

Phonological Awareness and Spelling Intervention for Older Children

by

Melanie Houston

B.A., University of Warwick, 1979

M.Sc., University of British Columbia, 1983

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the Faculty of Graduate Studies, Interdisciplinary

© Melanie Houston, 2007
University of Victoria

All rights reserved. This thesis may not be reproduced in whole or in part, by photocopy or other means, without the permission of the author.

Supervisory Committee

Phonological Awareness and Spelling Intervention for Older Children

by

Melanie Houston
B.A., University of Warwick, 1979
M.Sc., University of British Columbia, 1983

Supervisory Committee

Dr. John O. Anderson, (Educational Psychology and Leadership Studies)
Supervisor

Dr. Jillian Roberts, (Educational Psychology and Leadership Studies)
Co-Supervisor

Dr. Joseph Kess, (Department of Linguistics)
Member

Dr. Kimberly A. Kerns, (Department of Psychology)
Member

Abstract

Supervisory Committee

Dr. John O. Anderson, (Educational Psychology and Leadership Studies)

Supervisor

Dr. Jillian Roberts, (Educational Psychology and Leadership Studies)

Co-Supervisor

Dr. Joseph Kess, (Department of Linguistics)

Member

Dr. Kimberly A. Kerns, (Department of Psychology)

Member

This intervention study investigated whether children aged seven to ten years, experiencing difficulty developing literacy skills, could increase their phonological awareness and spelling skills by participating in a program lasting for 20 hours. A single subject, multiple base-line design was used with six participants. Phonological awareness blending and segmenting skills as well as single word writing skills were practiced explicitly and systematically in a highly structured program. Written words included mono-syllables, multi-syllabic words and words with derivational and inflectional morphemes. The words in the program focused on words with consistent sound-letter correspondence. All participants scored in the normal range for phonological awareness skills after the first 5 hours of instruction. Gains in phonological awareness skills did not influence spelling skills. Single word spelling only increased when writing skills were specifically targeted. All participants showed improvements in sound-letter correspondence writing skills. Some small, inconsistent gains were made in overall spelling skills.

Table of Contents

Title page	i
Supervisory Committee	ii
Abstract	iii
Table of Contents	iv
Acknowledgements	viii
Dedication	ix
List of Figures	x
List of Tables	xi

Chapter 1 Introduction

Phonological Deficits as a Theoretical Model	4
Spelling	5
Similarities between Writing and Reading	6
Phonological awareness	7
Intervention	8
Identifying Children with Spelling Difficulties	9
Challenges facing older children	9
Resource limitations	10
Research questions	11

Chapter 2 Literature Review and Proposed Organization

Historical perspective	13
Current Spelling Research Directions	15
Theoretical Justification for the Inclusion of Phonological Awareness Training in Spelling Programs	16
Definition of Learning Disabilities	21
Response to intervention (RTI)	22
Spelling Skills	22
Phonological Skills and Spelling	23

Phonological Awareness	24
Best Practices in Phonological Awareness Teaching	26
Sound Letter Spelling Correspondence	28
Inflectional/Grammatical Morphology	29
Derivational morphology	30
Intervention	31
Subgroup and Individual Differences	34
Strategies	35
Text complexity	36
Spelling Generalization	37
How Children Learn	38
Errors in spelling	39
Spelling and the Relationship to Reading	40
Applications in the schools	41
Conclusion	43

Chapter 3 Method

Participants	44
Participant Assignment Procedures	46
Location	46
Design	47
Procedure	47
Baseline	47
Probe	48
Pre-test and post-tests	48
Intervention	49
Teaching procedure	52
Facilitator training and monitoring	53
Data collection	53
Materials	54
Word lists	54
Control of phonological variables	56
Ethics Forms and Permission letters	57

Measures 58

Chapter 4 Results 59

Question 1: To What Degree can Students Between 7 and 10 years be Taught
Phonological Awareness Skills? 60

Question 2: To What Extent does an Increase in Phonological Awareness Skills
Transfer to Written Language Including Words, Dictated Sentences, and the
Student's Own Writing? 66

Transfer to writing individual words 71

Transfer to writing dictated sentences 76

Transfer to the students' own writing 80

Question 3: What Improvements in Spelling Skills can be Made with Students After
Either 10 or 20 hours of intervention? 82

Conclusion 87

Chapter 5 Discussion 88

Introduction 88

Phonological Awareness 88

Transfer from Phonological Awareness 90

Words 91

Dictated sentences 93

Spontaneous Writing 94

Conclusion Regarding Spelling Intervention 95

Program length 95

The Nature of Spelling 97

Group size 98

Individual Differences 98

Tests 99

Administration of the Program 100

Voiceless sounds 101

Strengths of the Program 101

Limitations 104

Children Most Likely to Benefit from the Program 116

Suggestions for Further Study 106

Conclusion 108

Bibliography 109

Appendix A: Example of Test used for Pre-test, baseline, probes and post-test

Appendix B: Lesson Examples

Appendix C: Letter of Permission to Parents

Appendix D: University of Victoria Certificate of Approval

Appendix E: Letter of Permission School District 61

Vita

Acknowledgments

I have taken an awfully long time to do this degree as I have concurrently worked three jobs through most of its life. Despite this my committee members have been supportive, patient and helpful. They are Drs. John Anderson, Jillian Roberts, Joseph Kess and Kimberly Kerns. I really cannot thank them enough. I would also like to thank Drs. Hugh Catts and Dan Bachor.

Dedication

This Ph. D. has to be dedicated to my family. To my mother who quietly pursued academic excellence for children and herself. To those who keep me happy every day: my children -Emma and Charlotte; my horse-Oday; and the dogs. To my adorable husband, Gordon, who - whatever I want to do - just helps make it happen...from taking off to the University of Kansas for the first part of this degree to trekking with the nomads in Outer Mongolia! And lastly, for fun, to Libby Purves, who, around the time I started this Ph.D., wrote in the Times of London that a woman can have a family, a life and a career as long as she doesn't care what she looks like and never does any house work! Well, I've skipped a lot of hair appointments and my house would not stand the white glove test, but I have just about juggled it all.

List of Figures

- Figure 1 Phonological Awareness and Spelling Program 55
- Figure 2 E1 Pre-test, Baseline, Probe and Post-test Program Data 68
- Figure 3 E2 Pre-test, Baseline, Probe and Post-test Program Data 69
- Figure 4 E3 Pre-test, Baseline, Probe and Post-test Program Data 69
- Figure 5 F1 Pre-test, Baseline, Probe and Post-test Program Data 70
- Figure 6 H1 Pre-test, Baseline, Probe and Post-test Program Data 70
- Figure 7 H2 Pre-test, Baseline, Probe and Post-test Program Data 71

List of Tables

Table 1	Scores out of 8 on Phonological Awareness Tasks Representing the Range of Sound Combinations Taught in Phase I of the Program. 62
Table 2	Criterion Measures on the Phonological Awareness Subtest of the Clinical Evaluation of Language Fundamentals -4. 63
Table 3	Standard Deviation Scores on the Rosner 40-item Auditory Analysis Test. 64
Table 4	Participants' Performance Shown as Raw Scores after Phase I (Approximately 5 hours), Phonological Awareness Training. The Maximum Score is 8 (if the Pre-test had been 0). 72
Table 5	Participants' Performance Shown as Raw Scores after Phase II (Approximately 10 hours); Phonological Awareness Training Plus Writing of Mono-syllables. The Maximum Score is 8 (if the Pre-test had been 0). 73
Table 6	Participants' Performance shown as Raw Scores after Phase III (approximately 15 hours); Phonological Awareness Training Plus Writing of Multi-Syllabic Words. The Maximum Score is 8 (if the Pre-test had been 0). 74
Table 7	Participants' Performance Shown as Raw Scores After Phase IV (approximately 20 hours); Phonological Awareness Training Plus Writing of Words with Derivational and Inflectional Morphemes. The Maximum Score is 8 (if the Pre-test had been 0). 75
Table 8	Dictated Sentences – Raw Score and % Correctly Spelled Words Plus Average Change from Pre-test. 77
Table 9	Dictated Sentences – Raw Score and % Correct Letters Plus Average Change from Pre-test. 78
Table 10	Spontaneous Writing – Raw Score and % Correctly Spelled Words Plus Average Change from Pre-test. 81
Table 11	Spontaneous Writing – Number of Words Plus Average Change from Pre-test. 82

Table 12	Percentile Results of the Woodcock-Johnson Spelling Subtest.	84
Table 13	Standard Score Results of the Woodcock-Johnson Spelling Subtest (mean = 100; Standard Deviation +/- 15).	84
Table 14	Skill Increase from Pre-test to Post-test 1 (at the End of the 10 hour Program) Comparing Raw Scores.	85
Table 15	Skill Increase from Pre-test to Post-test 2 (at the End of the 20 hour Program) using Raw Scores.	86
Table 16	Skill Increase from Pre-test to Post-test 3 (2 Months After the 20 hour Program) using Raw Scores.	87

Chapter 1

Introduction

Many children have difficulty learning to read and write and as a consequence considerable effort has been directed at describing the educational needs of these children (Ehri, 2000; NRP, 2000; Templeton, 1992). Understanding which children benefit from the different programs available and the level of intensity needed however is still not well understood (Compton, 2006). Also despite the many studies carried out, most researchers have focused on reading rather than writing. Spelling, in particular, has been a relatively neglected area of investigation. Berninger et al. (1998) suggest two reasons for this bias. Firstly there is an assumption that computer spell checks will be able to correct errors. Reliance on spell checks, however, they point out, requires a minimum spelling skill to enter the word initially and to choose the spelling from several alternatives. Secondly writing instruction has focused on discourse-level rather than word-level processes.

Another indication of the relative importance of spelling is to compare it with the extent of coverage devoted to reading. Unlike writing, several journals are primarily devoted to reading, such as the *Annals of Dyslexia* and the *Reading Research Quarterly*. In other journals, for example, the *Journal of Educational Psychology* and the *Journal of Reading and Writing: An Interdisciplinary Journal*, the topic of reading is regularly under consideration. Conducting a parallel search for coverage of spelling reveals considerably fewer published analyses (Perfetti, 1997). For example, the National Research Panel (2000) meta-analysis of phonological

awareness intervention studies reported the effect size for reading in 96 of the studies, but only about half that number (50) for spelling.

