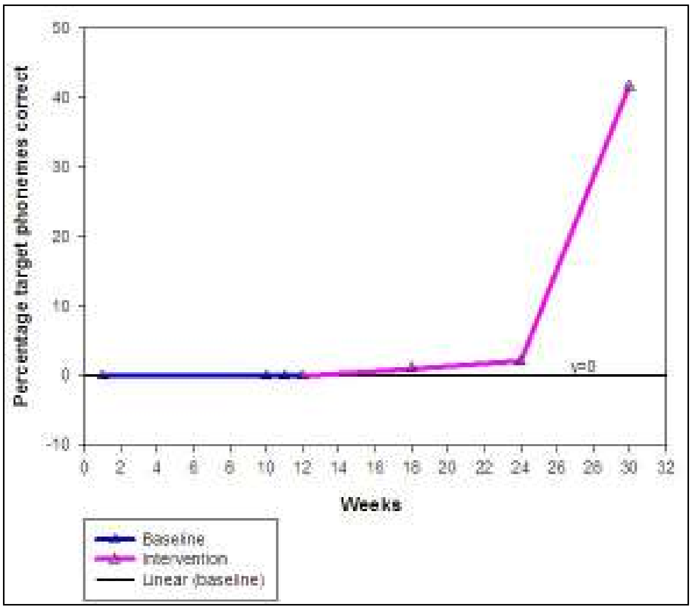
Participant 1. Speech sound targets using 2 Standard Deviation Band analysis



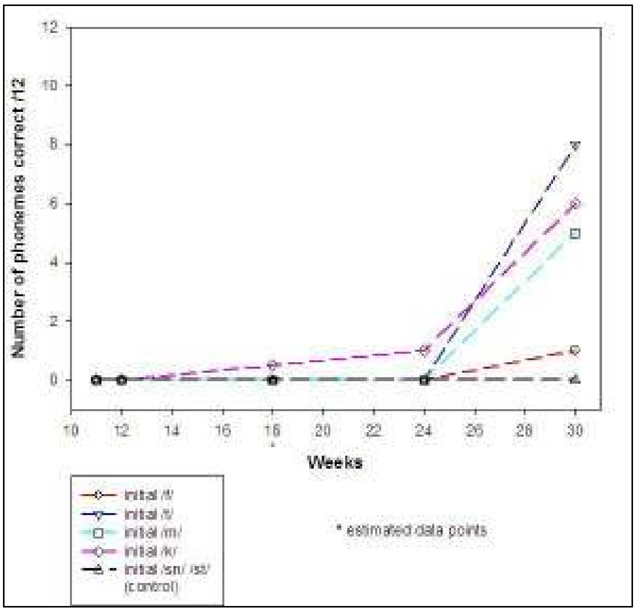
Participant 1. Speech sound targets using Statistical Process Control analysis



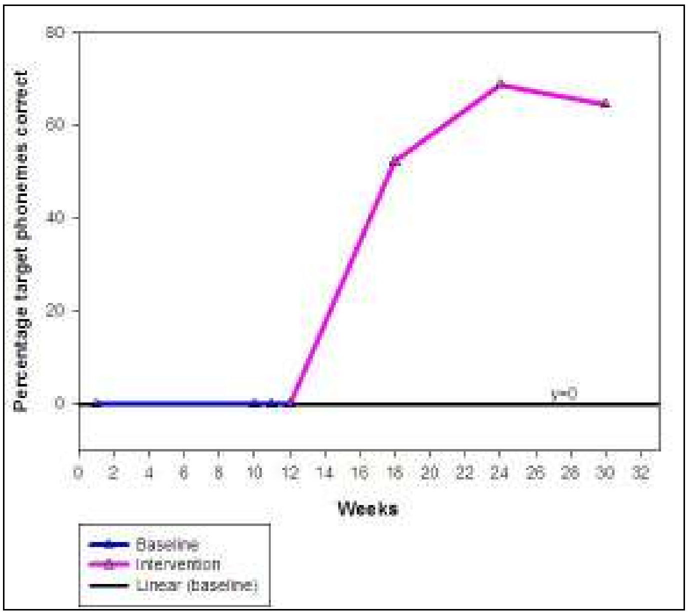
Participant 1. Individual speech sound targets



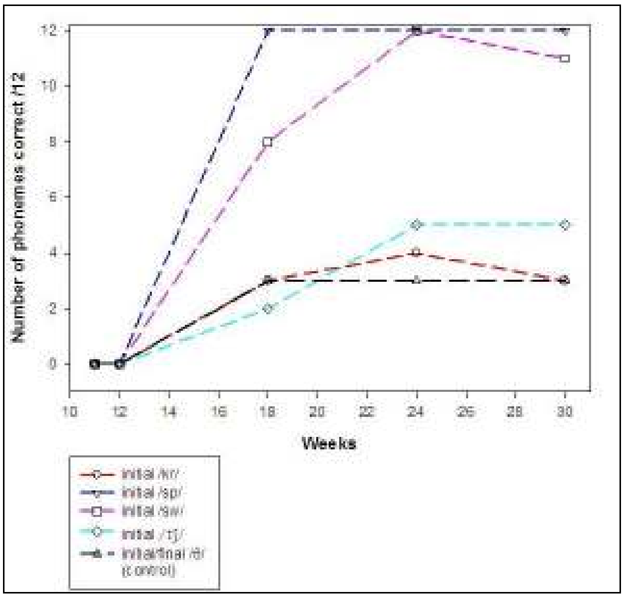
Participant 2. Speech sound targets using 2 Standard Deviation Band analysis



