Building Decoding Fluency

A dissertation
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of the requirements for the Degree
of
Master of Education
in the University of Canterbury
by
Julia Nixon

University of Canterbury, New Zealand
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ABSTRACT

It has been recognised for many years that competent reading occurs only after a number of component skills have been mastered. Many studies propose that a lack of phonemic awareness underpins many of the difficulties children experience in learning to read. A recent study, however, has suggested that 8 to 9-year old children who are struggling with reading may be hampered more by poor decoding fluency rather than by inadequate phonemic awareness. While many component skills of reading have been the focus of research, there is scant research into interventions designed to build decoding fluency directly. The present experiment attempted to increase decoding fluency in five, eight and nine-year old low-progress readers using direct teaching techniques. In addition, the project aimed to ascertain how long it would take to build decoding fluency and, once increased, whether the improvement would generalise to faster prose reading. Analysis of the results showed that it is possible to build decoding fluency directly and that faster decoding generalises to faster prose reading. These findings have significant implications for both the diagnosis of reading difficulties in eight and nine-year old children and the teaching of children who are having difficulty in learning to read.
CHAPTER 1

INTRODUCTION

A child who cannot read, or who experiences difficulties with reading, is likely to struggle with all areas of the curriculum and fail to meet their academic potential. Reading, however, is not just an individual problem; “the social, economic and cultural costs of illiteracy are high” (NZ Education and Science Committee, 2001).

Learning to read involves the acquisition of several, complex component skills. Children need to develop an adequate oral vocabulary, gain familiarity with the concepts of print, learn to discriminate between and recognise the letters of the English alphabet (letter knowledge), and learn to discriminate between the 40 or so English languish phonemes, that is, to develop phonemic awareness. Children must also acquire letter-sound knowledge, that is, a knowledge of the predictable relationships that exist between graphemes (letters or groups of letters) and phonemes (speech sounds) and must acquire the ability to apply this knowledge when decoding unfamiliar text. In addition, the beginning reader needs to become fluent in decoding and in reading connected prose so that he or she comprehends what has been read (Gelzheiser & Clark, 1991).

In sum, the act of learning to read can be conceptualised as a series of stages. Each stage is cumulative, that is, it builds upon previously acquired stages, so that a failure to master any of the earlier skill components is likely to hinder or prevent progression to the next stage (Adams, 1990; Chall, 1983). A child who falls behind in the early stages of learning to read may begin to lose confidence and motivation. As a consequence, their degree of participation in reading activities may reduce with the result that the gap between their reading achievement and that of their peers widens increasingly over time, a phenomenon known as the Matthew Effect (Stanovich, 1986).
Research into early reading acquisition suggests that the component skills that underpin decoding fluency are letter knowledge, phonemic awareness and letter-sound knowledge (Adams, 1990; Pikulski & Chard, 2003). As stated by Chard, Pikulski & Templeton (2000, p. 3), “concepts of print and letter recognition deal with the visual dimensions of language.” As pre-school children acquire an oral vocabulary, learn to recognise letters and gain familiarity with basic ‘rules’ of print (such as awareness that text is read from left to right), they are developing the initial component skills of reading. Pre-school familiarity with print concepts, ready letter recognition and rapid letter naming have all been shown to be of importance for reading development during the junior school years. For example, fast letter naming by 5 and 6-year old Kindergarten and Grade 1 children has been found to be predictive of later reading achievement (Speer & Lamb, 1976; Walsh, Price & Gillingham, 1988). In addition, Biemiller (1977-1978) found that readers who could identify words in hard passages (able readers) typically identified simple text at a “much faster” rate than did struggling readers. Being print wise appears also to positively influence initial reading progress (Bond & Dykstra, 1967). Although most children have a level of oral language development sufficient for early reading activities, levels of knowledge of print concepts, letter recognition and letter recognition speed varies considerably between children upon entry to school (Juel, 1988).

Around the time that they enter formal education, children are beginning to acquire phonemic awareness (Adams, 1990; Chard et al., 2000; Liberman, Shankweiler, Fischer & Carter, 1974). Phonemic awareness refers to the ability to aurally discriminate between the (approximately) 41 sounds (phonemes) of the spoken form of the English language. Good levels of phonemic awareness on entry to first grade have been found to distinguish good readers from poor readers at the end of the first grade (first year of schooling) and has been recognised as a critical component of learning to read (Adams 1990, National Reading Panel,
2000). Tasks which measure this skill include being able to segment, blend and manipulate phonemes in syllables and words that are spoken aloud (Gelzheiser & Clark, 1991, National Reading Panel, 2000).

By the end of their first year of schooling the majority of children will have acquired adequate levels of phonemic awareness and will be in the initial stages of learning to decode, a process that usually continues until the end of Grade 2 (Liberman et al., 1974). Decoding begins with the acquisition of letter-sound knowledge, the ability to relate the phonemes, or sounds, in speech to their corresponding graphemes or segment of text (Gelzheiser & Clark, 1991). According to Adams (1990), there are in excess of 200 graphemes in written English of which approximately 110 are used most frequently. Of these, between 7 and 35 are explicitly taught in phonics oriented early reading programmes (Adams, 1990).

Initially, decoding occurs letter by letter (until the imperfect relationships between letters and sounds become familiar) before blending the sounds together (Adams, 1990; Chard et al., 2000). Consequently, reading is slow and laborious. With experience and practice, by around Grade 2 or 3 many letters and letter groups are recognised automatically. As a result, decoding fluency increases and children are able to decode many unfamiliar words without assistance (Gelzheiser & Clark, 1991).

As reading skills develop, the beginner reader builds a repertoire of sight words that can be read instantly. Adams (1990) states that “skilled readers...demonstrate remarkable speed and facility in recognizing whole familiar words.” As expected, oral reading fluency increases as the child progresses through school. By the end of the second year of school the average child can read age appropriate levels of text at about 90 correct words per minute (CWPM). By the end of the third year, CWPM should have lifted to approximately 110 and at the end of the fourth year to around 120 CWPM (Hasbrouck & Tindal, 1992).
The importance of reading fluency in learning to read and read well, is firmly established (e.g. Gelzheiser & Clark, 1991; National Reading Panel, 2000). While accurate decoding skills encourage reading progress by increasing reading independence and knowledge through the self sounding-out of words, rapid decoding is associated with a number of benefits to the beginning reader (Adams, 1990). Good levels of reading fluency appear to be of particular importance if readers are to comprehend what they read. LaBerge and Samuels, (1974) and Samuels (1987) suggest that poor decoders expend so much attention deciphering text that they are not able to attend to its meaning. Automatic decoders, by contrast, are able to focus on understanding what they have read.

Increases in prose reading rate are associated with higher levels of reading comprehension (Kuhn & Stahl, 2003; Tan & Nicholson, 1997). A good level of decoding fluency indicates that decoding itself has been mastered so that the skill is retained. In addition, fluent readers read more and this in turn, results in faster progress in learning to read than that achieved by slower readers (Juel, 1988; Stanovich, 1986).

The final component skill to be mastered is reading comprehension. The National Reading Panel (2000, p. 8) describes comprehension as an “active process that requires an intentional and thoughtful understanding between the reader and the text.” As seen in previous sections, entering into this “active process” and adequately comprehending what is read is dependent on more than student willingness. As beginners learn to read, they begin to comprehend. However, mastery of the previous component skills is necessary for a good level of comprehension to be achieved (Adams 1990; Chard et. al., 2000; Juel, 1988; National Reading Panel, 2000; Kuhn & Stahl, 2003).

*Diagnosing the Cause or Causes of Children’s Reading Difficulties*

Although the majority of children in New Zealand and in other English speaking countries develop adequate reading skills, there are those who struggle to learn and, as a consequence,
fall far behind their peers. Kerslake (2000), for example, found that, in 1999, 17% of 6 year olds were entered into the Reading Recovery programme after one year of schooling. Tunmer and Chapman (2001) cite Nicholson (2000), stating that the number of referrals is even higher, representing some 20-25% of all six year olds in New Zealand.

It would appear that many New Zealand children experience difficulty in learning to read due to difficulty in mastering the component skills. It has been argued that “some teachers in the middle and later years of primary school…may not be aware of the skills or strategies that the lower achievers have yet either to learn or to gain proficiency in” (Education and Science Committee, 2000). In addition, Reading Recovery data shows that some children continue to enter the remedial system at the ages of seven, eight or nine years (Anand, Bennie & Dewar, 2003). Children referred for Reading Recovery are frequently those who have failed to master basic reading skills, such as phonemic awareness and letter-sound knowledge. It has also been argued that this is because these skills are not intensively taught either in the classroom or as part of the Reading Recovery programme (Tunmer & Chapman, 2001).