Although interest in reading predominates, programs and research in which poor spellers are addressed have developed over many years (Foorman, Francis, Novy & Liberman, 1991; Santa & Hoen, 1999; Tunmer & Hoover, 1993). Some of the more recent interest in spelling remediation has come from the increase in understanding of a core component of literacy difficulties, which is problems accessing phonological skills fluently. Catts and Kamhi (1999) stated that

Phonological processing difficulties include problems storing, retrieving, and using phonological codes in memory as well as deficits in phonological awareness and speech production. A prominent characteristic of the disorder in school-age children is difficulties learning to decode and spell printed words. These difficulties, in turn, often lead to deficits in reading comprehension and writing (p.63).

As a result of this, there has been an increased focus on specific program suggestions such as including phonological awareness training in spelling programs and further investigations whereby training in phonological awareness components are compared to other interventions with no or less phonological awareness training (Torgesen et al., 2001). For example, in some of their literacy remediation research, Torgesen et al. (2001) compared the Auditory Discrimination in Depth (Lindamood & Lindamood, 1984) program, which is a completely comprehensive phonological awareness program, to a phonics program, which includes some phonological awareness training.

In spite of the attention to some issues related to spelling instruction, a number of research questions remain to be answered. In the following dissertation, some of these issues will be addressed. The questions asked will include how phonological awareness skills training can be used to increase the efficacy of a spelling training program. For example phonological awareness skills training includes isolating sounds, which can then be combined with letter knowledge (Adams, Foorman, Lundberg, & Beeler, 1998; Bennett & Ottley, 1994). Children can be taught sound segmentation tasks such as b - a - t which can be combined with written long and short vowel patterns as well as controlled letter combinations (Berninger et al., 1998). Phonological processing skills also impact inflectional morphology such as the /s/ ending for plurals, which may sound like an /s/ in cats or /z/ in dogs, as well as derivational morphology such as *stick* in *unstick*. *Unstick* requires a child to use phonological as well as semantic information to spell, read and understand the meaning derivation and case alteration. Other questions will be focused on how programs can and should be adjusted as a function of student characteristics such as the age of the student and the amount of instructional time available. Phonological awareness training and spelling teaching programs need to be modified to make them more or less intense and they need to adjust to variables such as the complexity of the vocabulary and morphology the student is being expected to use. In addition, practical issues place limitations on the extent to which spelling can be addressed. Remedial time, for instance, is usually limited, so it is useful to investigate how best to use that time. Also, in the applied teaching situation, it might be relevant to ask what outcomes can be expected in limited time periods and how continuity can be

maintained from treatment block to treatment block.

Phonological Deficits as a Theoretical Model

The framework of this research is based on Gough and Tunmer's (1986) "simple view of reading". This account separates the word level of written text, that is decoding when reading and encoding when writing, from the other demands of literacy. These other skills would include word meanings, sentence structure knowledge and reasoning skills (Catts & Kamhi, 1999). In the research that follows the application of word level skills to sentence and text will be monitored but not taught. The theoretical framework, which is consistent with this paradigm, and which will drive the study will be the phonological core deficit model (Liberman, Shankweiler, & Liberman, 1989; McCardle, Scarborough & Catts, 2001; Stanovich & Siegel, 1994). While not assuming that this approach is sufficient to account for all areas of spelling difficulties or dyslexia, it is a theory that has shown explanatory strength both in identifying and remediating children experiencing difficulty developing literacy skills (Torgesen, 1993; Wagner et al., 1997). Within this theory a certain level of competence in phonological awareness skills is considered fundamental to children of all levels of competency learning to read (NRP, 2000). When phonological awareness skills are flawed, children have to rely on other strategies such as sight words, context and guessing, which then limits their ability to develop functional reading skills (Adams, 1990; Vellutino, & Scanlon, 1987). The phonological awareness skills needed for reading are also anticipated to be important for developing spelling skills.

Spelling

Spelling is a key component of learning how to read and write. Spelling skills are fundamental to being able to convey meaning using written language. If spelling is poor, the reader may not be able to understand what has been written. Misspelled words may be hard to decipher or the wrong spelling of a homophone, for example *to*, *too* or *two*, may mislead the reader. Spelling errors convey to many readers a degree of incompetence and in some cases make the writer feel inadequate, despite the fact that decoding and encoding skills are not strongly correlated with measured intelligence (Siegel, 1989; Stanovich, 1997). It is not uncommon for children to avoid words they cannot spell resulting in simplistic vocabulary and ultimately affecting the tone of the whole text.

Children learn to spell words using one or a combination of three skills: invention (sound-spelling correspondences), analogy, and memory (Ehri, 2000). In order to use the invention strategy, children need to have developed phonological awareness skills. These skills allow children to isolate and manipulate the sounds in words. Once the sounds are identified with similarities being noted, then children can learn the consistent letter correspondence and acquire the alphabetic principle (NRP, 2000). As children become older, spelling demands progress from mono-syllables to multi-syllables and more complex vocabulary. English writing also requires children to apply spelling rules and know when to adjust for exceptions. It does not allow them to solely rely on sound-letter correspondences. Some spelling rules apply to mono-syllables such as the addition of a final *e* to *pan* to get the word *pane*. Knowledge of derivational and inflectional morphology can help children spell (Ehri, 2000; Miles,

1989). Longer words may be spelled using invention, spelling rules and knowledge of roots such as *nation* in *national*. To use derivational morphology children may need to be able to understand parts of speech such as verbs and nouns and how they are related such as the verb *heal* and the noun *health*. Grammatical/inflectional morphology may be more consistent orthographically, but have phonological inconsistencies such as *walked /t/*, *trotted /ed/* and *cantered /d/*.

Unless spelling skills are generalized into everyday writing tasks they are of little value (Schumaker & Deschler, 1992; Torgesen et al., 2001). Usually these skills develop as children get older. However, the optimal composition of instructional programs for children with severe spelling difficulties to achieve competence is not yet clear. Programs for older children need to deal with the more complex vocabulary, morphology and spelling demands as well as developing earlier basic spelling skills.

Similarities between Writing and Reading

As already stated, much of the research attempting to better understand this population has addressed reading (McGuiness, McGuiness, McGuiness, 1996; Torgesen et al. 2001), while relatively few studies have addressed spelling skills (NRP, 2000). There are many similarities between the two skills such as an understanding of the alphabetic principle, print conventions and vocabulary knowledge and the fact that the writing process often includes reading and critiquing or editing what has been written (Berninger, 2000). There are also special skills required for spelling that are different for reading. These include the ability to specifically retrieve words letter by letter and accurately transcribe them onto the

page. Because of the relationship between the two skills and the large number of studies on reading, information will be used from both the remedial spelling and reading literature.

Phonological Awareness

As noted earlier, the following research focus will be spelling remediation for children seven to ten years of age, who experience severe difficulties learning to spell. In particular children who are having difficulties with phonological awareness skills will be targeted. Phonological awareness is the ability to identify and manipulate the sounds in words. It has been identified as a necessary skill for literacy development (Snowling, 2000; Torgesen & Mathes, 2000). As many as 20% of children have been identified at Kindergarten age as having phonological skills at a level that puts them at risk for difficulties with literacy development (Torgesen & Mathes, 2000). Although seemingly straight forward, phonological awareness skills are not typically fully developed until Grade 1. In early Kindergarten normally developing children may only be adept at the syllable and rhyme level. By the end of Grade 1, children should be able to segment all the sounds in a mono-syllabic word with consonant blends (Torgesen & Mathes, 2000). The task is made harder by the fact that many sounds are coarticulated (Ladefoged, 1975), for example the /f/ in *fish* sounds different than the /f/ in *friend*, because it is affected by the following sound. The /a/ in *had* sounds different than the /a/ in *hand* because the latter is 'coloured' by the /n/ sound. Phonological awareness persists in being a challenge for many older children to master. In order to be able to use alphabetic letters, children have to have fluent identification of the sounds underlying the letters. Many intervention programs

now target or include a phonological awareness component (Lovett, Borden, Lacerenza, Benson & Brackstone, 1994; Manis, Custodio, Szeszulski, 1993). Many of these programs have had success with developing reading skills at all levels and younger children's writing (NRP, 2000). Despite some progress with younger children, little success has occurred in attempts to remediate older children's spelling difficulties. The NRP (2000) has specifically called for research to better understand how to teach older students particularly in increasing their spelling skills.

Intervention

Intervention studies typically have been directed at carefully delineated age groups of children over specified periods of time (Olofsson, & Lundberg, 1983; Warrick, Rubin, & Rowe-Walsh, 1993). The participants usually include children whose difficulties range from mild to severe – often without separating the treatment effects of the different groups. For example Berninger et al. (1998) included children who were in the bottom 25th percentile of a Grade 2 cohort. More severely impaired children are rarely separated for treatment and little attention has been given to the amount of intervention needed by such children. Torgesen et al. (2001) did address some of these variables by providing an approximately 70 hour reading program to older children who fell below the 1.5 standard deviations on tests of word level reading and fell below the minimum phonological awareness skills for their grade. They found that the children made significant progress if given an explicit, systematic and intensive program. Further research needs to be carried out with reading remediation and similar research needs to be conducted for spelling skills (NRP, 2000). There is still a need to understand why children do or do not benefit from

programs such as that provided by Torgesen et al. (2001). There is also a need to understand what further intervention is needed for those children who show little or no progress.