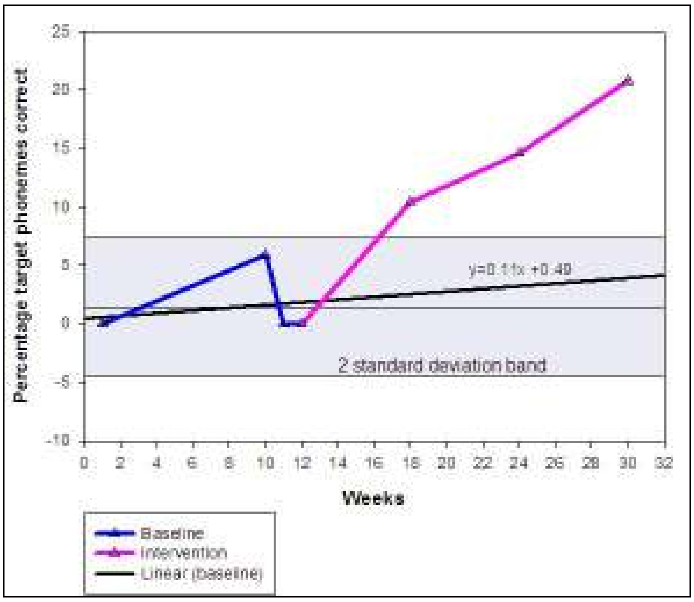
Participant 2. Individual speech sound targets



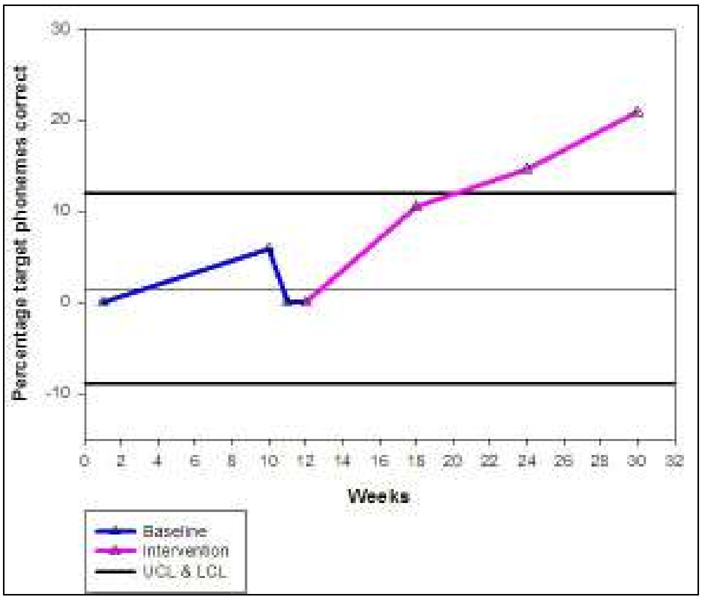
Participant 3. Speech sound targets using 2 Standard Deviation Band analysis



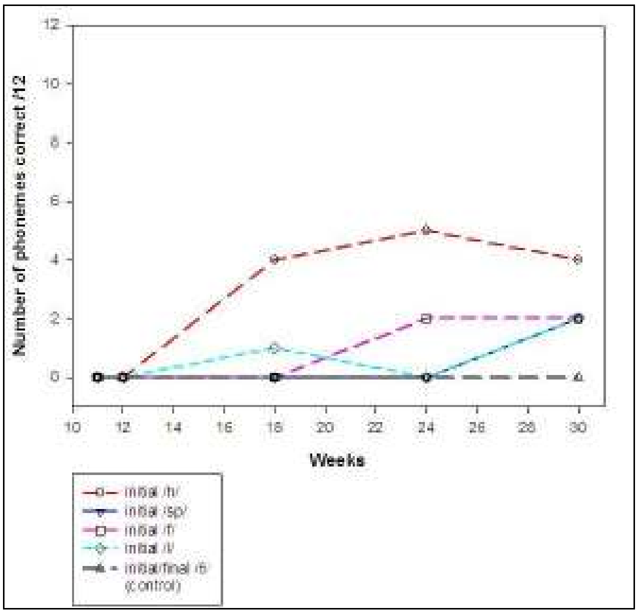
Participant 3. Individual speech sound targets



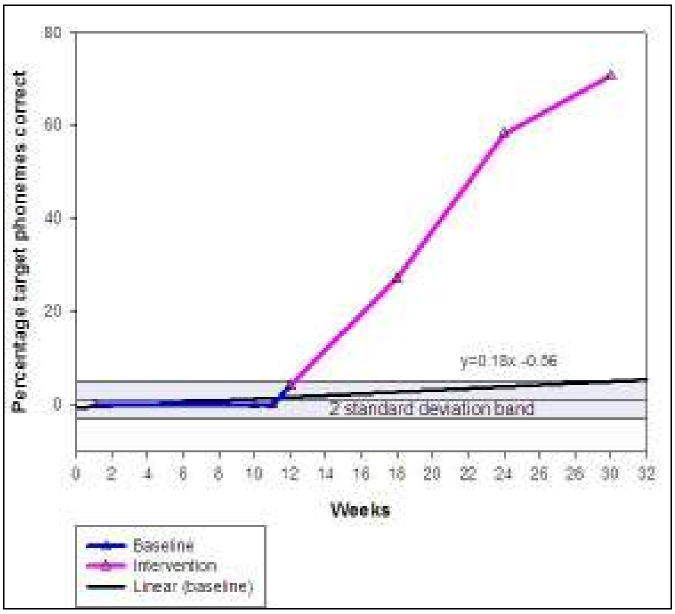
Participant 5. Speech sound targets using 2 Standard Deviation Band analysis