Despite the availability of reading help for such students, a meta-analysis of controlled Reading Recovery evaluations has shown that some 30% of students fail to finish the programme or do not outperform controls (Elbaum, Hughes, Moody & Vaughn, 2000). Other studies have found that children who participated in Reading Recovery progressed more rapidly when instruction included phonemic awareness training (Iverson & Tunmer, 1993). It has been suggested that “Reading Recovery is essentially a more intensive version of what occurs in regular New Zealand classrooms” so that placement into the programme means that the child is taught “using the same (literature based) methods that likely contributed to the failure in the first place” (Tunmer & Chapman, 2001, p. 11).
One way of preventing reading failure might be to develop a diagnostic system which more accurately identifies weaker or missing component skills so that these can be specifically targeted and trained directly.

It has been known for some time that children who enter school lacking letter recognition skills are likely to experience difficulty in learning to read (Adams, 1990; Bond & Dykstra, 1967; Scarborough, 1998; Walsh et al., 1988). Letter knowledge is usually tested by requiring the child to read the letters of the alphabet in their lower case form. Successful responses indicate that the child can discriminate between each letter (Hatcher, Hulme & Snowling, 2004). Clay’s Observation Survey (1998), used in New Zealand to assess children for admission to Reading Recovery, includes a Letter Identification task. This requires children to either name or sound out the letters of the English alphabet presented in both upper case and lower case.

It is now widely recognised that low scores on phonemic awareness tests during the first two years of schooling are predictive of future difficulties in learning to read (Adams, 1990; Juel, 1988; Kirby, Pfeiffer & Parilla, 2003; National Reading Panel, 2000; Scarborough, 1998). Phonemic awareness can be tested in many different ways. For example, Liberman et al. (1974) presented children with a phonemic segmentation test, where the child was asked to repeat a word spoken by an examiner while simultaneously using a dowel to tap out the corresponding phonemes. This form of phonemic awareness measure, where segments are identified through tapping requires the tester to ensure that the child is not responding to words which they can spell by tapping or naming the individual letters rather than the individual phonemes (Williams, 2002).

Other examples of phonemic awareness measures include asking the child to identify phonemes by orally saying each of the individual sounds in a word, or the sound in a
specified position (beginning, middle or end). Phoneme deletion or substitution is also used, where children are asked to pronounce a word after deleting a sound, or after replacing one sound with another (National Reading Panel, 2000). The Observation Survey (Clay 1998) does not include a measure of phonemic awareness.

Thirdly, scores on letter-sound knowledge measures during the early school years are also predictive of later reading progress (Adams 1990; National Reading Panel, 2000). Reading programmes which incorporate the systematic teaching of letter-sound correspondences generally result in faster reading progress in learning to read compared to those which lack this explicit instruction (Bond & Dykstra, 1967; National Reading Panel, 2000). Letter-sound knowledge is measured in a variety of ways including nonsense word decoding, as found in the Word attack test of the Woodcock Reading Mastery Tests-Revised (Woodcock, 1997a). Testing letter-sound knowledge alone, however, appears to be less relevant than testing for letter-sound fluency (decoding fluency). This is because a child who has letter-sound knowledge, but applies it slowly, is unlikely to sustain sufficient reading fluency to maintain comprehension (Adams 1990).

Williams (2002) studied 64 New Zealand children of mixed gender and ethnicity, who were aged 8 years 6 months old, to 9 years 6 months at the beginning of the project. Two groups were constructed, one consisting of “Normal Progress” readers, the other “Low Progress” readers. Normal Progress readers were distinguished by their reading accuracy scores on the Neale Analysis of Reading Ability, which were not more than 11 months less than, nor 24 months above, their chronological age. The “Low Progress” readers, by contrast, had reading accuracy scores that were at least 23 months behind their chronological age. They also had to be reading at the 6-year old level at least. Both groups of children were tested for phonemic awareness using an adapted version of the QUIL (Queensland Inventory of Literacy) and for decoding fluency using a purpose designed 1-minute grapheme
recognition test (Williams, 2002). Results showed a non-significant mean difference between the two groups on the measure of phonemic awareness. However, scores on the decoding fluency test were highly predictive of group membership. Children in the normal reading progress group, whose average rate of decoding fluency was 69 graphemes per minute, were able to decode significantly faster than those in the low progress group, whose average rate was 37 graphemes per minute. None of the low progress readers could decode at 60 correct responses per minute while almost all of the normal progress readers decoded at better than 60 correct responses per minute. Williams (2002, p.55) concluded that “the low progress readers in the present study lacked decoding fluency not phonemic awareness.”

Decoding fluency, then, is another component skill that should be examined when the rate of reading progress is low. Poor decoding fluency would appear to predict a lower rate of reading progress, particularly in the 4th and 5th year of schooling (Adams, 1990; Williams, 2002). Despite this, decoding fluency is rarely studied and is not usually tested; for example, Clay’s Observation Survey (1998) does not include a decoding fluency assessment. The Decoding Fluency Test used by Williams (2002) has the benefits of being simple, easy to score and requiring little time to administer. In addition, the test appears to have high predictive validity. The test is a 1-minute measure of grapheme-recognition consisting largely of one-syllable words with the target letter or letter group in the initial position.

A child’s sight word vocabulary also receives little attention in reading tests. Clay’s Observation Survey (1998) includes an untimed word test (WORD), which contains a selection of high frequency words. This, however, is a word recognition test and does not measure word recognition fluency. Another word recognition test commonly used in New Zealand is the Burt Reading Test (Gilmore, Croft & Reid, 1981). Although the Burt contains a wider range of word difficulty (high to low frequency words), like the WORD test, it is
untimed. Other word reading measures, such as the Word Identification test from the Woodcock Reading Mastery Tests-Revised (Woodcock, 1997a) are also untimed.

Another skill, receptive vocabulary (on entry to school) has been found by Scarborough (1998) to have a small correlation with rate of reading progress. Although tests of receptive vocabulary, such as the Peabody Picture Vocabulary Test-III (Dunn & Dunn, 1997) are available, a child’s receptive vocabulary is usually much greater than the controlled vocabulary in early reading books and so the skill is seldom tested. It would, however, be important to test receptive vocabulary if English is a second language for the child in order to ensure that he or she understands the words in the books that are used for reading practice.

The end goal of reading, reading comprehension, is measured in most reading tests such as the Woodcock Diagnostic Reading Battery (Woodcock, 1997b) or the Stanford Diagnostic Reading Test-4 (Karlsen & Gardner, 1996). Clay’s Observation Survey (1998) includes a running record observation of reading, after which comprehension questions are asked. A low reading comprehension score may, however, result from a child not knowing what the words mean or from the text being read so slowly that comprehension is not maintained (Adams 1990).

**Literature Review**

In order to identify previous research into decoding fluency, searches of PsycLIT, ERIC, and PsychARTICLES were conducted. Keywords used were “fluency building”, decoding read*, “phonological recoding, “sounding out”, “cipher reading”, “knowledge of the alphabetic principle”, “graphonemic”, “spelling-sound”, “grapheme-phoneme conversion” and “phonics”. In addition, author searches included the names of Nicholson, Tunmer, and Chapman. Several recent literature reviews were found (Kuhn & Stahl, 2003; National Reading Panel, 2000; Pikulski & Chard, 2003) and these were examined for further studies. Ancestor searches were also used to identify further research. Recommended material, such
as the dissertation by Williams (2002) and Adam's *Beginning to Read: Thinking and Learning about Print* (1990), were also valuable source documents. Studies were included if (a) the intervention aimed to build the decoding fluency of the participants, (b) the fluency level on the practice task at pre-test and follow up was described or could be calculated from the data given.

There is a large amount of research which discusses the effectiveness of interventions designed to improve prose reading fluency. Commonly used interventions include Repeated Reading (Samuels, 1979), in which children read text passages repetitively until they reach a fluency criterion. This intervention aims to assist the student achieve automated decoding so that attention can be focused on comprehension (Downs & Morin, 1990; Kuhn & Stahl, 2003). Neurological impress (assisted reading) is where a tutor and student read the same words in chorus, with the tutor maintaining a brisk reading rate and following the words read with a finger (Downs & Morin, 1990; Kuhn & Stahl, 2003). Independent silent reading is another fluency intervention, where children are encouraged to read quietly to themselves as much as possible (National Reading Panel, 2000).

Despite the wealth of research into building prose reading fluency, there appears to be almost no research into interventions designed to build decoding fluency directly. Studies were found that attempted to build word recognition fluency (e.g. Levy, Abello & Lysynchuk, 1997; Rinaldi, Sells, & McLaughlin, 1997; Tan & Nicholson, 1997). However these were not relevant to the present study.