Identifying Children with Spelling Difficulties

The percentages of children identified as needing service depend on the degree of severity considered a significant disability (Reid Lyon, Gray, Kavanagh, & Krasnegor, 1993; Stanovich, 1988) and the skills that are subsumed under a definition of reading/writing or a more general learning disability (Catts & Kamhi, 1999; Gough & Tunmer, 1986). Also the numbers identified are affected not only by the current understanding of remediation needs, but also by funding and other political and social factors (Allington & Cunningham, 2000; Reid Lyon et al., 1993). Literacy difficulties are not discrete, but lie on a continuum (Stanovich, 1988). Therefore the point that is chosen to be the cut-off on the continuum will affect the incidence numbers and the children requiring service, if service is delivered on the basis of diagnosis. In this proposal, only children with delayed spelling and phonological awareness skills from -1 to -2.5 standard deviations are included. In this way a subset of children with spelling difficulties will be specifically defined and identified. It can be difficult to compare results of studies, which have initially identified subjects using broad, different or unspecified criteria.

Challenges Facing Older Children

Working with older children provides two main challenges. Firstly the older children will have already experienced literacy difficulties for some time and are likely to have experienced little success with regular or specialized instruction. Also

the importance of motivation and attention to success in intervention programs have been noted (Crealock & Bachor, 1995; Torgesen et al., 2001). These two factors are likely to be reduced in children with a history of limited success. Secondly, because the children are older, the writing demands placed on them will be greater not only for spelling complexity, but also for vocabulary, grammar, paragraph, text, cognitive and general processing demands. In order to take such variables into account in the proposed spelling program, I not only address word level issues such as derivational and inflectional morphology, I also investigate generalization to writing at the sentence level. Spelling skills also need to be at a fluency level that can withstand competition from other processing demands such as memory and reasoning demands, if they are to be useful. A time limit was placed on the probe tasks to control for the development of this skill.

Resource Limitations

More research is needed to better understand what can be achieved with older poor spellers within a limited time frame. Torgesen et al. (2001) candidly state in their research that the 70 hours of intensive intervention given in their study are not at all representative of the service levels available in schools typically. Not only is 70 hours unusually high, but they also found distinct differences in how different groups of children within their study benefited. Almost half the children were functioning at an average level by the end of the study. It is possible that some of the stronger children in this group may not have needed the full 70 hours. On the other hand the lowest quartile of children showed no significant gains. This finding raises several questions. One possible question is whether this group would benefit from

intervention of a longer duration. Another question is whether there is a very small percentage of children who do poorly with literacy skills regardless of the intervention given. As a starting point, one purpose of this investigation is to see what children attain given typical intervention times available in a school setting. It is quite possible that many children with severe learning disabilities will have had more intervention time throughout their academic careers than was given in the Torgesen et al. study, although it will have been less intensive and less systematic. Given that services are most likely to remain limited within any academic year, a reasonable way to explore the efficacy of spelling intervention is to study what can be achieved in limited periods of time (efficiency).

Research Questions

In this study a combination of teaching methods, including phonological awareness, is delivered to children seven years to ten years for 10 and 20 hours to address the following questions:

1. To what degree can students seven to ten years old be taught phonological awareness skills?
2. To what extent does any obtained increase in phonological awareness skills transfer to written language including words, dictated sentences, and the student's own writing?
3. What improvements in spelling skills can be made with students, who have difficulties, with either 10 hours or 20 hours of intervention?

Chapter 2

Literature Review and Proposed Organization

In order to better understand the research questions (see Chapter 1) a description of understanding in the field to date is given. Firstly an overview of spelling research and educational application is described both from a historical and current perspective. Following this synopsis the theoretical basis of some of the more recent approaches is presented. These approaches include phonological awareness training so a description of phonological awareness and its relevance to literacy is described along with sound letter correspondence. Next the role of other language issues in spelling programs, such as derivational morphology and inflectional morphology, are discussed. These skills are related to phonological skills, but are also combined with other language skills beyond the single sound or letter. There have been extensive reviews of phonological awareness training (NRP, 2000; Troia, 1999). Based on the meta-analysis completed under the auspices of the NRP (2000), phonological information and best practices in phonological awareness instruction will then be described. Spelling intervention studies with lower achieving students using a phonological awareness component have been carried out with specific recommendations for efficacy (Berninger, 1999). Studies directly addressing phonological awareness and spelling will be reviewed. Descriptions of interventions with students with severe disabilities are rare in this field. Studies with this latter population are important, as it may not be possible to simply apply programs that work with children experiencing mild difficulties to children who have more severe

challenges. Torgesen et al. (2001) have given reading and spelling programs to children with severe learning disabilities and found that explicit, intensive and systematic programs of longer duration are needed for this population. Torgesen et al. discuss the varying success of different subgroups. Some participants responded extremely well to treatment and others did not. These groups will be described as subgroup and individual differences have relevance to the research questions being asked in this study. Children bring their own strategies to the learning process and error patterns differ. These two variables are also described briefly. Often children's performance depends on the nature of the task, so some issues that may simplify or place greater demands on children will be discussed.

Historical Perspective

In understanding spelling instruction at the present time, it is worth briefly reviewing the progress of spelling instruction in the last century. As actual word spellings have changed very little in that period, it is the approach to instruction that has changed and the attitude to the role of spelling in the writing process. Based on an examination of spelling programs implemented between 1890 and 1980, Venezky (1980) argued that program development and research in spelling had changed little in approximately 90 years. Venezky noted that in 1887 Rice had reviewed children's spelling and interviewed teachers. From this information Rice drew principles for spelling instruction which can still be applied. His first suggestion, as an example, was to use a variety of teaching methods – a conclusion similar to that reached by Berninger et al. in 1998.

In analyzing spelling programs over the last century, a key component has been training in phonics (Adams, 1990). Phonics training involves systematic and explicit instruction in letter-sound correspondence and spelling patterns. Phonics training is still recognized as necessary for some children (NRP, 2000). However, it has been criticized as being drill-like and dull, sometimes leading children to mechanically decode words without attending to their meaning (Adams, 1990). Indeed in more recent reports, the limitations of phonics approaches in isolation have been acknowledged and the need to address other skills, such as fluency and vocabulary acquisition as well as meaning approaches, is noted (NRP, 2000).

In the 1970's, 1980's and 1990's, when phonics training was being questioned as a teaching method, the belief was widely held that children either learned to spell following the principles of the Phoenician or the Chinese approach (Baron & Strawson, 1976). The Phoenicians invented the alphabet and as such a letter-to-sound correspondence system is attributed to them. The Chinese alphabet system, on the other hand, represents whole words. Children were seen to approach literacy tasks with one or the other bias. A difference was also noted between spelling and reading in general, with spelling being viewed as needing a more phonologically based approach and reading using a more visual approach (Bryant & Bradley, 1985; Smith, 1971). However these authors noted that more proficient readers and writers combine these strategies as they get older. Some people holding the view of two separate reading methods believed that some children could become literate using only a sight word method. If children had difficulty with sound-letter skills then the suggestion was made to bi-pass sound-letter correspondence skills. Venezky (1980) however,

concluded that this separation was a false dichotomy as children need to learn to use both analytical and visual skills to read and write.

In summary, a historical overview leads to the conclusion that the principles of spelling instruction remained fairly static for a long period of time. There have been adjustments in the importance afforded spelling in the curriculum and the emphasis on visual, phonics or combined approaches.

Current Spelling Research Directions

More recent researchers have shown that children not only need to be able to isolate letters, they also need to be proficient at the ability to segment and sequence sounds (phonological awareness) and select the appropriate letter correspondence (Snow, Burns & Griffin, 1998). In a recent review of reading and spelling research the National Research Panel (2000) stated that the

... processes involved in writing words, either by generating approximate spellings of the words or by retrieving correct spellings of the words or by retrieving correct spellings from memory, require phonemic segmentation skill (Griffith, 1991). Phonemic segmentation is required for spellers to select letters to represent the phonemes. Phonemic segmentation is required to help children retain correct spellings in memory by connecting graphemes to phonemes. In the analysis it was expected that PA training would benefit children's ability to spell. (Chap. 2, p.12)

Despite these clear statements, after conducting a meta-analysis of the studies addressing spelling remediation the NRP also concluded

...PA instruction was not effective for improving spelling in disabled

readers. This is consistent with other research indicating that disabled readers have a difficult time learning to spell. (Chap. 2, p. 6)

To date authors, who include phonological awareness training, have provided useful instructional guidelines pertaining to *readers* (Hatcher, Hulme & Ellis, 1994; Kozminsky & Kozminsky, 1995) and others have clearly conceptualized and described *general spelling* remediation programs (Berninger et al., 1998). The next step for researchers in this field is to establish the degree to which phonological awareness training can be incorporated into spelling programs to provide effective remediation for *older disabled spellers*.

Theoretical Justification for the Inclusion of Phonological Awareness Training in Spelling Programs

There are several possible ways to teach spelling. The approach chosen might be driven by a particular theoretical stand or it might be influenced by other factors. Some of these other factors might include the availability of published programs such as Spelling Through Phonics (McCracken & McCracken, 1996) and The Bangor Dyslexia Teaching System (Miles, 1989) as examples, personal experience or educational philosophy and beliefs. The program itself might teach spelling skills, patterns, rules and exceptions in a developmental order from examining how typical children acquire skills. The order might be assigned from subjective judgments of increasing spelling challenges. Yet another way might be to address the difficulties being experienced on a child by child, individual program basis.

The program being used in this study will be theoretically driven and based on the phonological core deficit model (Liberman et al., 1989; McCardle et al., 2001;

Stanovich & Siegel, 1994) and the phonological theory of reading disorders (Torgesen 1993). Phonological theorists state that the main reason children have problems spelling and reading is because they are unable to isolate the sounds in words, which they need to attach corresponding letters – the alphabetic principle and ultimately encode and decode. Liberman et al. (1989) were some of the first researchers to clearly state that an awareness of the phonological and morphophonological structure of words is not necessary for spoken language, but becomes critical for written language knowledge. They also noted that children experiencing difficulty have a general phonological deficiency such that they are weak in verbal short term memory, saying phonologically complex words, naming skills and hearing words in noise. More recently, McCardle et al. (2001) found that measures of lexical and syntactic abilities along with phonological measures enhance predictions of reading difficulties. There is some debate as to whether there are several areas of language associated with learning disabilities as well as phonological disabilities (McCardle et al. 2001) or whether the language and literacy difficulties all stem from the same core phonological deficit (Shankweiler & Crain, 1986).