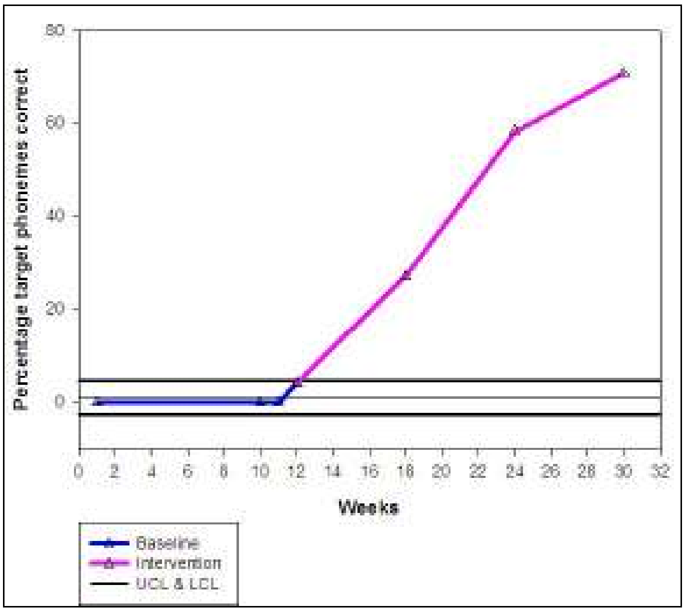
Participant 5. Speech sound targets using Statistical Process Control analysis



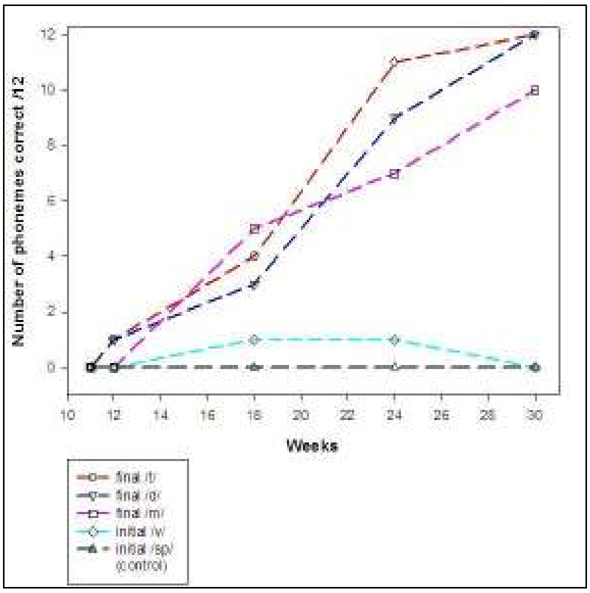
Participant 5. Individual speech sound targets



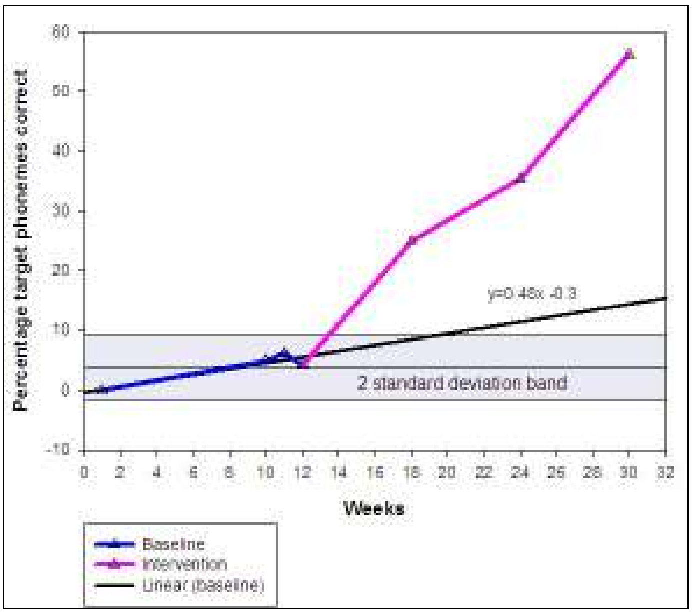
Participant 6. Speech sound targets using 2 Standard Deviation Band analysis



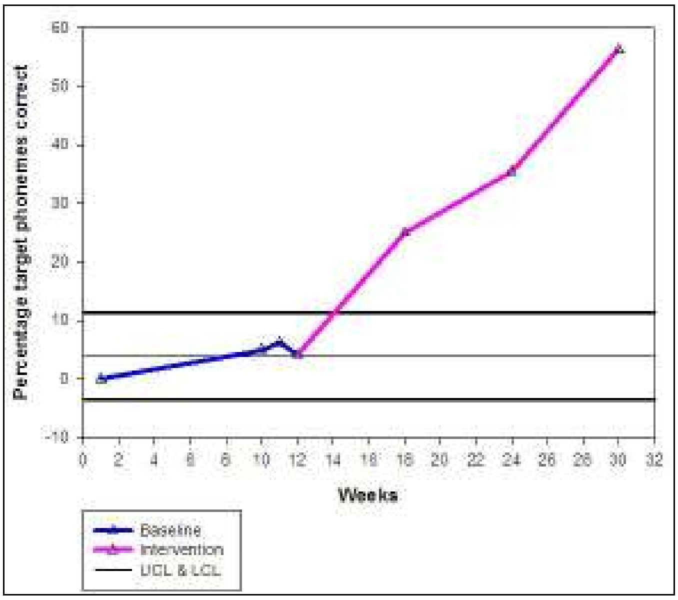
Participant 6. Speech sound targets using Statistical Process Control analysis