An exhaustive search of the remedial reading literature, however, located only three studies which attempt to build decoding fluency (Fiederowicz, 1986; Fredriksen, Warren & Rosebery, 1985; Jones, Torgeson & Sexton, 1987). Only the study by Jones et al. met the criteria for inclusion. It is acknowledged that there may be other, unpublished studies such as that of Roth & Beck (1984, as cited in Torgeson, 1986).
Participants in the Jones et al. (1987) study, were 20 children, (15 males, 5 females), who were aged 8 to 10 years old. All had been identified by their schools as learning disabled and were at least one year behind in reading. The children were assigned to either the experimental group or a learning disabled control group. Participants in the experimental group practised on the Hint and Hunt 1 computer programme, while those in the learning disabled control group simultaneously practised spelling. The researchers controlled for the variables of age, sex, race, IQ, reading level and speed and accuracy for oral reading of single syllable words. Ten children, of average reading ability and matching age, were assigned to a normal progress control group.

Computer and paper based tasks were used to screen participants for word and paragraph reading-aloud skills. Pre- and posttest measures targeted oral reading accuracy and fluency for target words and generalisation words presented on paper and on a computer. Both training and non-training stimuli were tested. Intervention occurred in 15 minute sessions, 5 days per week, for a period of 10 weeks.

The Hint and Hunt I programme required the participants to complete ten levels of increasing difficulty, each consisting of two separate games. In the first programme (Hint) five short vowels and four digraphs and diphtongs contained in single syllable words were taught without emphasis on speed. Five or six medial vowels or vowel combinations were taught on each of the ten levels. Words containing the same consonants were used within a level but the consonants used were varied across levels. The particular vowels, digraphs, dipthongs and consonants practiced are not specified. Upon achieving mastery of Hint, students moved to playing Hunt, which trained recognition of the graphemes taught in the introductory game. As student’s performance improved, they progressed from playing the slowest version of Hunt (called Fast) and progressed to faster versions of the game (Faster, Very Fast and Super Fast). The speeds associated with each version are not reported.
Jones et al. (1987) compared scores on computer administered tests of reading accuracy and speed. Participants were also required to read aloud 47 target words (practiced in the Hint and Hunt 1 programme) which were printed on a sheet of paper. Jones et al. (1987) found that experimental participants significantly \((p < .05)\) increased their word reading speed from a mean of approximately 20 words correct per minute at pretest, to a mean of approximately 32 words correct per minute at posttest as a result of 12.5 hours of practice. The learning disabled control group is estimated to have increased their average word reading speed from 18 words correct per minute to 20 correct words per minute, a non-significant improvement of 2 correct words per minute. The control group, whose average pre-test word reading speed is not known, read an average of 63 correct words per minute at posttest.

Jones et al. (1987) further found that the mean score of the trained group on the paragraph reading test had increased. The paragraph consisted of 111 printed words, 99 of which were single syllable words. Fifty seven of the words were target words practised in the Hint and Hunt 1 programme. Experimental participants significantly increased their prose reading fluency from an average of approximately 51 words correct per minute at pretest to an average of around 76 words correct per minute at posttest. The average accuracy of the learning disabled control group improved non-significantly from a pretest level of approximately 67 correct words per minute to a posttest average of 69 correct words per minute. While the average pre-test score of the normal readers is not reported, the average posttest score for this group was 146 correct words per minute.

In conclusion, the average decoding fluency of the experimental group students (who practiced using the Hint and Hunt I programme) increased significantly more than the learning disabled control students (who practiced spelling). Following intervention, however, the decoding fluency and prose reading fluency of the experimental group remained at only half the rate of that of their typical progress peers. These results suggest that, while
decoding fluency can be built by focused and interactive practice, further intensive
intervention may be required to increase prose reading fluency to an age-appropriate level.

Aim of the Present Study

The present study was designed to explore one of the implications of the Williams (2002)
study which found that poor decoding fluency, rather than a lack of phonemic awareness, is a
critical deficit in low-progress 8 and 9 year old readers. Assuming that this is the case, the
present study asked whether decoding fluency can be built in these children and, if so, how
long does this take? This present study also asked, if it is possible to build decoding fluency
in such children, will they also become more fluent prose readers?
CHAPTER 2

METHOD

Participants

Schools in the Christchurch area were contacted by telephone one at a time, the research procedure was explained to the principal and the school was asked if they wished to participate. A total of six schools were contacted of which two, Y and Z, agreed to participate. Teachers of Year 4 and Year 5 pupils were asked to refer children in their class who were at least one year behind in reading and who were aged from 8 years to 9 years, 11 months. Years 4 and 5 were co-taught in School Y, with one teacher working in the morning, the other after the lunch break. One of these two female teachers became the primary contact at the school. At School Z, Year 4-5 pupils were spread across two classrooms (Z1 and Z2). Both teachers, one female (Class Z1) and one male (Class Z2) were involved in the research project. The teacher of Class Y submitted the names of two male pupils. One female pupil was referred by the teacher of Class Z1, while the teacher of Class Z2 referred 4 children, three female, and one male. Informed consent was gained by the participating schools distributing the parent and child information and written consent sheets to nominated children, who took the forms home. Signed consent forms were returned directly to the researcher by mail. In school Y, informed consent was gained from all parents and children prior to screening. In school Z informed consent was obtained after screening had occurred but before beginning the intervention.

The participants in the present study consisted of two children from School Y and three children from School Z. As shown in Table 1, both classes from School Z were represented. All but one of the children were aged between 8 years and 9 years, 11 months at the time of screening. The exception was Child 2, who was 10 years old. Referred children were included in the study if they pronounced a minimum of 30 out of 60 segments correctly on
the Phonemic Segmentation Test, obtained a score of less than 60 correct responses per minute on the Decoding Fluency test and lagged a minimum of one year behind their peers as measured by the accuracy scale of the Neale Analysis of Reading Ability.

Table 1. Demographic Characteristic and Pre-test Scores of the Five Participants in the Study.

<table>
<thead>
<tr>
<th>Child</th>
<th>Age Yrs/ Mths</th>
<th>Sex Male/ Female</th>
<th>School/Class</th>
<th>Phonemic Segmentation Score</th>
<th>Decoding Fluency Score**</th>
<th>Accur-rate</th>
<th>Neale*** Compre-hension Rate</th>
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<tbody>
<tr>
<td>1</td>
<td>8.9</td>
<td>M</td>
<td>Y</td>
<td>50</td>
<td>20</td>
<td>6:10</td>
<td>6:3</td>
</tr>
<tr>
<td>2</td>
<td>10.0</td>
<td>M</td>
<td>Y</td>
<td>49</td>
<td>49</td>
<td>7:2</td>
<td>6:9</td>
</tr>
<tr>
<td>3</td>
<td>8.10</td>
<td>F</td>
<td>Z1</td>
<td>43</td>
<td>38</td>
<td>7:9</td>
<td>6:7</td>
</tr>
<tr>
<td>4</td>
<td>8.6</td>
<td>F</td>
<td>Z2</td>
<td>52</td>
<td>36</td>
<td>6:8</td>
<td>7:5</td>
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<tr>
<td>5</td>
<td>8.4</td>
<td>M</td>
<td>Z2</td>
<td>56</td>
<td>42</td>
<td>7:4</td>
<td>6:7</td>
</tr>
</tbody>
</table>

*Total phonemes segmented correctly / 60  
**Correct Graphemes / minute  
***Age Equivalent Scores in years and months

Classroom teachers selected one peer tutor for each individual participant. Tutors were selected based on their social maturity and their compatibility with the child they were to tutor. They were also required to be average or above average readers. Each peer tutor worked with his or her individual tutee for the duration of the intervention.

Settings

Children from School Y were screened in a staff member’s office, while monitoring and follow up tests took place in the school’s family room. At School Z, the unoccupied staff room was used for screening, monitoring tests, and for follow up testing. On the occasions when the staffroom was unavailable, testing occurred either in the school library or in the journal room. Settings were generally quiet and well lit; however, one testing session in the library at School Z was conducted during a class visit amidst a moderate noise level.

Practice sessions in School Y took place either on the steps just outside the classroom or in the school’s family room. At School Z, participants initially practised in their regular
classrooms (Z1 or Z2). Children from Class Z1 were also permitted to practice in the
cloakroom or in the playground provided they stayed on task. Following the school vacation,
children from Classes Z1 and Z2 practised in the cloakroom adjoining the two classrooms.

Measurement Procedures

Potential participants were screened using the Phonemic Segmentation Test (Williams,
2002). This test is an adaptation of the phonemic segmentation test in the Queensland
Inventory of Literacy, a standardised Australian test which assesses phonological awareness
in school aged children (Dodd, Holm, Oerlemans & McCormick, 1996). This test is shown
in Appendix 1. The test is comprised of nine real words and seven pseudowords, each of
which has between 2 and 6 phonemes. Prior to the test, each child received instructions and
was asked to tap any finger on the table as they pronounced each segment. The procedure
was demonstrated and then corrective feedback was given for five practice items. Results
were recorded as the total number of correctly pronounced segments. The entry criterion for
the Phonemic Segmentation test was a minimum of 30 out of 60 segments pronounced
correctly.