Some argue for a direct causal relationship between phonological awareness skills deficits and written language skills (Adams, 1990; Blachman, 1994; Stanovich, 1988). Torgesen (1993) cites his own and a number of other studies to show that - at the very least - increases in phonological awareness skills increase literacy skills.

The application of the core phonological deficit theory is relevant primarily to a narrower definition of literacy difficulties than is sometimes used. The definition of literacy difficulties to be used in this proposal will necessitate operationalizing both

the component of literacy skills being addressed and the population of children being considered learning disabled. Firstly there are a great many skills required to be literate. For example, to write a story, it would not be sufficient to have alphabetic and spelling knowledge, it would also be necessary to have vocabulary and grammar skills as well as ideas, which would be presented in an orderly, coherent and engaging manner. The difficulty with this description of writing skills for remediation purposes is its breadth. The main category of skills needed are phonological and orthographic as well as general language competencies and higher level thinking skills (Perfetti, 1986). The only skills listed above that are specific to the writing task are phonological awareness, orthographic and spelling knowledge. The other skills are general language and cognitive abilities that apply to a multitude of activities of which literacy is one. Gough and Tunmer (1986) suggested the “simple” view of reading, whereby reading would be considered to consist of two parts – decoding and comprehension. Although reading requires competency in both skills, it is the decoding portion that is particular to reading. Likewise the encoding portion is particular to spelling. Other writing skills are also needed for speaking and not specific only to the writing task. The simple view does not minimize the importance of all the skills, but serves to divide those exclusive to literacy tasks. Catts and Kamhi (1999) suggest that the simple view of reading, which isolates decoding from comprehension, is more applicable to the process of learning to read, whereas the more complex thinking skills are more relevant when children are reading to learn. A parallel approach was taken in this study, in that the encoding part of spelling was addressed. In this way the part of writing is addressed that is most specific to the

literacy process. There was some overlap with language skills as word meanings and morphological markers were addressed. Language skills, however, were only dealt with at the word level. Focusing on the *word* is also the part of writing that is most relevant to the phonological core deficit model.

Secondly having isolated one part of the writing process as of interest, this decision then places constraints on the population of children that were selected for this investigation. Eligible children were those who had deficits in both phonological awareness and spelling.

Deficits in reading comprehension generally parallel deficits in listening comprehension. Groups of children have been identified who have problems with phonological skills, listening comprehension and who have similarly low IQs. They have been given different labels including the term “garden variety” poor readers (Gough & Tunmer, 1986; Stanovich, 1988). There are other children who have poor phonology and language skills and average IQ scores or higher. These children have been labeled Language Learning Disabled by Catts and Kamhi (1999).

Stanovich addresses the debate that children termed dyslexic or Language Learning Disabled are different from “garden variety” (Gough & Tunmer, 1986) poor readers. The former group would be operationalized to have a different cause of their reading disability than the latter group. This would be shown by cognitive scores that differed qualitatively from reading matched, nondyslexic children or from matches with same-age reading disabled non-dyslexic children – “garden variety.” Stanovich rejects the idea that the two groups differ only in degree of developmental lag.

However, he points out that in many studies reading levels have been assessed without distinguishing between decoding level (DL) and comprehension level (CL).

The advantages of isolating children with phonological skills that are delayed in relation to other cognitive skills is that a clear link between phonological abilities and literacy development has been established. As well, isolating phonological skills as a main cause of literacy difficulties suggests a clear course for intervention. Although this approach was applied in this study, it was selected with an awareness of its limitations. Even as a strong proponent of the phonological theory, Torgesen (1993) pointed out these limitations. The main ones that he cites include little knowledge to date of the manifestation of these difficulties as children get older. So, for example, he states that problems such as short-term memory limitations may be more noticeable with age. He considers short-term memory problems as linked to phonological awareness abilities. If these children differ from “garden variety” poor readers, then we should be able to identify and describe their strengths as well as their needs, although he does allow that verbal IQ may vary more broadly. Strengths, however, have barely been addressed in the research literature. He also asserts that the phonological theory would benefit from incorporating more developmental neuropsychological concepts.

Whatever the causal relationship between phonological skills and more general language may be, the causal relationship between reading disabilities and a phonological deficit has been well established (NRP, 2000) as has the amelioration of reading deficits through phonological awareness training (Hatcher et al.; Torgesen et al., 2001). Therefore at the word level the phonological account seems to have the

most explanatory power. For the purpose of this research then I focused on children with phonological deficits.

Definition of Learning Disabilities

There have been a number of challenges in formulating theories in the field of learning disabilities. One of these challenges is in defining what should be excluded and included as a learning disability. The definition that will be adopted in this research proposal will be that given by the Research Committee of the International Dyslexia Association that addresses spelling difficulties along with reading problems

Dyslexia is a specific language-based disorder of constitutional origin characterized by difficulties in single word decoding, usually reflecting insufficient phonological processing. These difficulties in single word decoding are often unexpected in relationship to age and other cognitive and academic abilities; they are not the result of a generalized developmental disability or sensory impairment. Dyslexia is manifest by variable difficulty with different forms of language, often including, in addition to problems in learning to read, a conspicuous problem in acquiring proficiency in writing and spelling (cited in Reid Lyon et al., 1995).

However it is frequently the case that scientific criteria are significantly narrower than clinical/ educational criteria (Torgesen, 1993; Ysseldyke, 1983). The narrower scientific definition, as stated above, will be adopted for the purpose of this proposed study. Clinical settings need to offer services to children regardless of the cause of their difficulties. Some children, for example, may be poor readers because of lack of teaching or because of emotional or behavioural factors.

Response To Intervention (RTI)

In the last few years attention has focused on moving away from psychometric and exclusionary criteria to diagnose learning disabilities. These have been criticized on several grounds for not being helpful either diagnostically or remedially in solving the needs of children with learning disabilities (Vellutino, Scanlon, Small, and Fanuele, 2006). Included in the objections is the lack of accounting for deficits as a result of instructional limitations and the inability to capture the educational needs of children with learning disabilities. Fletcher, Morris and Reid Lyon (2003) argue that measurements should be made on more than one occasion covering periods of instruction, use different assessment methods and should focus on the primary skills, specifically reading, writing and math. Evaluation of response to intervention, they argue, is of more interest in understanding a child with learning disabilities and their instructional needs than normative test scores. The latest interest is in understanding what instruction is needed, when, and for how long and administered by whom for different individual and subgroups of children (Compton, 2006; Torgesen, 2003). This approach, termed RTI, is considered a more useful measure diagnostically and remedially. RTI approaches assist increasingly specific and intense instruction to children as their learning needs are systematically identified (Justice, 2006). The following study helps to develop this approach with quite specific instruction and participant descriptions.

Spelling Skills

A dominant role for phonology in spelling instruction is now clearly established (Frith, 1980; Snowling, 1994). Not only are phonological awareness and

spelling skills highly correlated (Kamhi & Hinton, 2000), most early spellings are driven by sound letter correspondences as the primary strategy, for example *apl* for apple. Other language skills also influence spelling competence. Knowledge of grammar can help children with their spelling, such as knowing that the past tense is spelled *-ed*, despite different pronunciations such as *kicked (/t/)*, *hated (/ed/)*, and *bagged (/d/)*. Knowing the derivations of words, i.e. semantic knowledge can help in spelling. For example, spelling *health* is easier if its root *heal* is considered. Baker & Brown (1980) argued that literacy tasks are actually made easier by not having a one to one sound letter correspondence, as the other cues are more important and helpful. Along with phonological skills additional cognitive strategies used for spelling are analogies (Ehri, 2000; Goswami, 1988; Treiman & Cassar, 1997) and visual memory (Bruck & Waters, 1988; Lennox & Siegel, 1996). The cognitive load, i.e. the number of processing demands of the writing task (such as the complexity of the concept and vocabulary), may also affect children's ability to apply their spelling skills and strategies.

Phonological Skills and Spelling

From the above overview it can be seen that in order to address spelling remediation, within the phonological framework, the following factors need to be included:

- 1) Phonological awareness skills
- 2) Phoneme-grapheme correspondence
- 3) Inflectional morphology, e.g., grammatical morphemes
- 4) Derivational morphology and word roots
- 5) Spelling strategies, including visual memory and the use of analogies.

Phonological Awareness

Phonological awareness is a learned concept (Adams, 1990; Liberman & Liberman, 1990; Perfetti & Zhang, 1996) because the need to segment words to sounds only arises in a print environment. In a study with illiterate adult poets Morais, Cary, Alegria, & Bethelson (1979) found that despite their use of language, these poets, not having been exposed to print, were still poor at phonological awareness tasks. Phonological awareness acquisition is defined by Torgesen and Mathes (2000) as requiring two skills. Firstly children need to learn to segment syllables and words to separate sounds. Torgesen and Mathes (2000) state that

...phonological awareness is most commonly defined as one's sensitivity to, or explicit awareness of, the phonological structure of words in one's language. In short, it involves the ability to notice, think about, or manipulate the individual sounds in words. (p.2)

Secondly children need to be able to identify the sounds consistently with their distinguishing articulation features including when they occur in different word positions such as in the middle or at the end. Examples of the ability to segment would be a child being able to tell that /k/ was the first sound in *clap* and the middle sound in *making*. Locke (1990) noted that the human brain is specially programmed to identify the sounds of speech.

Torgesen and Mathes (2000) give the benchmarks of phonological awareness development. Children in early Kindergarten should be able to recognize and generate rhyme such as *white* and *light*. By the end of Kindergarten children should be able to pronounce initial word sounds such as /m/ in *mile* and blend two sounds such as

/s/.../ee/ to make *see*. In the middle of Grade 1 children should be able to isolate the sounds in three phoneme words /s/.../a/.../t/ and blend up to 5 phoneme words with initial and final blends.