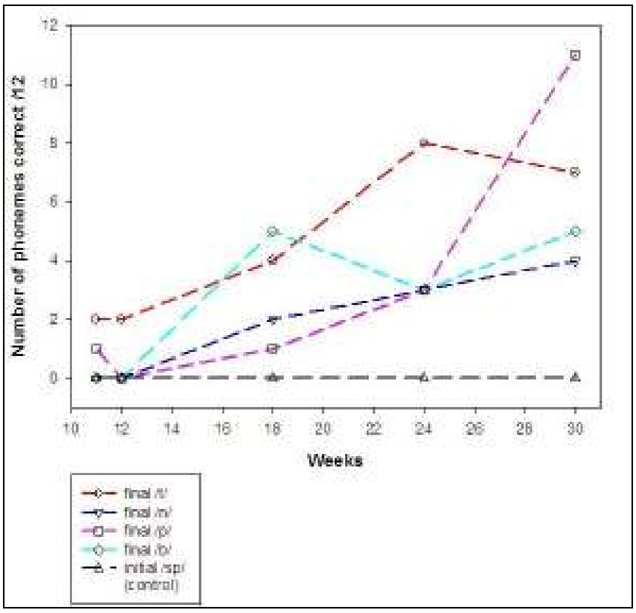
Participant 6. Individual speech sound targets



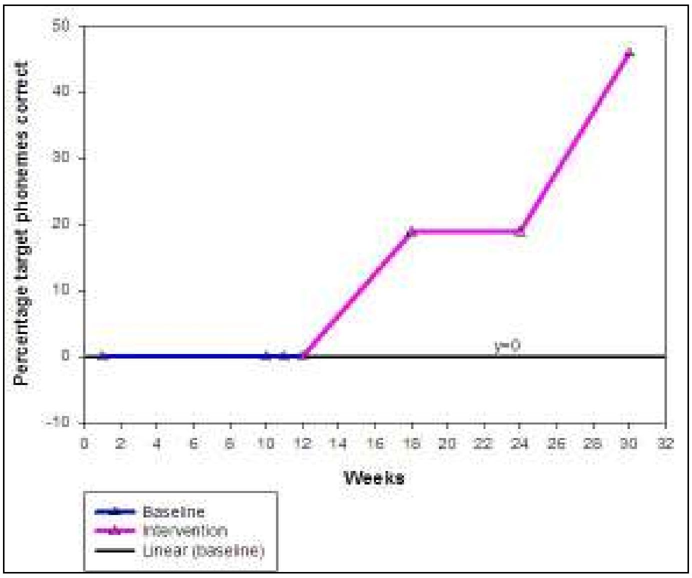
Participant 7. Speech sound targets using 2 Standard Deviation Band analysis



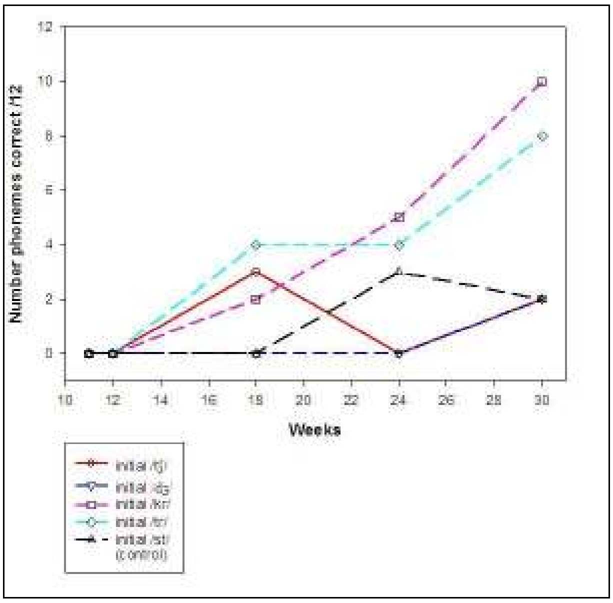
Participant 7. Speech sound targets using Statistical Process Control analysis



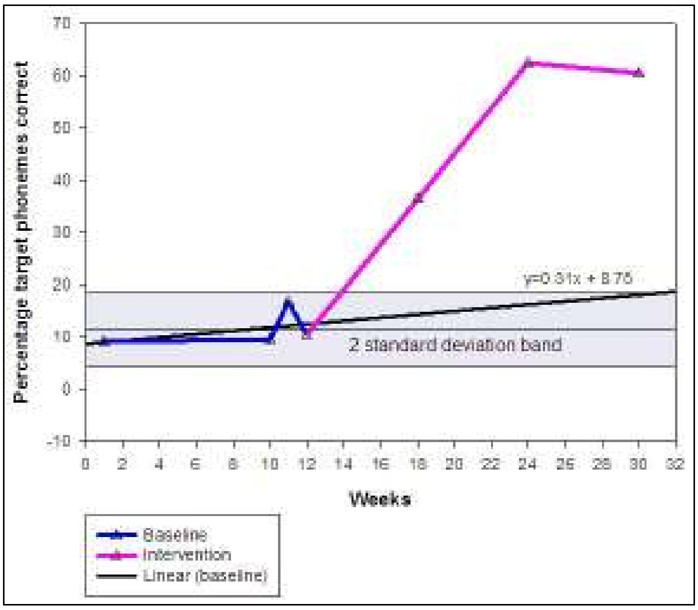
Participant 7. Individual speech sound targets