Decoding Fluency was assessed with the Decoding Fluency Test (Williams, 2002). This
one minute grapheme-recognition test uses short words and non words containing the 45
graphemes which are most commonly used to represent the 40 English language phonemes.
The words appear five to a line and the entire set appears twice, ordered differently, in the
first and second half of the test. The tested grapheme appears at the start of each word except
in the case of the words “ox”, “hay” and “boy”. A word is scored as correct if the target
grapheme in that word is pronounced correctly. For example, far would be scored as correct
if said as “f-ur”, due to the target grapheme “f” being correctly pronounced. This test is
shown in Appendix 2. The Decoding Fluency test was preceded by instructions and 10
practice items. Children were asked to read the practice items aloud as quickly as they could.
During practice, fast reading was modelled and corrective feedback given as required. Incorrect responses were marked on a standard recording form. At the end of one minute, the unmarked responses were totalled and scored as correct responses per minute. The inclusion criterion in this study was less than 60 correct graphemes per minute.

Progress in reading was measured by the Neale Analysis of Reading Ability (Neale, 1999). This test was chosen for its high reliability and its Australian norms, which are more appropriate for a New Zealand sample than tests standardised in America. The Neale is comprised of six timed and graded narrative passages which are read aloud. Four or eight comprehension questions are asked following the reading of a story. Raw scores for accuracy, comprehension and reading rate are converted to standard year-and-month scores based on norms for the child's year of schooling. Pre-test and follow up scores of prose reading fluency (fluency scores) were also derived from the Neale. This was done by counting the number of words read correctly over all passages passed by the child (less than 16 errors recorded for the passage), then divided by the time, in seconds, taken to read the passed passages. The total was then multiplied by 60 to give words read correctly per minute.

Timed running records were used to measure reading fluency while the intervention was in progress. Administration and scoring were done largely in accordance with the running record conventions described on page 9 of Using Running Records (Ministry of Education, 2000). Some exceptions were made to Ministry guidelines. Running records were timed, with each child reading aloud for two minutes. The number of words read was totalled, errors subtracted and the remainder divided by two to give a measure of correct words read per minute. The difficulty level was controlled, with each child being tested using material which they could read with 90% accuracy or greater. The children were initially asked to read a journal story corresponding with the reading level recommended by their teacher. The
results of running records were analysed for accuracy. Where a child’s reading fell below the 90% criterion, a new journal story with a reduced difficulty level was introduced and the running record procedure was repeated. This process continued until accuracy reached the required level.

The four children initially referred by the teacher at School Y agreed to be screened and were tested individually over the course of a single day. The Phonemic Segmentation Test was administered first, then the Decoding Fluency test and then the Neale (Neale, 1999). Of the four children tested, two met criteria. With one exception, identical screening procedures occurred with the five potential participants at School Z. However, to avoid participants generalising the Decoding Fluency Test instruction to “Read as fast as you can” to the Neale, as happened at School Y, the Neale was administered first, followed by the Phonemic Segmentation Test and then the Decoding Fluency Test.

Teaching Materials

A set of 60 CVC practice words which met the following criteria were selected for fluency building (1) at least two words containing each of the targeted vowel and vowel digraphs in the medial position (2) at least two words containing each of the targeted consonant and consonant digraphs in the initial position and (3) a reasonably even distribution of consonant sounds in the terminal position. A list of the practice words can be found in Appendix 3. The 50 graphemes selected for practice were the most common representations of the 40 English phonemes. The list is an extended version of the list compiled by Williams (2002). Five graphemes were added to Williams’ list, namely a..e, i..e, u..e, ck, and y in its vowel form. CVC words containing these graphemes were selected from the List of 400 Common Words (Carnine & Silbert, 1973) and the List of Basic Sight Words (Holdaway, 1972). All words with irregular spelling or pronunciation were excluded. Where a suitable pair of words could not be found on the above lists the search was extended to the Scrabble Brand Word Guide.
(Orleans & Jacobson, 1953). This was necessary for the low frequency graphemes qu, j, v, x and z. Five exceptions to the CVC rule were introduced to allow the use of “fly” and “my” (to represent y as a vowel), “Joy” and “Roy” (to represent the vowel digraph “oy”) and “video” (to represent the consonant “v”).

Two words were added to an initial pool of 58 words to bring the sample of words to the target number of 60. Each word was checked to ensure that its meaning was likely to be known by a low achieving eight year old. The words were then assigned to two sets, A and B. Each set contained at least of one word representing each target grapheme. Each set of words was then divided so that the first fifteen words in list A became A1 and the second 15, A2. In the same way, list B was divided into subgroups B1 and B2.

Practice activities were designed to meet several criteria. They needed to engage 8- and 9-year old children, be easy to understand and use, suitable for a classroom setting and able to be completed within a short time frame. Snap cards, flashcards and reading racetracks were chosen.

Flashcards were printed on plain white cardboard measuring 11.5 x 7cm, using Tahoma 48 point font. Each flashcard had one word, placed horizontally. Snap cards were printed on pale yellow cardboard, measuring 11.5 x 7 cm, using Tahoma 36 point font. The cards were designed in the manner of playing cards with the same word printed at both ends of a card and aligned for players sitting opposite to one another. The Reading racetracks were adapted from Rinaldi et al. (1996) by substituting words from the present experiment’s lists for the original words. The racetracks were printed on pale yellow A4 cardboard using Ariel 21 point font. Four racetracks were created, each track containing the words from one subset placed randomly, but so that words containing the same grapheme were not side by side. Samples of the materials for these activities are reproduced in Appendix 4.
Pre-intervention Procedures

Training of the participants and their peer partners took place in the computer room at School Y and in the staffroom at School Z. Peer tutors and participants were trained together during class time. To begin with, peer tutors were given timers and asked if they required training in their use. At both schools, at least one peer tutor was familiar with timer operation and trained the other tutors while the participants read the 15 flashcards in set A1 aloud as a group. Children who experienced difficulty reading any word were taken aside individually and taught the word, receiving corrective feedback, until they could read each word accurately. The participants were then asked, as a group, for the meaning of each word. If they did not know the meaning, they were told and then asked to clarify their understanding by saying what the word meant. It was then explained to the children that they would be asked to practise reading activities for 21 minutes per day, with 7 minutes to be spent on each activity. They were told that the activities could be completed in any order.

All of the children were shown how to lay out the flashcards face up in three horizontal rows, each containing five cards. The participants were instructed that the aim of the activity was to read all of the cards as quickly as possible while their peer tutor timed them. Peer tutors were asked not to give corrective feedback until after the participant had finished reading the set. They were then to correct any errors by pointing to the word and pronouncing it correctly. All children were told to follow the same procedure for each set of flashcards.

Next, the children were instructed in the use of Racetrack A1 and told that all subsequent racetracks should be used in an identical manner. They were asked to divide into peer tutor/participant pairs and to practise using the racetrack. Participants were told that the aim of the activity was to read the words on the racetrack as rapidly as possible, trying to beat their best time at each attempt. Peer tutors timed participants as they completed one lap of the
racetrack, speaking each word aloud. At the end of each lap, the tutors pointed to incorrect words and gave their correct pronunciation. During this time, the writer and her colleague moved from pair to pair offering corrective feedback.

All of the children were then introduced to the Snap cards. They were told to read the word on each card as fast as possible as the card was placed in the playing area and to make a snap if any two consecutive cards contained a common sound in any position. The aim was to win the complete set of cards. The author and her colleague demonstrated playing Snap with a deck comprised of the A1 and A2 cards for three minutes. They then invited each child to act as an opposition player in a two person game while the rest of the children watched. Corrective feedback was given whilst playing. Peer tutors were instructed to prompt participants to recognise a snap and to offer corrective feedback during games. Participants and peer tutors were made aware that the Snap game was to be played in the same way regardless of which sets of cards were used. The children were told to begin another game if play finished before the 7 minutes allocated to playing snap ended.

Practice diaries were then given to the participants and their use explained to all of the children. Each diary contained a table with a named column for each activity. Each column had seven vertical rows, each labelled with a day of the week. The children were asked to present their diary to their peer tutor for signing after completing practice each week day but to disregard Saturday and Sunday as no practice was planned for these days. Diaries also contained a graph for charting decoding fluency and prose reading fluency scores. The children were told that this would be filled in after each monitoring session by the author.