The link between phonological awareness skills and written word recognition has now been irrefutably established. Torgesen and Mathes (2000) go so far as to state,

The discovery of the importance of phonological awareness in early reading is one of the most important breakthroughs in reading instruction in the last 20 years. Research now shows very clearly that at least 20% of school children will experience difficulties learning to read without explicit instruction to stimulate phonological awareness. Such instruction also appears to accelerate reading development in all children. It is essential that all teachers who work with young children experiencing problems learning to read, understand what phonological awareness is, how it can be quickly assessed, and how to help children acquire it. (p.vii)

Indeed one of the earliest studies in this field was carried out by Bradley and Bryant in 1978. They found that children with reading disabilities performed less well on tasks of phonological awareness than children who were able to read normally and yet were three and a half years younger. These findings for reading will be taken as pertinent to spelling as the links between the two have already been described.

It is also worth noting that blending and segmenting continuants is easier for children than stops. For example, a word like smile is made of continuant sounds that can be extended i.e. *sssmmmiillle*. Stop consonants are essentially brief and cannot

be extended to give the child extra time to process, e.g. the consonants in *pit*. Another helpful distinction is between voiced and voiceless sounds. It is important that voiceless sounds are made without laryngeal vibration e.g. /p/ (whispered) /a/ /t/ (whispered). Unfortunately a common error is to add /uh/ when segmenting words such as /puh/ /a/ /tuh/, which when blended becomes *puhatuh*.

Best Practices in Phonological Awareness Teaching

The National Research Panel (2000), in reviewing 52 studies of intervention for phonological awareness skills identified six ways to teach phonological awareness:

- 1) Phoneme isolation, for example, identifying the first sound;
- 2) Phoneme identity, for example, recognizing the same sound in different words;
- 3) Phoneme categorization, for example, identifying a word that starts with a different letter than the other words;
- 4) Phoneme blending, which requires the child to recognize a word once the component sounds have been given;
- 5) Phoneme segmentation, which involves isolating or counting the sounds in a word; and
- 6) Phoneme deletion, which requires the child to be able to say the word that is left once a sound is removed, for example, *trot* without the initial /t/ is *rot*.

The NRP meta-analysis, however, revealed that teaching only one or two skills was the most effective. They found small group instruction, incorporating letters as well as sounds was efficacious and the greatest gains were seen in programs lasting 5-18 hours.

There are many ways to teach phonological awareness as already described. It can be argued that applying the best practices of instruction, as identified by the NRP, in the order described by Torgesen and Mathes (2000) is a reasonable way to proceed. Some authors (Lindamood & Lindamood, 1984) have found that drawing attention to the articulatory patterns of sounds is beneficial to children. As phonological awareness initially deals with sounds without their letter correspondences, manipulation of tokens into boxes has been found helpful (Bennett & Ottley, 1994; Lindamood & Lindamood, 1984). In addition, training phonological awareness skills early on can prevent literacy difficulties (Bradley & Bryant, 1978; Lundberg, Frost & Peterson, 1988).

Despite the importance of phonological awareness skills in literacy development, findings from the NRP meta-analysis led them to state that Phonological Awareness training improves spelling performance in Kindergartners, first graders and at risk students, but not in older disabled readers. (p.9)

It is hard to understand why something that is important for other populations is not helpful for older children with the more severe disabilities. One possibility is that the method and amount of teaching that is necessary for younger, less challenged students may simply not be individualized or intense enough for the older student with learning disabilities. This is born out by a study by Torgesen et al. (2001). Torgesen et al. had success in improving the reading and phonological awareness skills of 8-10 year-olds with severe literacy difficulties when the intervention was

“explicit, intensive and supportive.” (p.147). This study of reading and spelling with reading as the primary goal can be further tested with spelling as a primary goal. It is worth noting that the conclusions drawn by the NRP meta-analysis as cited above did not include studies of the length and intensity carried out by Torgesen et al (2001).

Sound Letter Spelling Correspondence

As a focus of this research is to target the relationship between phonological awareness and spelling, words that conform to a one-to-one sound-letter relationship will be the main focus. Children need to be able to segment sounds in words and know the letters that correspond to the sounds. There are about 40 separate phonemes in English and about 70 different letters and letter combinations that represent those sounds (Cronnell, 1978). Thus speaking written words is an easier task than writing them. An example is a word like *shunt*. Children need to be able to isolate all the sounds, sequence them and attach the appropriate letter *sh-u-n-t*.

Rosner (1971) addresses sound-letter correspondence instruction at four levels of difficulty. The first level is simple Consonant *C* Vowel *V* Consonant *C* words such as *bin* or *bud*. The next level is monosyllables with consonant clusters such as *spend*. The third level is simple multi-syllabic words such as *comply*. The fourth level has the most complex multi-syllabic words such as *misunderstand*. Rosner (1979) avoids spelling rules and teaches words in spelling patterns such as *-an* and *-er*. These increasing levels of complexity not only consist of an increased number of letters, they are also placing higher phonological awareness demands on the child and greater processing demands for memory, skill and fluency, which may affect the child's ability to actually use the core skills functionally.

Another approach that can be taken is to use a standard spelling program such as in the McCracken Spelling Through Phonics Program (McCracken & McCracken, 1996). In this program the spelling skills a child should have by Grade 3 are listed grade by grade. In addition, word lists that give examples of these patterns are supplied. Spelling patterns that comply with sound letter correspondence can be picked from the program such as short vowel patterns e.g. sit, bit, fit. Initially sound isolation skills can be taught – such as placing a token for each sound before the child is asked to write the word. If the child is asked to write a word with a spelling rule, the rule can be taught before the child starts to write.

Inflectional/Grammatical Morphology

Errors of spelling frequently occur with grammatical and inflectional morphology and these can be particularly resistant to correction (Fisher, Shankweiler & Liberman, 1985). A clear example of spelling affected meaningfully by inflectional morphology is *walked*, where the *-ed* spelling is required because a past tense is being expressed. The past tense is more clearly expressed consistently as *-ed* than in its phonetic form such as *jump^t*, *trot^{id}* and *canter^d*. Henderson and Chard (1980) point out that recognizing orthographic regularity when reading is however quite different from explicitly retrieving forms in order to spell accurately. The inference being that more is required of the child to actually produce the correct *spelling* of these words.

English contains less grammatical morphemes than other languages. Some of the more common grammatical morphemes found in English are as follows:

- 1) Nominal inflections: plural and possessive (-s);
- 2) Verbal inflections: Progressive (-ing), present (-s); past tense (-ed); passive (-en); perfect (-en);
- 3) Adjectival inflections: comparative (-er) and superlative (-est); and
- 4) Free morphemes: Verb negation (not); modal auxiliaries (will, may, can); infinitive (to); personal pronoun (eg. I we, they); possessive pronoun (eg. his, hers); reflexive pronoun (eg. herself); gerunds (-ing); participle (-ing).

Derivational Morphology

Carlisle (1988) found that it takes several years for children to become proficient at adding prefixes and suffixes. Many words include or combine roots, prefixes and suffixes. Recognizing these components can be extremely helpful in understanding and spelling the word. Despite this being a difficult skill to acquire, Treiman, Cassar & Zukowski (1994) found that even in Kindergarten, children used derivational morphology by producing *dirty* correctly more often than not in their study. Without morphological knowledge being applied *dirty*, in American English dialects, would be spelled *dirly* following the pronunciation rather than the root *dirt*.

Another example of a meaningful spelling adaptation comes from words, that change from noun to adjectives by adding *-ious* such as *anxiety* -> *anxious* and from verbs to adverbs such as in *quick* to *quickly*. These examples exemplify what Baker (1980) would argue are advantages of the anomalies. For example the meaning of magician is clearer when it is spelled as magician (derived from magic) rather than the phonetic spelling majishun.

Freyd and Baron (1982) investigated whether children use knowledge of morphology or whether they treat words as unanalyzed wholes. They compared groups of special, high-achieving, Grade 5 students with a mean IQ of 139 to students from a heterogeneous, more typical Grade 8 class. They found that the Grade 5 students were inclined to analyze words into roots and suffixes, whereas the Grade 8 students tended not to analyze the words and treated them as whole words. When words were analyzed by the Grade 8 students, they tended to notice only the root. It, therefore, seemed that the superior students were significantly more likely to use the information from the derivation. Freyd and Baron's attempt to train the use of derivational relations yielded inconclusive results.

Intervention

Berninger et al. (1998) studied the effectiveness of a spelling program given to the bottom 25% of a Grade 2 (average age 95.4 months) cohort of 128 participants. The average participant scored just below -1 standard deviation. In 24 20-minute sessions Berninger et al. combined and compared several different spelling instructional methods that included phonological awareness training. They found the most effective teaching strategies in this study were as follows:

- 1) Multi-layered intervention;
- 2) Teaching the alphabet principle, i.e., sound-letter identification and correspondence;
- 3) A combination of whole word and onset-rime (phonological awareness) training, e.g. sm-ile;
- 4) Functional spelling units of more than one letter, e.g. *back*; and
- 5) Transfer to composition.

Berninger et al. (1998) also used the most common words to increase the usefulness and applicability of the skills being taught. The participants in the Berninger et al. study, however, were not grouped for relative severity of disability, so it was not possible to separate the effects of the intervention on different groups of children, such as those experiencing greater or lesser difficulties. Among other things, Berninger et al. suggest teaching connections between phonology, morphology and semantics. They also suggest including polysyllabic words as the words used in their study were mono-syllabic.

Torgesen et al. (2001) targeted the lowest group of students in a reading training study that incorporated phonological awareness training and spelling. The participants were limited to children who were performing at least minus 1.5 standard deviations below average on word attack tasks. Most children were below minus 2 standard deviations. Two programs were compared. These were Embedded Phonics (Torgesen et al. 2001) and the Auditory Discrimination in Depth (ADD) program (Lindamood & Lindamood, 1984). The Embedded Phonics program included explicit instruction at the word level for sounds and letters. In addition, opportunities to read and spell sight words as well as words with spelling patterns were provided. The children participated in phonics activities and games. The ADD program emphasized sounds and the articulatory patterns needed to make those sounds. Reading and spelling were part of the program and most of the words had exact sound letter correspondence though some contained spelling patterns. There was little difference in outcome between the two programs, although for phonological spelling, over the long term, the ADD group did better. Spelling in general showed little improvement

for either program. Torgesen et al. found that some of these children made very significant gains in reading if the training was intensive, systematic and explicit. They gave each student 67.5 hours of individual training, which contained a generalization component. Two variables in this study stand out as significantly different from the best practices findings of the NRP (2000) meta-analysis. The NRP found that phonological awareness training was not helpful for older spellers, whereas Torgesen et al. found some improvements in spelling for this age group, albeit small. The NRP found that 18-20 hours was most efficacious, while Torgesen et al. argued for a much longer intervention. The latter results, however did vary in that they found four distinct subgroups with different treatment response patterns. Approximately 50% of the children were at or above average in reading by the end of the study. All children made significant progress and retained that progress as much as two years after the study although they did not continue the rate of gain made during the study. The best predictors of children's response were their attention and behaviour; general verbal ability; and prior levels of reading skills.