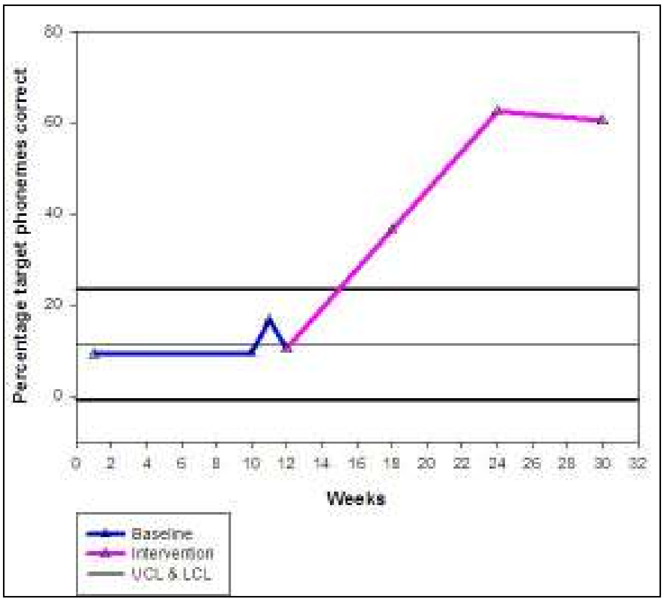
Participant 8. Speech sound targets using 2 Standard Deviation Band analysis



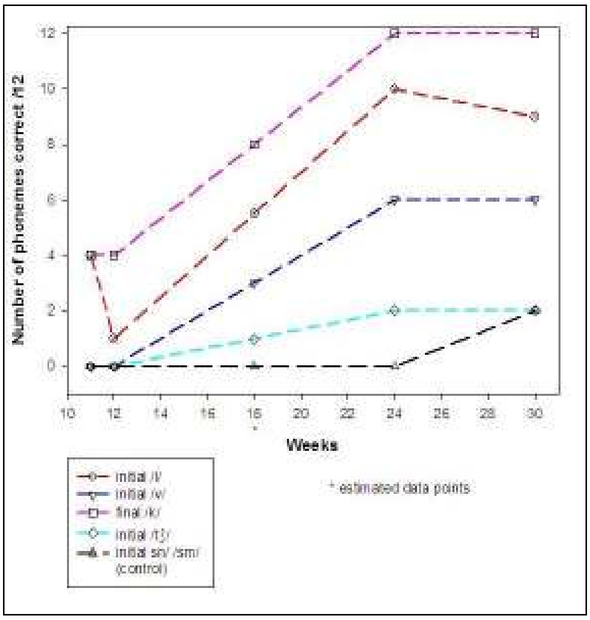
Participant 8. Individual speech sound targets



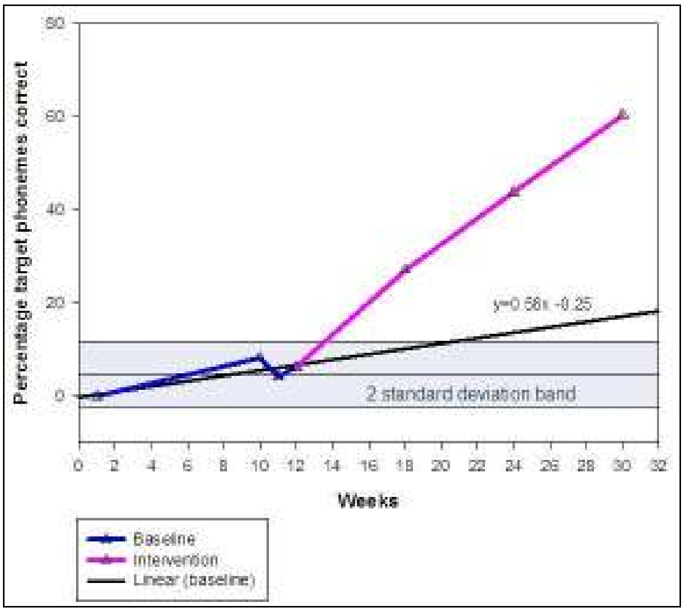
Participant 9. Speech sound targets using 2 Standard Deviation Band analysis



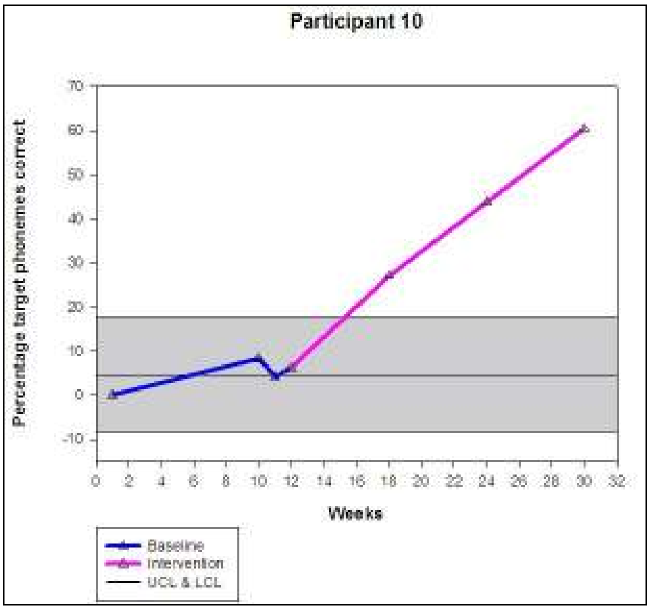
Participant 9. Speech sound targets using Statistical Process Control analysis