Finally, each participant was given a named kit containing one set of A1 flashcards, one deck of Snap cards (comprising sets A1 and A2), an A1 reading racetrack and a practice diary. Each peer tutor was given a timer for use in the practice sessions. The children were then released back to class.
Practice Procedures

The participants in School Y (Child 1 and Child 2) began daily practice 34 days after screening had taken place and practiced on each of the five weekdays, for a total of 16 days. The children generally practiced either in an area of the classroom or outside, on the classroom steps. Practice generally occurred in the morning but moved to an afternoon session if this did not suit the class schedule. Supervision was provided by the classroom teacher. For Class Z1 and Z2, intervention began 33 days after screening. Children at School Z (who were in Class Z1) practised for 21 minutes per day on the five weekdays. Between Days 1 and 15, they worked in an area of the classroom, in the cloakroom or seated just outside the classroom in the playground. They were supervised by their regular teacher. In Class Z2, Child 4 and Child 5 practiced for 21 minutes every school day for the first week. Sessions were held in an area of the classroom and supervised by the classroom teacher. Practice did not occur for these children between Days 6-15 when an unplanned reversal occurred. During this time, the classroom teacher was unable to initiate practice and the children participated in the regular classroom schedule. On Day 16, School Z provided a teacher aide to supervise practice. From Days 16-20 Child 4 and Child 5 attended a single daily practice session held in the cloakroom adjoining their classrooms.

During the intervention, flashcards were used to measure the participants’ readiness to move to a new set of cards. Flashcards were laid out on a flat surface (as described above) and the child was asked to read all of the words as rapidly as possible. Children who read all 15 cards accurately in 12 seconds or less progressed to the next set of flashcards and racetracks.

Each child was tested individually using the Canterbury Decoding Fluency Test four times per week. In School Y, children were not corrected if they made an error on the Decoding Fluency test whereas in School Z correction occurred immediately after the completion of the
test. Timed running records were administered twice per week, with a minimum of two consecutive days between administrations.

At both School Y and School Z intervention ceased when it was considered that all children who could reach 70 graphemes correct on the Decoding Fluency test had done so.

*Follow Up*

Follow up testing took place in the family room at School Y 42 days after intervention had finished. Children were tested individually using Form A of the Neale Analysis of Reading Ability and then given the Canterbury Decoding Fluency Test. At School Z, follow up occurred in the staffroom 55 days post intervention due to the school’s busy schedule. Each child was tested on Form A of the Neale Analysis of Reading Ability followed by the Canterbury Decoding Fluency Test.
CHAPTER 3

Results

The pre-test and post test (follow up) scores for each of the five participants are presented in Table 2 and the results of the monitoring tests are shown in Figures 1 to 5.

Child 1

At pre-test, Child 1 achieved 20 correct responses per minute on the Decoding Fluency test. During the initial training, it was evident that he was unfamiliar with many of the practice words. Child 1 stated that he disliked reading and regularly stated that he had underperformed during testing and practice. His peer tutor stated that Child 1 would not actively participate in Snap games and had to be prompted when cards were placed that qualified for a snap. The tutor further noted that he found it necessary to frequently remind Child 1 to stay on task during practice and had only limited success in maintaining his participation.

As can be seen in Figure 1, Child 1 made rapid gains, moving from 20 to 54 correct responses per minute during the first 6 days of intervention.

![Graph showing progress of Child 1 over time]

*Figure 1. Number of correct responses on the Decoding Fluency Test and number of words correct per minute on connected prose for Child 1.*
His decoding fluency then reached a plateau for 9 sessions before increasing to 68 correct responses per minute on Day 16 and to 72 correct responses per minute on Day 17. At follow up, 42 days later, Child 1 completed the Decoding Fluency test at the rate of 61 correct responses per minute, a threefold improvement over baseline. Prose reading fluency at baseline was 38 correct words per minute. This increased steadily throughout intervention, peaking at 84 correct words per minute on Day 14. Follow up measures, administered after 42 days, show that the gains were maintained, with Child 1 achieving a prose reading fluency rate of 68 correct words per minute. Child 1 was easily distracted from being on task and tended toward being boisterous. He would frequently refer to the pictures when reading from journals and had a slow, disjointed manner of reading regardless of the material used.

**Child 2**

Child 2 had a pre-test Decoding Fluency score of 49 graphemes per minute, as shown in Figure 2.

![Graph](image)

*Figure 2. Number of correct responses on the Decoding Fluency Test and number of words correct per minute on connected prose for Child 2.*
The demeanour of Child 2 was nervous during the initial testing sessions and he read quietly and hesitantly, without attending to punctuation. Child 2 was very motivated to improve his reading despite stating that he did not like to read. He was consistently on task during practice sessions and made his best effort during tests. Toward the end of intervention, Child 2 stated that he found reading much easier as a result of the intervention and said that he now enjoyed reading.

Child 2 made rapid, steady progress between Days 1 and 9, increasing his correct responses per minute from 49 to a peak score of 102 on Day10. The performance of Child 2 then reached a plateau over the final 6 sessions. At Follow up, 42 days later, Child 2 had maintained the gains, scoring 83 correct responses per minute on the Decoding Fluency Test, an increase of 34 correct responses per minute over baseline.

Child 2 also made steady gains in prose reading fluency, starting with a pre-test score of 46 correct words per minute, and improving over the next 9 sessions to a peak score of 95 correct words per minute on Day10. This gain was maintained at follow up, 42 days after the finish of intervention, with Child 2 achieving 102 correct words per minute on the Derived Neale prose reading fluency measure, more than doubling his initial prose reading fluency score.

Child 3

Pre-test measures show that Child 3 achieved a score of 38 graphemes per minute on the Decoding fluency test, as shown in Figure 3.

Child 3 was a confident, good natured child who read slowly, carefully and accurately but who was easily distracted by pictures, particularly those in the first text, when doing running records. Her tendency toward distraction extended to practice sessions, where her peer tutor experienced difficulty in keeping her on task. In each of the pre-test, monitoring and follow up conditions, Child 3 placed extraordinary emphasis on accuracy when reading connected
prose. She was resistant to requests to read faster, fearing that this might cause her to read words incorrectly.

![Figure 3. Number of correct responses on the Decoding Fluency Test and number of words correct per minute on connected prose for Child 3.](image)

Child 3 initially made steady gains in decoding fluency, increasing from 38 to 62 correct responses per minute recorded at Session 6. Child 3 reached a plateau between Days 8 and 10, then maintained her score over the two weeks of no practice during the school holidays, resuming with a score of 64 correct responses per minute on Day 15. Her scores continued to plateau until Day 16, when she achieved 75 correct responses per minute. Further improvement was noted on Day 18, with 91 correct responses per minute.

Gains were maintained 55 days after intervention, with Child 3 achieving a follow up score of 77 correct responses per minute, an improvement of 39 correct responses over baseline. The prose reading fluency score for Child 3 at pre-test was 37 correct words per minute. Her scores increased steadily to 56 correct words per minute on Day 5, after which they reached a plateau until Day 18, with a slight improvement to 63 words recorded. Further improvement was recorded on Days 20 and 21, when this child achieved 66 correct words per
minute. At follow up, after 55 days, Child 3 achieved a prose reading fluency score of 55 correct words per minute on the Derived Neale measure, an increase of 18 correct words per minute over her pre-test score.

**Child 4**

As can be seen in Figure 4, Child 4 read 36 graphemes correctly per minute on the Decoding Fluency test at pre-test.

![Graph](image)

*Figure 4. Number of correct responses on the Decoding Fluency Test and number of words correct per minute on connected prose for Child 4.*

During training, Child 4 was clearly unfamiliar with many of the graphemes presented for practice and had to be repeatedly told how to pronounce them. Child 4 was very nervous about being timed and read haltingly and mechanically with little evidence of self correction. She expressed an intense dislike of reading and responded negatively to suggestions that she could improve. Child 4 also said that she did not enjoy the practice activities and found being corrected by her peer tutor, or by the investigator unpleasant. She consistently made several habitual errors on the Decoding Fluency test, was frequently off task during practice and
would not generally engage in the Snap game, instead allowing her tutor to call a Snap even when prompted to make the call.

With the exception of a very small decrease on Day 5, the decoding fluency scores of Child 4 improved steadily from 39 correct responses at baseline to 51 correct responses per minute on Day 6. There was departure from the intervention plan between Days 7 and 15 as the teacher of class Z2 was unable to implement the practice procedures as agreed. In addition, Child 4 did not practice over the school holidays, and due to being away, did not return to school until 3 days after the standard break had finished. During the period of no practice, Child 4 reached a plateau but maintained her gains.

Practice resumed on Day 16, and, by Day 17, slight improvement was noted as Child 4 achieved a score of 59 correct responses per minute. This was followed by a substantial increase on Day 18, when Child 4 scored 71 correct responses per minute. At follow up, 55 days after the finish of intervention, this increase was not maintained as Child 4 achieved 56 correct responses per minute on the Decoding Fluency Test, an improvement of 20 correct responses per minute over baseline.

Prose reading fluency scores for Child 4, as shown in Figure 4, show a pre-test score of 39. Day 6 shows an improvement to the peak score of 67 correct words per minute followed by a plateau extending beyond the period of no practice (Days 7 to 16) to the close of intervention. Follow up data, taken 55 days after the close of intervention, shows a prose reading fluency level of 61 words correct per minute on the Derived Neale measure, an increase of 21 words correct per minute.

Child 5.