Replications of the Torgesen et al. study are needed. As argued earlier, more studies in which spelling is the focus would increase understanding. Further, more exploration of treatment length is required, as schools face practical restrictions in the amount of assistance that can be provided in an academic year. Documenting what if anything can be achieved in a limited period of time is interesting because:

- 1) It has realistic, practical applications;
- 2) It identifies the more severe students as needing different service delivery models;

- 3) It gives systematic accountability for services; and
- 4) It encourages teachers to be explicit about what has been done and what has been achieved, so that services in the future have clear guidelines where to re-start the child's program. Explicit carryover of programs from year to year is not standard practice in the schools as yet.

Subgroup and Individual Differences

Given discrepancies in intervention needs and outcomes for individuals and subgroups, further research is needed to better understand contributing variables. Two of the differences have already been described. The first was the length of treatment time that seemed beneficial for significant improvements in literacy development. The NRP meta-analysis indicated that 18-20 hours of instruction showed the greatest gains, whereas the Torgesen et al. study indicated that approximately 70 hours was necessary. One of the reasons for the difference may be that the former measure refers to the period in which the greatest gains were made, whereas the latter was a measure of how much treatment was needed in total. The second area of difference is that even given longer treatment time, some children still fail to improve. It may be that some of these children need more or different intervention methods.

As spelling demands change with age, children's ongoing performance success or failure may vary also. The age of the child, the severity of difficulty being experienced and the tasks administered vary enough in many studies to make comparisons difficult or meaningless. Although some best practices in spelling instruction are emerging, it is far from clear how those practices should be adjusted for different subgroups and individual needs.

There has been much debate as to the number of subsets of children that exist and their defining features with little resolution (McCardle et al., 2001). One subtype that identifies processing speed as well as phonological awareness seems to have some merit. However it is not well described as yet and the processing delay may prove to be a part of the general phonological problem. Tallal and Piercy (1973) have made claims that literacy problems are the result of difficulties in the speed of auditory processing.

The study included only children who are seven to ten years old, have phonological awareness delays and difficulties spelling.

Strategies

Ehri (2000) states that there are three ways to spell: by memory, invention and analogy. Invention requires the speller to identify all the sounds and apply the corresponding letter. Lennox and Siegel (1996) found that between Grade 2 and Grade 5 children shift from a phonological to an analogy strategy. For example, analogies would work for *panic* and *manic*, but not for *fright* and *white*. Snowling (1994) also noted that in order to be able to use analogies, a sizeable store of words would already have to be stored as a reference, making this skill of little use to younger spellers. As children get older, they can use more than one system and are likely to have stored more spelling chunks such as *-ound* (Ehri, 2000). None of these strategies however is totally reliable, although they should at least be monitored in a spelling program.

Spellings that do not conform to direct sound-letter correspondence are prevalent in English. Treiman and Bourassa (2000) argue that children use more than

sound-letter correspondence when they spell any words. They argue that, as well as using visual memory, spelling is a creative process with children—at least in some part— using knowledge of word derivations and other, often language based, strategies. For example, children become more aware of combinations of letter patterns that re-occur such as *-ed*, *-ate*, *-ion* (Becker, Dixon, & Anderson-Inman, 1980) and common rime stems such as *-ent*, *-ich* (Fry, 1994). In some cases further knowledge is required to know which spelling patterns should apply. For example, *threw* vs. *through* is spelled differently depending on the word's meaning. Some words such as *telephone* simply have to be remembered idiosyncratically (Ehri, 1992).

Not only are there specific spelling patterns which have to be learned beyond sound-letter correspondence competence, there are also spelling patterns which are not allowed. For example, in English every syllable has at least one vowel. Treiman (1993) showed that even Kindergarten children towards the end of the academic year, were already sensitive to allowable orthographic patterns such as *nuck* vs *cku*

Text Complexity

Although less direct other skills may affect spelling. Children need to use different syntactic structures when composing text. For example, cause/effect texts may be more likely to use words such as *because* and *consequently*, whereas comparison texts may use key words such as *although* or *but* (Westby, 1999). Familiarity with this language in spoken or written form will assist children to at least attempt the spelling of these words. Older children will be writing in many different genres and need to master words that reflect this competence.

Another important influence on spelling is the complexity of the ideas to be conveyed. Words will be expressed in more or less complex grammatical forms and represent more or less complex ideas. Kintsch and van Dyk (1978) termed these micropropositions and macropropositions respectively. Writing at higher levels may influence the words the child attempts, in that more complex vocabulary may be required. These additional skill requirements build progressively through higher grades. They also add to the child's processing load thereby requiring greater levels of fluency and automaticity at the written word level. It is reasonable to teach writing skills systematically building to the ability to write down cognitively complex ideas. Mastery should be assessed within a range of task difficulty from single words to complex ideas and text.

Although the focus of this study is at the word level i.e. spelling individual words, it can also be seen that other language skills may facilitate or tax a child's spelling skills. These factors, as described in the section on text complexity, are addressed at least to a limited extent in this study as the subjects in the study were seven to ten years of age and expected to use more complex vocabulary, sentence structure and variety of text genres.

Spelling Generalization

Spelling skills are of little use if they can only be used in word lists with words spelled using similar patterns. Spelling skills are only really useful if they can be used across all contexts including spontaneous writing tasks. Generalizing the use of spelling skills is fairly challenging as the child is expected to keep a coherent idea in mind as they accomplish the fairly demanding tasks of word recall, spelling,

handwriting and sentence construction. Part of the metacognitive strategies suggested by Meichenbaum (1982) include teaching for transfer and allowing sufficient practice to enable children to generalize their skills.

De Weck et. al. (2002a) found when they made the writing task less demanding by omitting elements, the Grade 4 children (average age 9.5 years) performed better at a spelling task. Interestingly – and surprisingly to the researchers – the Grade 2 children (average age 7.7 years) performed equally well on each task indicating that their orthographic representations were unstable in all conditions. In a similar study including Grade 4 children with spelling difficulties, de Weck et al. (2002b) found that these children performed similarly to the Grade 2 children in the previous study. In qualitatively analyzing the results they found that the phonological representations of the Grade 4 poor spellers were particularly unstable. The study was conducted in French and an example given of a phonology error would be something like *envant* instead of *enfant*.

How Children Learn

Frith (1985) noted that at around six and a half years of age normally developing children spell phonologically using a letter-sound correspondence strategy. Grade 1 children were shown to retain spellings of words after four practices (Reitsma, 1983) and Ehri and Saltmarsh (1995) found that word spellings were retained three days later after only a few practices. Ehri (2000) suggests a connectionist theory to explain children's spelling acquisition, which includes flagging silent letters in memory, creating special pronunciations e.g. *lis-ten* or *choc-o-late* (Drake & Ehri, 1984) or chunking spelling patterns such as *-est*. Ehri and

Wilce (1987) found that although reading words improved spelling it was not sufficient. Spelling demands greater accuracy.

Errors in Spelling

Frith (1980) noted that 12 year old poor spellers use a letter-sound strategy similar to normally developing 6 and a half-year-olds. She also noted that unexpectedly poor spellers, that is those who are good readers, make phonetic errors. These phonetic errors are the result of not being able to decide which grapheme is attached to an identified sound. This latter difficulty contrasts with phonological awareness plus phoneme-grapheme difficulties, which are experienced by children who are poor readers and spellers. If a child spells *plaid* as *plad*, the error is called phonological as the sound identification and sound-letter skills are intact, that is the alphabetic principle (Treiman & Bourassa, 2000). Some phonological errors cited by Treiman and Bourassa are less obvious such as *jragon* for *dragon*. *Ch* is a common substitution found for *tr*. Vowel omissions are common also such as *hr* for *her*. With these and other examples, Treiman and Bourassa make the point that children's phonetic errors may be broader in scope than adult errors. They also describe how children are more likely to group sounds than adults such as *bamblbs* for bumblebees. This last example also shows children's tendency to use letter names in their spelling. Treiman and Bourassa argue that relating spelling development to the development of children's phonological awareness more accurately captures the spelling development process than stage theories. They describe how children's spelling develops. One example is when children learn to put vowels before /r/ such as in *work* from *wrk*. They suggest that this evolves as children are exposed to written language.

Kamhi and Hinton (2000) reviewed several studies and found that the spelling errors of children with dyslexia were qualitatively similar to the spelling errors of younger children. In non-word spelling, children with dyslexia made phonological rather than visual errors e.g. *pit* for *pilt*. They also found that poor readers knowledge of orthography was commensurate with their spelling level. In a review of studies Kamhi and Hinton (2000) found that poor readers had difficulty applying morphological knowledge, which they already had, to the spelling task. Kamhi and Hinton conclude that poor spellers have particular difficulty “breaking words and syllables down into phonemes” (p.42). This is consistent with findings from other researchers such as Boder (1973) who found that the greatest group of poor spellers – 63 percent – had deficits in sound analysis or phonic skills.

Spelling and the Relationship to Reading

Spelling and reading competence share many of the same skills. Smith (1971), primarily by studying the patterns of words with a final *e*, argues that phonemic, graphemic and semantic representations are used in both activities. Ehri (2000) argues for a strong link between reading and spelling. Reading requires us to decipher words that have been spelled and we often read over what we have spelled. Ehri (2000) reviewed thirteen studies and found in eleven of them that reading and writing performance were correlated above 70. Ehri (2000) has also found effects of spelling development on reading development and vice versa.