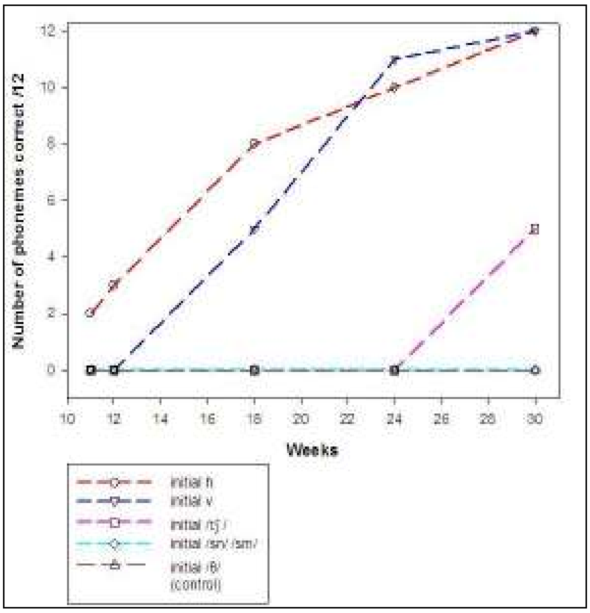
Participant 9. Individual speech sound targets



Participant 10. Speech sound targets using 2 Standard Deviation Band analysis



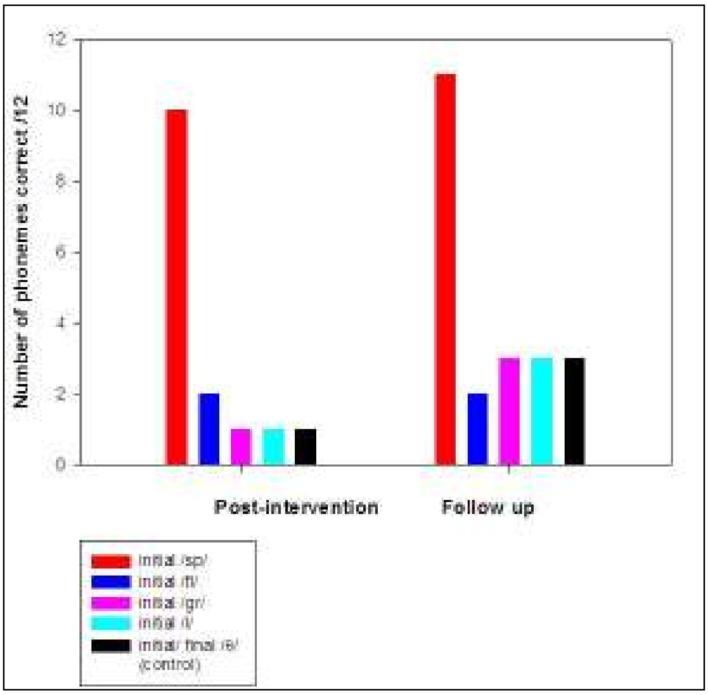
Participant 10. Speech sound targets using Statistical Process Control analysis



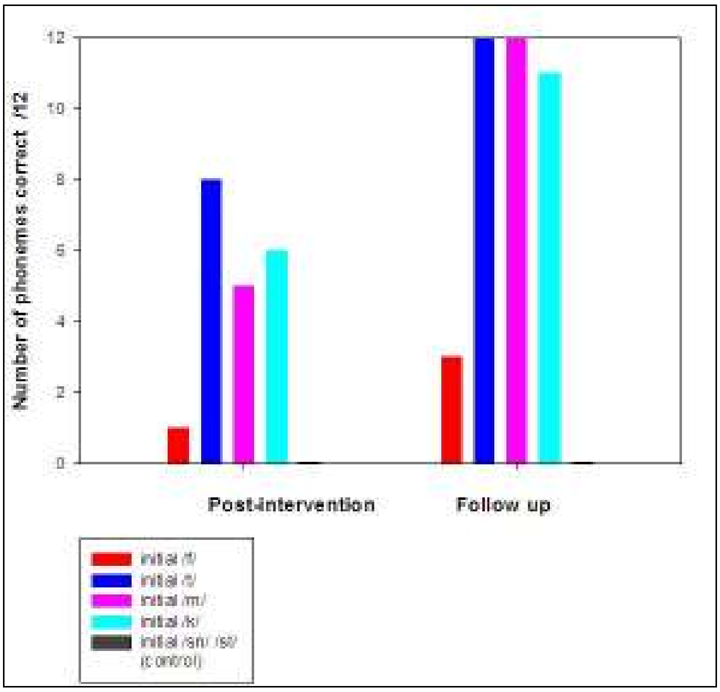
Participant 10. Individual speech sound targets