During training, it was evident that Child 5 was acquainted with the graphemes used in the practice activities and was able to pronounce them correctly without assistance. As shown in Figure 5, Child 5 had a pre-test Decoding Fluency score of 42 graphemes per
Child 5 was eager to improve his decoding skills and participated well in practice and testing, competing against his own scores. He improved rapidly over the initial 5 days of intervention, moving from 60 correct responses per minute on Day 2 to 78 correct responses per minute on Day 5. This accuracy rate was maintained over the first week of the unplanned reversal (Days 6-10), and maintained over the two weeks of the school holidays.

![Graph](image)

**Figure 5. Number of correct responses on the Decoding Fluency Test and number of words correct per minute on connected prose for Child 5.**

Despite the unplanned reversal continuing between Days 11-15, Child 5 further improved his score to 88 correct responses per minute on Day 13. No further gains were made during the final week of intervention (Days 14-18). At follow up, 55 days later, Child 5 achieved a score of 97 correct responses per minute, more than double that scored at pre-test. The prose reading fluency of Child 5 also showed a steady increase. During the first week of intervention, he improved his prose reading score from the 38 correct words per minute recorded at baseline to 64 words correct per minute on Day 3. This increase was maintained over the four weeks of school holidays and unplanned reversal. During the final week of
intervention (Days 14 to 18) Child 5 made a further improvement to 88 words per minute on Day 13. Follow up data, collected 55 days later shows that this improvement was partly maintained, with a score of 70 correct words per minute on the Derived Neale fluency measure. This represents an increase of 32 correct words per minute over baseline.

_Group Results_

As seen in Table 2, results from the Decoding Fluency Test show that participants increased their decoding fluency by 102%, from a mean of 37 graphemes correct pre minute at pre-test, to 75 at follow up. This shows an average gain of 38 graphemes correct per minute. Prose reading fluency also improved, (by 78%) as shown by scores on the Derived Fluency test, with an increase from an average of 40 words correct per minute at pre-test, to an average of 71 correct words at follow up.

_Table 2. Pre-test and Follow up Scores of the Five Participants._

<table>
<thead>
<tr>
<th>Child</th>
<th>School/Decoding Class</th>
<th>Pre Intervention</th>
<th>Post Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Derived Fluency*</td>
<td>Derived Fluency Score**</td>
<td>Neale*** Comprehension</td>
</tr>
<tr>
<td>1</td>
<td>Y30 32</td>
<td>6.10</td>
<td>6.3</td>
</tr>
<tr>
<td>2</td>
<td>Y49 46</td>
<td>7.2</td>
<td>6.9</td>
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<tr>
<td>3</td>
<td>Z1 38</td>
<td>7.9</td>
<td>6.7</td>
</tr>
<tr>
<td>4</td>
<td>Z2 36</td>
<td>6.8</td>
<td>7.5</td>
</tr>
<tr>
<td>5</td>
<td>Z2 42</td>
<td>7.4</td>
<td>6.7</td>
</tr>
<tr>
<td>Mean</td>
<td>37 40</td>
<td>7.1</td>
<td>6.8</td>
</tr>
</tbody>
</table>

*Correct Graphemes / minute
**Derived from the Neale Analysis of Reading Ability
***Age Equivalent Scores

Accuracy, Comprehension and Rate, as measured by the Neale Analysis of Reading Ability, also show substantial mean gains. Rate of reading for connected prose rose from a mean of 7-years at pre-test, to a mean of 8-years, 8-months at follow up, an average increase of 20 months. Prose reading Accuracy increased from an average of 7-years, 1 month at pre-test to an average of 7-years, 7 months at follow up, an average gain of 6-months.
Comprehension also increased from a mean of 6-years, 8 months at pre-test, to 7-years, 5 months at follow up, showing a mean gain of 9 months.

Of all the children in the present study, Child 4 increased her decoding fluency from 36 correct responses at pre-test, to 56 correct responses at follow up, thereby improving by a modest 55% and showing the smallest gain of any child. By contrast, Child 1 and Child 5 made the greatest gains in decoding fluency, Child 1 improving from 20 correct responses at baseline to 61 correct responses at follow up; an increase of 205%. Child 5 increased his decoding fluency by 130%, going from 42 correct responses per minute at pre-test to 97 correct responses per minute at follow up.

With regard to prose reading fluency, Child 3 and Child 4 made the smallest gains of the participants. At pre-test, Child 3 read at a rate of 37 correct words per minute and, at follow up, had increased her rate to 55 correct words per minute; a 48% increase. Child 4 had a pre-test score of 39 responses per minute and this had increased to 61 correct words per minute at follow up, a 56% improvement.

The greatest increases in prose reading fluency were made by Child 2 and Child 5. Child 2 increased his number of words correct per minute by 121%, moving from a score of 38 words correct per minute at pre-test, to 102 correct words per minute at follow up. Child 5 read 38 words correctly per minute at pre-test and increased to 70 correct words per minute at follow up, showing an improvement of 84%. Child 1 also made a noteworthy increase in his prose reading fluency. At pre-test his score was 38 correct words per minute. By follow up, this had increased to 68 words per minute; an improvement of 78%.
CHAPTER 5
DISCUSSION

The present experiment found that decoding fluency can be trained directly although the rate of progress varied across the five children. All participants were able to increase their decoding fluency to better than 70 correct responses per minute at some point during the intervention or at follow up. The first to reach 70 correct responses per minute or better were Child 5 on Day 3 after 1.05 hours practice and Child 2 on Day 4 after 1.4 hours practice. Two children reached this level of responding more slowly than did the others; Child 3 on Day 16 after 5.6 hours and Child 1 on Day 17 following 5.95 hours of practice. The remaining participant, Child 4, reached 70 correct responses or better on Day 8, after 2.8 hours of practice.

The average decoding fluency at pre-test was 37 correct responses per minute. This had increased by 38 correct responses per minute to 75 correct responses per minute at follow up. This equates to an average gain of six correct responses per minute per hour of practice.

In addition, the gains in decoding fluency generalised to gains in prose reading fluency for all five participants. Overall, average prose reading fluency increased by 31 words correct per minute from 40 words correct at pre-test to 71 words correct per minute at follow up over 5.9 hours of practice. This represents an average increase of 5 correct words per minute per hour of practice. Of the five participants, two (Child 2 and Child 5) read at better than 90 correct words per minute, requiring between 2.4 and 2.2 hours of practice respectively to reach this rate. Only Child 2 maintained his gain at follow up. Child 1 reached a peak rate of 84 words per minute after 4.9 practice hours but did not maintain this gain at follow-up. The other two participants read at a peak rate of 66 (Child 3) and 67 (Child 4) correct words per minute following 5.6 practice hours for Child 3 and 2.1 practice hours for Child 4.
Results of the Replication Study

Closely similar results were found in a replication study (involving a further five children) undertaken by Zintl (2005). The Zintl participants improved their decoding fluency from a mean of 35 correct responses per minute at pre-test, to a mean of 76 correct responses per minute at follow up, an average of 41 correct responses per minute (or an increase of 7 correct responses per minute per practice hour). Four out of the five participants (80%) built their decoding fluency to more than 70 correct responses per minute. Of the five participants, one had reached a rate of 70 correct responses per minute or within 2 days (.7 hours) of practice time (Child 8), one within 4 days (1.4 hours) of practice (Child 6), and two within 6 days (2.1 hours) of practice (Child 7 and Child 9). The final participant (Child 10) did not reach 70 correct responses per minute by the end of intervention.

In the Zintl study, prose reading fluency improved from a pre-test mean of 43 correct words per minute to a follow up mean of 70 correct words per minute, a mean improvement of 27 correct words per minute (translating to an increase of 4.5 correct words per minute per hour of practice). Although four of the five participants increased their prose reading fluency, only one child (Child 9) read at better than 90 correct words per minute. This child read at 123 correct words per minute following 5.6 hours of intervention and was reading at this rate at follow up. While Child 8 achieved a peak of 88 correct responses per minute following 5.9 hours of practice, this gain was not maintained at follow up. Of the other participants, Child 7 reached a maximum of 78 words per minute after 3.1 hours of practice, and Child 6 read at 63 correct words per minute following 2.1 hours of practice. The prose reading fluency of Child 10 had not improved by the close of the intervention.

A previous study done by Jones et al. (1987) attempted to build decoding fluency in struggling readers using computer assisted practice. The 8- to 10-year old participants in the Jones et al. (1987) study increased by 12 correct words per minute from a mean of
approximately 20 target words correct per minute on pre-test measures to around 32 words correct per minute following 12.5 hours of practice.

Rate of Improvement

Research has shown that, by the age of 8 or 9 years, a majority of children have successfully negotiated the early stages of learning to read (including the development of adequate phonemic awareness) and will be reading at a rate of approximately 90-110 correct words per minute (Hasbrouck & Tindall, 1992).