There have been some inconsistencies in the findings of the congruence of reading and spelling in young children. For example, Gough, Ehri, & Treiman (1992) found that the inconsistency of knowledge between spelled and read words was only

8-11%. Although studies point to some discrepancy between reading and spelling with children having literacy difficulties (Gough, et al., 1992), spelling and reading difficulties were usually found to co-occur (Ehri, 2000). It is possible to find children whose reading is better than their spelling, but not the other way round (Kamhi & Hinton, 2000). Approximately one third of poor spellers are good readers, so what is different about them? From Frith's study in 1980, it seems that good readers-poor spellers have particular difficulty with sound-letter correspondence. Kamhi and Hinton (2000), after reviewing several studies of good readers-poor spellers with contrasting results found that linguistic factors can explain the differences between good and poor spellers whatever their reading ability. The common element among these studies is that the good readers-poor spellers are only proficient at either the decoding or comprehension aspect of reading. Given the strong relationship between reading and spelling and the many shared skills, it is often helpful to apply findings in one area to the other.

Applications in the Schools

Spelling typically is not taught systematically in Canadian schools. When a child is identified as experiencing spelling difficulties (s)he is usually put on a specific program. This may be individualized for the student, it may be a commercially available program, which may or may not involve computer time and it may be whole language based such as the Reading Recovery program (Clay, 1979). There is typically a lack of commitment to including the essential components of literacy instruction, these being phonological awareness, alphabetic understanding and automaticity with the code (Coyne, Kamee'enui, & Simmons, 2001: NRP, 2000).

This inconsistency may involve lack of school wide understanding and commitment to literacy goals and a lack of coordinated and adapted instruction for the range of learning needs. This last point is extremely important and directly made by Torgesen (2000), who stated that knowing the intensity and duration of intervention was also important when considering how to teach children, especially those with severe phonological disorders. Torgesen cites evidence that remedial programs for children provided in the public schools typically sustain reading failure rather than accelerating reading acquisition. Slavin (1994) found that children who were experiencing reading difficulties in Grade 3 were at serious risk for reading problems and dropping out of school. In Grade 3 children are expected to be able to read and start reading to learn.

Results of the Torgesen et al. (2001) study also beg the question of what should be realistic goals for some of the lower achieving literacy group who fail to show gains after specific, intensive programs. The only area of spelling, for the group as a whole that increased significantly was phonological spelling and more so for the group receiving the ADD program. Also word level reading skills were “normalized” for only a half to two thirds of the children in the study. This begs the question as to whether more of the same is needed for the lower group or whether they should use other strategies such as text talkers and dictating into the computer.

Due to limited resources being available, even if the needs of students are identified, the services may not be fully available in the schools. Accountability and understanding is needed for how much of what type of service is beneficial to children with severe spelling difficulties and for how long it should continue.

Conclusion

The importance of phonological awareness skills is well established, although the exact type and level of service is not established. From the preceding review of pertinent research in the field it can be seen that there is a need to understand better the services needed to improve the spelling skills of children experiencing the most difficulties especially older children. It is also necessary to address how these services might be administered in school settings that are unlikely to be able to provide the intensity of service required even when the need has been identified.

Chapter 3

Method

The following phonological awareness and spelling intervention study uses a multiple baseline design (Kazdin, 1982) with six participants. A single-subject research design was used in this study for several reasons. This design has been acknowledged for some time as being useful for intervention research studying functional behaviours (Skinner, 2005; Ysseldyke & Algozzini, 1995). The within-subject repeated measures allow detailed and sensitive documentation of the progress of skill acquisition, while still allowing control of variables (Kazdin, 1982). The single-subject design also allows detailed recording of individual behaviour and a dissociation from the hypothetical average found in many larger research designs (McReynolds & Kearns, 1983) thus giving the kind of additional detail needed in further response to intervention research (Compton, 2006). This design is accountable for efficacy and efficiency and with the multiple baseline design still allows causal statements to be made about the relationship between the intervention and the change in behaviour (McReynolds & Kearns, 1983). Below the participants, design, procedure, materials and measurements are detailed.

Participants

Six children between the ages of 7 and 10 years participated in the study. This age was chosen as the children were older than those typically given phonological awareness programs and as such of interest to help better understand the role of phonological awareness instruction of children beyond the first two years of school.

The older age group also allowed application of phonological awareness skills to more demanding writing skills than those expected of children in the first two grades. Phonological awareness competency is usually assumed in more complex writing tasks. Having an upper limit on the age range allows the implications of the findings of the study results to have a clearer and more specific application. Gender was not controlled for, though three girls (E1, H1 and H2) and three boys (E2, E3 and F1) were the participants.

The inclusionary criteria for potential participants were that they had native English language competence and had been identified within the previous 6 months as having spelling and phonological awareness problems by a teacher and speech-language pathologist in a public school in Western Canada. The tests used to identify potential participants were a score below -1 standard deviation on the Rosner 40 item Auditory Analysis Test (1979) and a score below -1 standard deviation on the Spelling subtest of the Wide Range Achievement Test-3 (1993) as well as teacher report of spelling difficulty in classroom assignments. More detailed assessment of these skills was collected during the study. Selecting students at this level a) allows generalization of the findings to a fairly wide range of students; however, b) is focused on a specific group with defined characteristics. The use of a single case design allows further inspection of response to intervention in relation to initial participant characteristics. As in the Torgesen et al. (2001) children were only included in the study if their verbal intelligence was estimated to be above 75. Peabody Picture Vocabulary Test – 3 scores ranged from standard scores of 96 to 117 with a mean of 107. The exclusionary criteria were a history of neurological,

emotional and/or sensory problems including hearing loss (bilateral loss below 20dBHL).

The identity of the study participants was not known to the researcher until after the participants had been randomly selected by group. After possible participants were identified, the study participants were chosen on a random basis (third, sixth and ninth groups were included in the study after groups were randomly listed). The participants were grouped with two or three students together according to age, ability and compatibility – as determined by their teachers. Three participants were in one group, two participants were in another group and one participant was seen with another child whose data was not used as he had previously received speech therapy services. Once allocated to a group the group membership was consistent throughout the study. Participants were only included in the study if they and their parents gave their informed consent. The parents were informed of the instructional goals of the program and were given information about the outcome. The parents were neither trained to support the program nor monitored for any additional support they may have been giving. The multiple baseline design enabled control of program effects separate from external factors.

Location

The experiment was conducted in a variety of school rooms as a function of room availability in the school. The rooms used were as quiet and free from interruption as possible.

Design

The design was implemented with six participants. It was a multiple baseline design with probes taken during treatment. The multiple baseline design was used to establish internal validity with a no treatment baseline period and careful monitoring of skills as new treatments were introduced. Pre-tests were given within four weeks of the start of the program. There was a baseline phase of six sessions. This was followed by four treatment phases lasting approximately 5 hours each with ten lessons in each phase except the first phase which had nine lessons. Each session lasted approximately 30 minutes. Tasks were designed to last approximately 30 minutes, however the number of items in each lesson was assumed to be a more interesting number than exact time during which a little or a lot might be achieved. The participants were seen three or four times a week. Each participant's intervention program lasted approximately 20 hours in total. Post-tests were given after Phase II (10 hours), after Phase IV (20 hours and the end of the program) and 2 months after the completion of treatment.

Procedure

Baseline

In the baseline phase eight randomly picked words from each of the four treatment phases were given to the participants in each of six sessions over a two week period with three sessions in each week. The words were balanced to represent the hierarchy of difficulty within each treatment phase. No words were repeated in any part of the program. The first eight words required the participant to use tokens to

represent each sound. The 24 words from the last three treatments were dictated by the examiner and written by the participant. Each word was said in isolation, repeated in a sentence then spoken again. Each iteration took approximately 5 seconds. If the child had not finished writing the word after 15 seconds, the word was given again. The child was given 30 seconds maximum to write the word starting from when the word was first spoken by the experimenter. A limited amount of time was chosen so that the probes did not take too long to administer, which could tire the child and cause class scheduling problems. Also writing is not functional unless it can be completed within a reasonable length of time.

Each participant serves as their own control in this research design, which allowed a sensitive measurement of each child's progress as well as overcoming the ethical concerns of a non-treatment control group.

Probes

In the treatment phases, 32 randomly picked words were administered at each probe – eight words from each of the four treatment targets as in the baseline phase. Administering the probes took a maximum of 16 minutes. In the treatment phases the probes were given by the author on randomly picked days once a week.

Pre-test and post-tests.

Each participant was given pre- and post-tests of phonological awareness and spelling as well as being asked to write a previously read story and write dictated sentences. The phonological awareness pre-tests were the Rosner (40 item) Test of Auditory Analysis (Rosner, 1971); and the CELF-4 Phonological Awareness subtest (Wiig, Semel & Secord, 2003). The Woodcock-Johnson III (2001) Spelling subtest

was used to test spelling. In addition to the standardized tests, the pre-tests and post-tests included the same tests given in the baseline and probes, which tested taught word patterns (always using un-repeated words). These tests were administered by the researcher in the children's schools in a quiet one-to-one environment.

As well, in the pre- and post-tests, each participant was asked to write eight dictated sentences. The sentences included words representing the patterns in the intervention phases. The sentences were repeated three times and spoken in phrases of up to seven words. The participants were also asked to write a previously read story. The stories presented were balanced as each was a one page biography of a famous character. Participants were given eight minutes to write the story. Some children have difficulty carrying over skills to more spontaneous writing so this was a limited measure of this skill.

The pre and post-tests were given within four weeks of the start and finish of the study respectively. An additional administration of the post-test was given after 10 hours of intervention - at the end of the second treatment phase and before the start of the third treatment phase. The tests were given in one session. An additional post-test was given to four of the participants two months after the end of the study (the other two participants were on vacation by the similar period after their program).