Appendix E

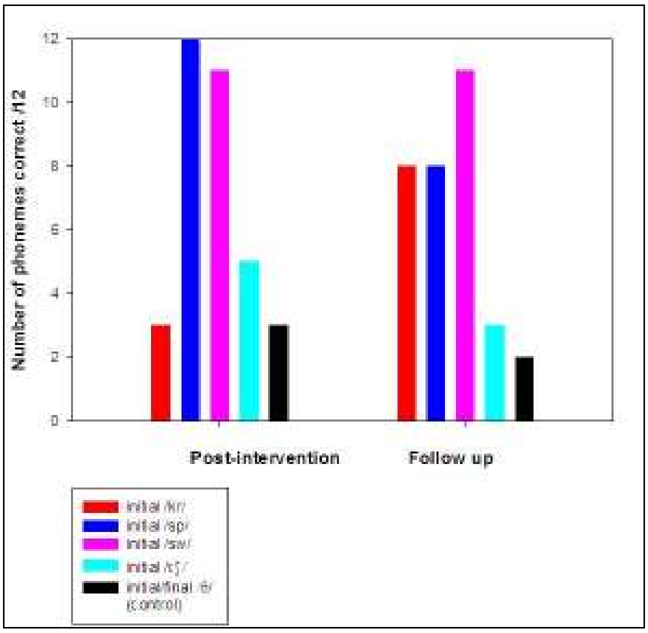
Participants' individual speech sound target graphs post-intervention and follow-up



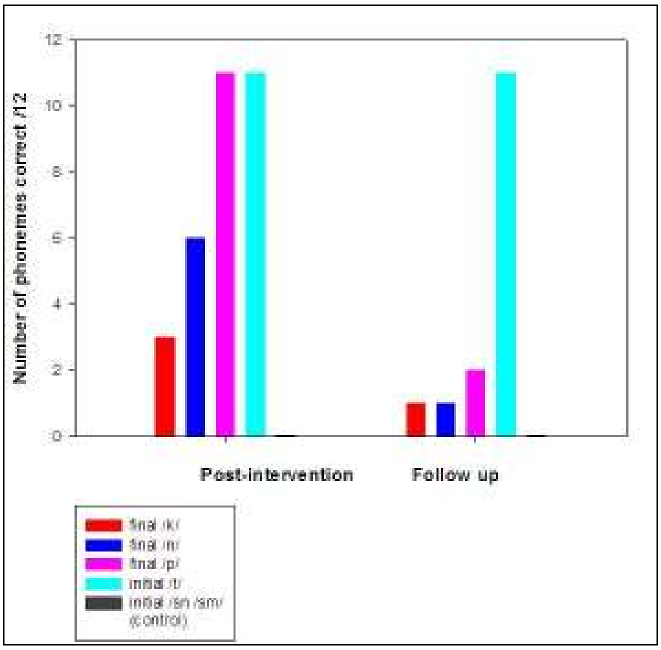
Participant 1. Individual speech sound targets post-intervention and follow-up



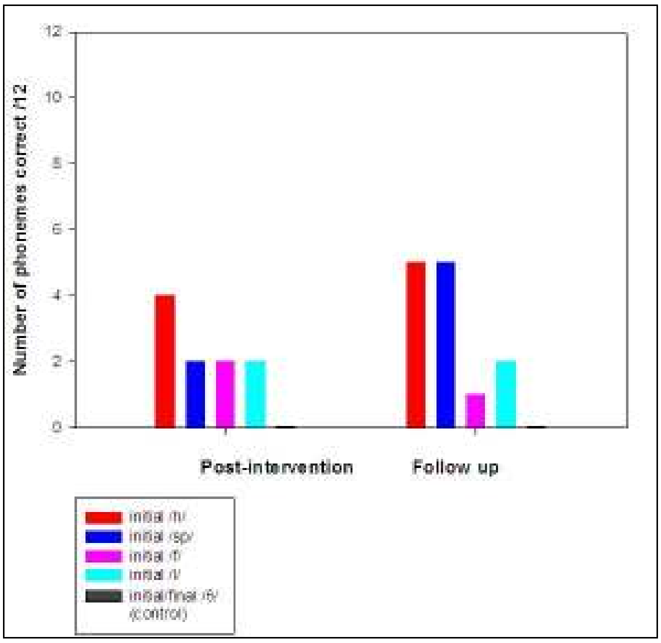
Participant 2. Individual speech sound targets post-intervention and follow-up



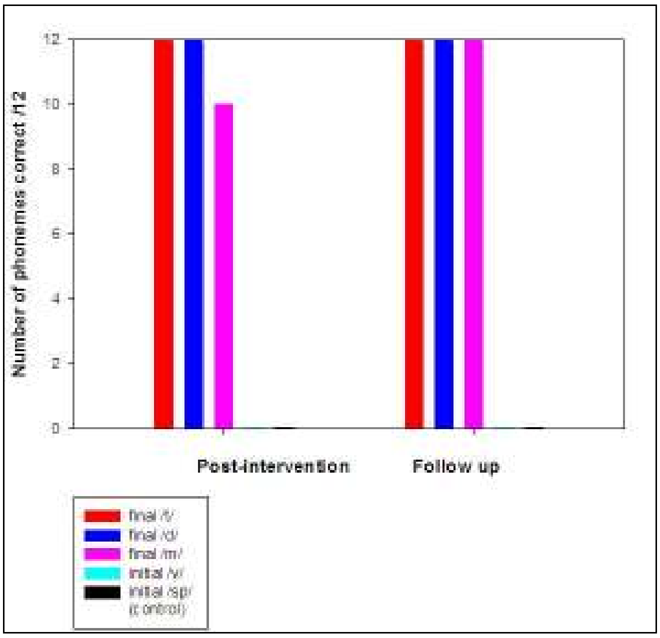
Participant 3. Individual speech sound targets post-intervention and follow-up