In the present experiment, the average decoding fluency of the participants increased from 37 to 75 correct responses per minute after 5.9 hours of practice. This rate of improvement greatly exceeds the rate of improvement reported by Jones et al. (1987).

It is possible that the participants in the Jones et al. (1987) study increased their decoding fluency at a slower rate than did participants in the current study due to differences in the required rate of responding. Participants who had progressed to Hunt initially read words at a relatively slow speed (Fast) before moving to higher speeds (Very Fast and Super Fast) once they had demonstrated 100% accuracy at each level. The present study allowed participants to progress at their own rate, without imposing an upper limit on word reading speed. In addition, participants in the current study were able to read the majority of the training words prior to intervention and were therefore able to focus on increasing their decoding fluency speed during practice time.

Gains in decoding fluency skill made by participants in the present and replication studies over the 8 days (2.8 hours) of intervention discussed above appear to have generalised to prose reading over the same period. The present study found that mean prose reading fluency had improved from 40 to 71 correct words per minute; an average increase of 31 correct words per minute. The average prose reading fluency of the Zintl (2005) participants increased from 43 correct words per minute to 70 words correct per minute, an improvement
of 27 correct words per minute after about 6 hours of practice. This rate of improvement is substantially greater than the (average) prose reading fluency gain of 12 words reported by Jones et al. (1987) after participants had engaged in 12.5 hours of practice.

It seems possible that differences in practice stimuli may have contributed to the degree with which gains in decoding fluency generalised to prose reading fluency. When building fluency, it is important that children receive practice on stimuli which are varied enough to produce generalisation. Children using the Hint and Hunt I programme practiced (unspecified) stimuli consisting of five short vowels and four digraphs and diphtongs presented in single syllable words with a variety of beginning and ending consonants, providing practice on 9 vowels. The present study used a wider selection of stimuli and provided practice on 24 vowels.

Individual Variability

Child 4 and Child 10 made the smallest increase in decoding fluency across participants in both the current and the replication study. Data for Child 4 shows that she entered the current study with the second lowest decoding fluency score of the participants and had the smallest increase (55%) in decoding fluency at follow up. Although Child 4 increased her decoding fluency score beyond 70 graphemes per minute on one occasion, the improvement was not maintained. In addition, she was reluctant to respond pro-actively to feedback and rarely corrected errors made during practice or testing. As Child 4 became more aware of her lack of progress, she became increasingly reluctant to participate in practice (e.g. refusing to snap even when prompted by her peer tutor) or assessment (displaying off task behaviour). It is thought that reduced learning opportunities, lack of response to feedback and increasing demoralisation may have contributed to the (comparatively) modest gains in decoding fluency that were made by this child.
Child 10 also made only a modest (57%) improvement in decoding fluency. At screening, this child correctly pronounced only 30 out of a possible 60 segments on the Phonemic Segmentation Test (Williams, 2002) and was the only child to score less than 40 on this measure. The 90 percent of children who scored in excess of 40 correctly pronounced segments increased their decoding fluency more rapidly and to a higher level than did Child 10. These results strongly suggest that a higher level of phonemic awareness is necessary in order for improvements in decoding fluency to occur. However, more research on this is needed.

At the other end of the spectrum, Child 1, Child 5, Child 6 and Child 7 made the greatest gains in decoding fluency, improving from their pre-test scores by 205%, 130%, 188% and 157% respectively. Of these four children, all but Child 7 entered the study with the highest pre-test scores on the Phonemic Segmentation Test, with each correctly identifying 50 or more of 60 possible phonemes. It appears that higher levels of phonemic awareness, (reflected here by scores of greater than 50 on the Phonemic Segmentation Test) facilitate greater gains in the acquisition of decoding fluency. Child 9, however, was the only child who increased her prose reading fluency to better than 120 correct words per minute at follow up.

Child 6 and Child 7 made only small gains in prose reading fluency. Both of these children guessed at unfamiliar words rather than using decoding strategies. It is possible that some low progress readers, through long acquaintance with simple texts, develop a repertoire of sight words that appear frequently in low level reading material. As their reading is corrected, they add to their bank of sight reading words by memorising the visual appearance of the new word (it is possible that this technique allowed Child 7 to record one of the highest increases on the decoding fluency measure without substantial generalisation to prose reading fluency). Their level of prose reading fluency is, therefore, governed by the frequency with
which these recognised words appear in the text. Where unfamiliar words appear, they do not use decoding strategies, instead similar sight words are substituted. Further intervention may be required to overcome the possible habitual, maladaptive reading strategies developed by some low progress readers.

It is likely that a minimum decoding fluency rate of 68 correct graphemes per minute, or better, is necessary for substantial generalisation to prose reading fluency to occur. Child 4 and Child 10, who were decoding at a rate of less than 70 correct graphemes per minute at follow up, recorded minimal improvement in their prose reading fluency. By contrast, all children who made large gains in prose reading fluency were decoding at 68 graphemes per minute or better at follow up.

*Procedures*

The Phonemic Awareness test used to screen children for acceptance into the project, appears to be a reliable tool which effectively distinguished those lacking phonemic discrimination skills from those with adequate levels of phonemic awareness. All children who exceeded the minimum score of 30 to 35 correct responses on the phonemic awareness test increased their decoding fluency to 70 correct responses per minute or above. Conversely, Child 10, who achieved a borderline score on the measure, was unable to build decoding fluency to this level (Zintl, 2005).

Williams’ (2002) Decoding Fluency test, used to screen potential participants, to monitor progress and to gather follow up data, also seems to be a reliable measure. When participants engaged in decoding fluency practice, their scores on this measure improved and when they stopped practicing, their scores ceased to improve. While it is possible that the repeated use of this measure resulted in practice effects, these were reduced by asking the child to start reading on a new line at each testing session. The fact that the participants ceased to improve
when they ceased to practice suggests that the practice effects from repeated testing were fairly minimal.

The prose reading material which was used to measure prose reading fluency was selected so that participants were reading with at least 90% accuracy. Initially, selection of texts was based on the teachers’ estimation of each child’s reading level. Some children, however, were unable to read at the required level of accuracy using recommended material. Consequently, running records were taken using texts of decreasing difficulty until reaching a level at which the children met the 90% accuracy criterion. Subsequent running records were based on reading material at this level. Even with difficulty controlled in this manner, there was some variability within participants from one running record to the next. Such variability can clearly be seen in the data collected from Child 4, whose prose reading fluency scores (words read correctly per minute) decreased with the introduction of a new story on Day 14. Although the total words read during the one minute period was largely sustained at this time, prose reading accuracy reduced from approximately 95% to 91%. It is thought, therefore, that this child’s decrease in prose reading fluency may reflect variability in the difficulty of texts within a given level.

Pre-test and follow up data from the fourth measure, the Neale Analysis of Reading Ability (Neale, 1999) required some modification as the Neale Rate score is calculated using total words read per minute. In order to measure the number of words read correctly per minute, errors were subtracted from the number of total words read prior to calculating prose reading fluency on the passages which were read with 90% accuracy.

The reversal, which occurred in Class Z2, between Days 5 and 15, was unplanned and occurred as a result of circumstances beyond the investigator’s control. Interestingly, it resulted in participants reaching a plateau on both monitoring measures. Although unplanned, this reversal provides support for the view that the observed improvements in
fluency were a direct function of the practice activities and not a function of the passage of
time or the classroom reading programme.

*Implications*

The children in the present experiment all made important gains in both their decoding
fluency and in their prose reading fluency. Despite this, only one child was able to reach a
level of prose reading fluency better than 90 words per minute. It seems vital that children
such as these receive continued intervention to further promote improvement in their prose
reading fluency. A recent review by the National Reading Panel (2000) suggests that guided
oral reading techniques may currently be the most effective way of building prose reading
fluency. This could take the form of repeated reading or paired reading. Binder, Haughton
and Bateman (2002) argue that goal directed, monitored, short, frequent practice sessions
underlie effective fluency building programmes. Incorporation of these components acts to
maintain student motivation and enables systematic changes to be made in tuition as required.

Further improvement is also necessary if these children are to avoid falling prey to the
Matthew Effect (Stanovich, 1986). Stanovich (1986) argues that children who fall behind
their peers in reading are at risk of falling further and further behind as they progress through
school. He suggests that this is due in part to a loss of confidence and a corresponding lack
of motivation to read. Tunmer and Chapman (2002) argue that avoidance responses may also
develop as the poor reader tries to conceal their inadequacies in reading from others. Both of
these factors contribute to further reductions in reading practice. During the present
experiment, the majority of children expressed views consistent with this, such as their
demoralisation regarding their lack of reading progress and their dislike of reading. A matter
of great concern is that declining motivation and declining reading practice can escalate
minor reading difficulties, with the result that a small achievement gap between the child and
his or her peers widens alarmingly (Stanovich, 1986; Tunmer & Chapman, 2002). Further
intervention seems vital if poor readers are to avoid this "downward spiral" (Tunmer & Chapman, 2002).

The results of the present study appear to have a number of implications for educational practice. The acquisition of adequate phonemic awareness appears to be necessary if children are to succeed in learning to decode fluently (Adams 1990). At this time, the Clay Observation Survey, which is used to screen children for entry into the Reading Recovery programme (1998), does not contain a phonemic awareness measure. It would seem necessary to include such a measure in order to consistently identify children who are lacking phonemic awareness. In this way, intervention can be put in place to build phonemic awareness to a level that facilitates the acquisition of letter-sound knowledge.

Decoding fluency is, in turn, thought to be a pre-requisite for the acquisition of reading fluency and hence comprehension but has been found to be lacking in 8 to 9-year old struggling readers (Williams, 2002). It seems advisable that children in their second or third year of schooling who are found to have adequate phonemic awareness but who are still struggling to read be tested using a simple measure such as the Decoding Fluency Test (Williams, 2002). A diagnostic measure for decoding fluency could be added to Clay's (1998) observation survey, which is currently used to screen children for inclusion in Reading Recovery. It would further seem advantageous if New Zealand norms for decoding fluency could be developed so that fluency levels could be compared to those of typically developing readers. Monitoring of improvements to prose reading fluency could be accomplished by the simple means of timing running records. This is not, however, currently part of the standard assessment procedure (Clay, 1998). At present, low progress readers in New Zealand schools are not assessed for reading fluency and no New Zealand norms exist.
Conclusion

The results of the present experiment suggest that the fluency building activities used in this study are an effective and efficient way to increase decoding fluency in 8 to 9-year old children who have acquired adequate levels of phonemic awareness. Participants in the current study increased their average decoding fluency much more rapidly than did participants in the experiment by Jones et al. (1987). The present intervention, which ran for approximately three weeks in School Y and Class Z1 and for two weeks in Class Z2, was sufficient for 60% of participants to build their decoding fluency to 70 correct responses per minute. Gains made in decoding fluency have further generalised to prose reading fluency for those children who reached 70 correct responses per minute. Group results show an average increase in prose reading fluency which exceeds that made by the participants in the study by Jones et al. (1987). According to Hasbrouck & Tindall (1992), reading fluency progresses slowly and steadily, with oral fluency norms suggesting that a child at the end of the second year of schooling should be reading at approximately 90 words correct per minute and a child at the end of the fourth year should be reading at approximately 120 correct words per minute. Few of the children in the present study reached this level, so although prose reading fluency was enhanced as a result of the brief 2- to 3-week intervention, further interventions to promote intensive reading practice will be required for most of the children in both the present study and the Zintl (2005) study.
REFERENCES


APPENDIX 1

PHONEMIC SEGMENTATION TEST
(Adapted from the QUIL TEST)

Date: __________  Tester: __________  Participant: __________

I’m going to say some words and you will have to listen carefully. You are going to say
the sounds in the words and I want you to use your fingers to help you. In the word it
there are two sounds- /i/ and /t/.

The tester demonstrates two sounds by saying “it” and then putting down her small finger and
saying “/i/” and ring finger and saying “/t/”.

Now we are going to do some practice items. Some of the words are made up words and
some are real words. Say the word first. Then say the sounds.

The tester gives feedback and if necessary further practice on the practice items.

Fom? (3)  baby? (4)  knife? (3)  stelp? (5)  sledge? (4)

Say the word first. Then say the sounds.

<table>
<thead>
<tr>
<th>Stimuli</th>
<th>Response</th>
<th>Sounds</th>
<th>Sounds</th>
<th>Word Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. big</td>
<td>/b/ /i/ /g/</td>
<td>3</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>2. oskad</td>
<td>/o/ /s/ /k/ /a/ /d/</td>
<td>5</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>3. itch</td>
<td>/i/ /tch/</td>
<td>2</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>4. frog</td>
<td>/f/ /r/ /o/ /g/</td>
<td>4</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>5. lek</td>
<td>/l/ /e/ /k/</td>
<td>3</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>6. strebe</td>
<td>/s/ /t/ /r/ /e/ /be/</td>
<td>5</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>7. on</td>
<td>/o/ /n/</td>
<td>2</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>8. plate</td>
<td>/p/ /l/ /a/ /te/</td>
<td>4</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>9. yut</td>
<td>/y/ /u/ /t/</td>
<td>3</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>10. vist</td>
<td>/v/ /i/ /s/ /t/</td>
<td>4</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>11. dancer</td>
<td>/d/ /a/ /n/ /e/ /er/</td>
<td>5</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>12. og</td>
<td>/o/ /g/</td>
<td>2</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>13. zokt</td>
<td>/z/ /o/ /k/ /t/</td>
<td>4</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>14. white</td>
<td>/wh/ /i/ /te/</td>
<td>3</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>15. stamp</td>
<td>/s/ /t/ /a/ /m/ /p/</td>
<td>5</td>
<td></td>
<td>1 0</td>
</tr>
<tr>
<td>16. absence</td>
<td>/a/ /b/ /s/ /e/ /n/ /ce/</td>
<td>6</td>
<td></td>
<td>1 0</td>
</tr>
</tbody>
</table>

Raw Scores /60

Words added to QUIL in bold.

Table constructed by Deborah Williams and Karen Bradley.
### APPENDIX 2

**CANTERBURY DECODING FLUENCY TEST**

<table>
<thead>
<tr>
<th>Graphemes</th>
<th>Errors:</th>
<th>Participant Correct Graphemes per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>pa</td>
<td></td>
<td>to</td>
</tr>
<tr>
<td>on</td>
<td></td>
<td>far</td>
</tr>
<tr>
<td>oil</td>
<td></td>
<td>bee</td>
</tr>
<tr>
<td>ed</td>
<td></td>
<td>the</td>
</tr>
<tr>
<td>eel</td>
<td></td>
<td>no</td>
</tr>
<tr>
<td>quit</td>
<td></td>
<td>aim</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td>zoo</td>
</tr>
<tr>
<td>coo</td>
<td></td>
<td>cha</td>
</tr>
<tr>
<td>ra</td>
<td></td>
<td>up</td>
</tr>
<tr>
<td>shoo</td>
<td></td>
<td>eat</td>
</tr>
<tr>
<td>to</td>
<td></td>
<td>in</td>
</tr>
<tr>
<td>the</td>
<td></td>
<td>aim</td>
</tr>
<tr>
<td>oo</td>
<td></td>
<td>me</td>
</tr>
<tr>
<td>vee</td>
<td></td>
<td>out</td>
</tr>
<tr>
<td>at</td>
<td></td>
<td>up</td>
</tr>
<tr>
<td>lée</td>
<td></td>
<td>oat</td>
</tr>
<tr>
<td>we</td>
<td></td>
<td>quit</td>
</tr>
<tr>
<td>on</td>
<td></td>
<td>art</td>
</tr>
</tbody>
</table>
APPENDIX 3

LIST OF PRACTICE WORDS

<table>
<thead>
<tr>
<th>SET A1</th>
<th>SET A2</th>
<th>SET B1</th>
<th>SET B2</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>road</td>
<td>way</td>
<td>that</td>
</tr>
<tr>
<td>run</td>
<td>down</td>
<td>feet</td>
<td>roy</td>
</tr>
<tr>
<td>van</td>
<td>mouth</td>
<td>zip</td>
<td>church</td>
</tr>
<tr>
<td>ken</td>
<td>short</td>
<td>cake</td>
<td>zoom</td>
</tr>
<tr>
<td>quiz</td>
<td>cheap</td>
<td>get</td>
<td>shirt</td>
</tr>
<tr>
<td>prize</td>
<td>hurt</td>
<td>size</td>
<td>job</td>
</tr>
<tr>
<td>not</td>
<td>weed</td>
<td>wide</td>
<td>year</td>
</tr>
<tr>
<td>chain</td>
<td>joy</td>
<td>six</td>
<td>my</td>
</tr>
<tr>
<td>box</td>
<td>boil</td>
<td>her</td>
<td>coin</td>
</tr>
<tr>
<td>fly</td>
<td>teeth</td>
<td>tune</td>
<td>video</td>
</tr>
<tr>
<td>nice</td>
<td>shoot</td>
<td>rain</td>
<td>queen</td>
</tr>
<tr>
<td>kick</td>
<td>sharp</td>
<td>dark</td>
<td>porch</td>
</tr>
<tr>
<td>chase</td>
<td>say</td>
<td>cuff</td>
<td>boot</td>
</tr>
<tr>
<td>wait</td>
<td>girl</td>
<td>loan</td>
<td>town</td>
</tr>
<tr>
<td>cute</td>
<td>term</td>
<td>then</td>
<td>loud</td>
</tr>
</tbody>
</table>
APPENDIX 4
SAMPLE FLASHCARDS

yes

kick

quiz
SAMPLE RACETRACK

Actual size 28cm x 12cm at widest point