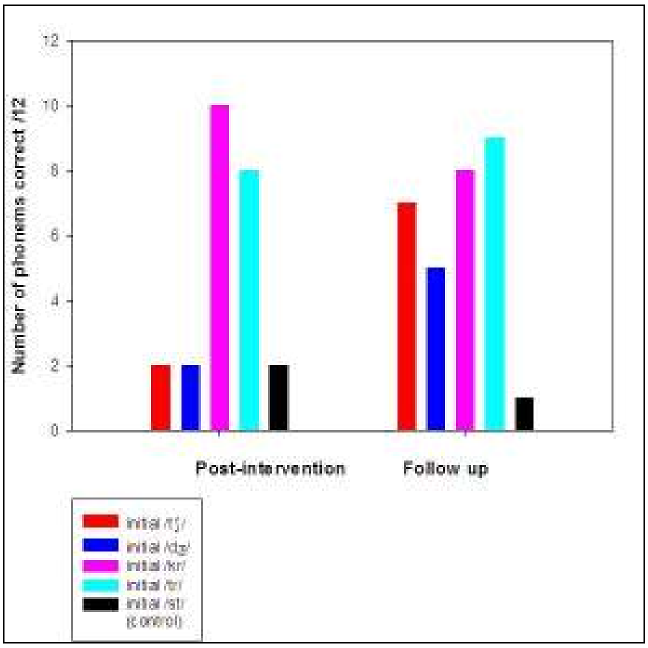
Participant 4. Individual speech sound targets post-intervention and follow-up



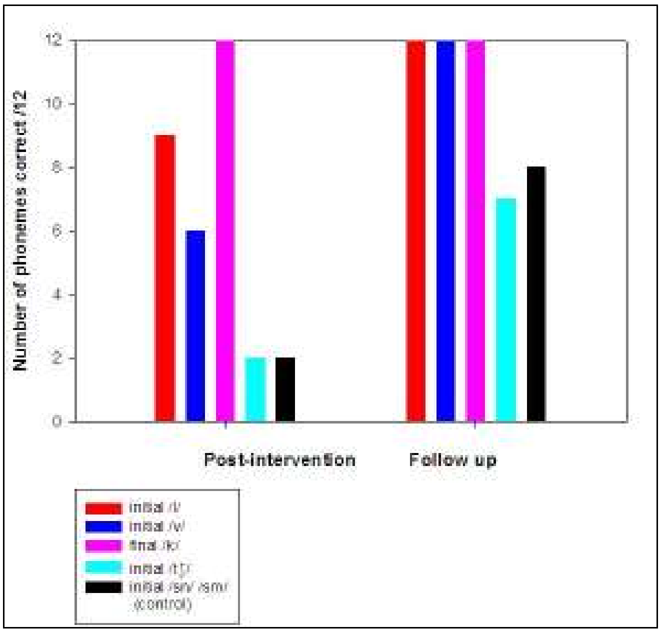
Participant 5. Individual speech sound targets post-intervention and follow-up



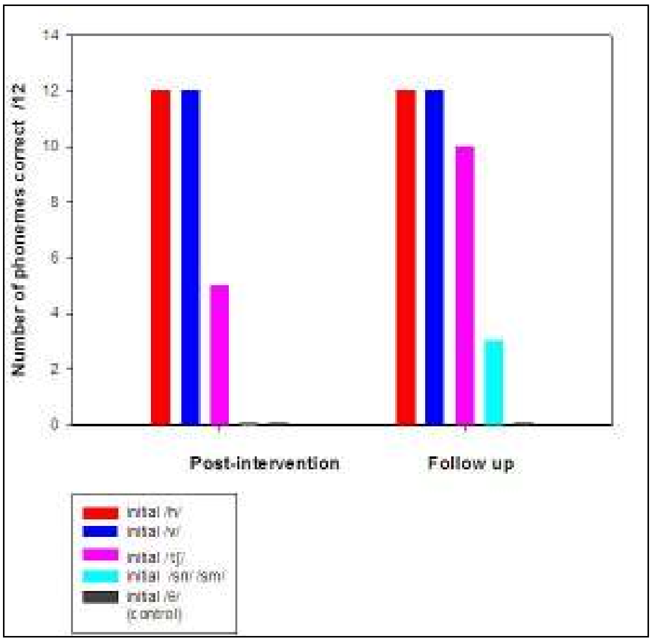
Participant 6. Individual speech sound targets post-intervention and follow-up



Participant 8. Individual speech sound targets post-intervention and follow-up



Participant 9. Individual speech sound targets post-intervention and follow-up



Participant 10. Individual speech sound targets post-intervention and follow-up

Appendix F

University of Canterbury Human Ethics Committee

approval to conduct research

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Ref: HEC 2005/82

12 September 2005

Anne van Bysterveldt
Communication Disorders
UNIVERSITY OF CANTERBURY

Dear Anne van Bysterveldt

The Human Ethics Committee advises that your research proposal "Reading instruction methods, phonological awareness and reading skills of New Zealand children with Down syndrome." has been considered and approved.

Yours sincerely

Dr Alison Loveridge
Chair, Human Ethics Committee