Intervention

The intervention was sub-divided into four phases. Each phase followed back-to-back. Each treatment session lasted approximately thirty minutes. There were three or four treatment sessions a week. The scheduling needs of the school dictated the

daily intervention times. The response accuracy of items attempted by the participants was recorded.

The focus of the first treatment phase was phonological awareness skill acquisition. Syllabic structure progressed from simple C (consonant) V (vowel) to complex CCCVCC. Short and long vowel contrasts progressed from acoustically less similar to more similar. The participants practiced and showed their skill by placing tokens in boxes. The box numbers remained stable and in excess of the number needed. The participants were given ten words each to segment. They took turns in the group. This activity was followed by an activity giving each child ten word sounds to blend into words. Following this the participants were again given ten words each to segment similar to the first task of the session. Finally each child was given ten words to read. Three groups of ten words were used throughout the session. Each child did phonological awareness and/or spelling activities with each list and the words were then re-used for the reading activity. The repetition of word lists served two purposes. It allowed repetition to scaffold the learning of children who were experiencing difficulties. It also allowed for control of phonological variables, which would not have been possible if more words were required as there would not be enough words for all the lists.

In the second and third treatment phases the focus was to apply the phonological awareness skills learned in the first phase to written words. The participants showed the number of sounds in the word using the blocks before they attempted to write the word. In the second treatment phase only monosyllables were used. Words with spelling rules as opposed to sound letter correspondence were

avoided. When spelling patterns that violated sound-letter correspondence did occur, they were pre-taught e.g. long vowels spelled with -e at the end, -all or g representing j. The words progressed from words with one or two consonants to as many as five consonants. The difficulty of the vowel and consonant tasks increased as described later in this chapter. Vowels were introduced with limited contrasts before the participant was asked to write them randomly. In Phase II the participants were asked to write ten words. They then had a blending task of ten words each followed by a writing task of ten more words. The session ended with ten words for each child to read.

In the third phase the words had more than one syllable. The participants showed the number of syllables using blocks before they attempted to write the words. They were reminded that every syllable has at least one vowel. Again the number of syllables and consonants increased as the treatment progressed. In Phase III the participants were asked to write ten words using blocks beforehand to show the number of syllables. This was followed by a syllabic blending task ie. words broken down into syllables rather than individual sounds. Each participant blended five words spoken in separate syllables by the examiner and then repeated five hard to pronounce words (Fergus, 1983). The participants finally wrote ten more multi-syllabic words. This was followed by ten words to be read by each participant.

In the fourth phase inflectional and derivational morphology was taught by pointing out the meaning adaptation as well as the different phonetic renditions of the spelling. For example the derivation of -tion changes the verb into a noun. The suffix pronunciation remains stable, but part of the root pronunciation may change. The

plural –s ending contrastively may be pronounced /s/ or /z/ as in cats and dogs respectively. The first, third and fourth tasks were similar to Phases II and III. The second task required the child to identify the derivational or inflectional morpheme in each of ten words from the root.

In the second to fourth phases the participant was asked in the final lesson of each phase to write dictated sentences and a previously read story. The spontaneous writing was used to encourage and examine generalization of skills. The participants were encouraged to edit their own work.

The intervention was provided by the investigator, who is currently employed as a speech-language pathologist and a special student assistant who was trained before and during the study and was also monitored weekly. The special student assistant administered approximately half the teaching sessions, but did not participate in the test, probe or baseline data collection. She did collect data during the sessions she administered. Both the speech-language pathologist and special student assistant are employed by the Western Canadian school district participating in the study. The lesson composition followed the patterns shown in the Figure 1 (p.55) with an example of each word type.

Teaching procedure

Each session began with a set of words at a skill level based on a hierarchy. The hierarchy of task difficulty and the order of item presentation were consistent across participants. The new pattern at the start of each lesson was taught with three examples given and then the experimenter assisted the participants in completing three more items. The participants were then asked to complete items independently.

When an error was made by any of the participants, the word was repeated. The participants took turns to complete sounds and letters with prompts as follows:

- 1) Show where the error is and ask the participant to correct it.
- 2) Point out previously completed items that follow a similar pattern to give a clue to correction.
- 3) The examiner or other participants demonstrated the correct answer.

Teaching strategy two was used at the discretion of the facilitator depending on the pacing of the group. Sometimes the lesson had a momentum which helped the participants to learn fluency of skills. In order to keep the momentum, errors were sometimes only partially addressed or addressed as a group at the end of the task.

The focus of the study was phonological awareness skill acquisition and its application to writing. The acquisition of spelling rules beyond sound-letter correspondence was considered to be a separate issue, however these rules are so copious that they cannot be completely avoided. Spelling rules were targeted systematically as necessary. It was necessary to include some long vowels as long vowels are part of the phonological knowledge that the child needed to acquire.

Facilitator training and monitoring

The adult facilitators of the program (the investigator and school assistant) ran several pilots of the program, which served as training. They also watched each other once a week give a lesson as a check that protocol was being followed.

Data collection

Responses were collected in written form for each phonological awareness task by the experimenter or special student assistant giving the program. These and

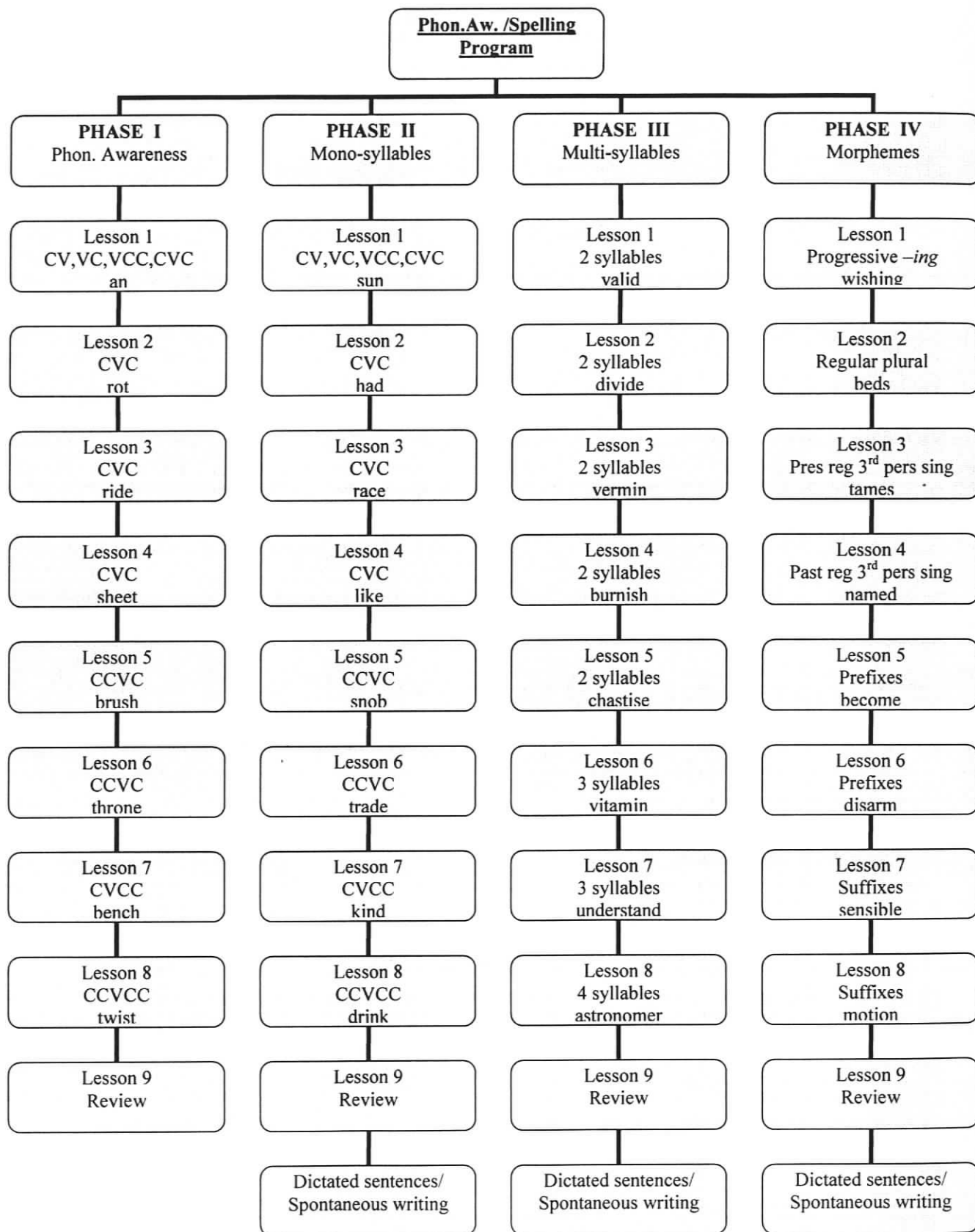
the students spelling attempts were scored by the experimenter. Only the first unassisted student response was scored.

Materials

Word lists

The following materials were used: a) word lists for phonological awareness activities and mono-syllabic activities, b) word lists for multi-syllabic spelling activities, c) word lists for derivational and inflectional morphology, d) pre-test and post-tests, baseline word lists and probes. The word lists followed strict patterns as described below and shown in Figure 1. Words conforming to these patterns were generated by the examiner or taken from Rosner (1979) or Mc Cracken and MacCracken (1996).

Figure 1 Phonological Awareness and Spelling Program



Control of phonological variables

The following phonological variables were controlled.

- 1) The use of continuants. These are made up of /f/, /v/, /th/, /l/, /r/, /m/, /n/, /s/, /z/, /w/, /y/, /h/ and all vowels. Continuants are typically easier for children to segment as the sound can be prolonged.
- 2) In contrast stop consonants are harder to isolate and identify because the acoustic signal is more fleeting. /p/, /b/, /t/, /d/, /g/ and /k/ are the set of stop consonants. Stop consonants were articulated carefully without adding additional sounds. A common mistake made with stops is to add the 'uh' sound so that words that should be segmented such as c-a-t become segmented as cuh-a-tuh. This is not helpful to the child as it is misleading.
- 3) Some morphemes are easier to identify and isolate than others. For example the -ed ending in walked is a /t/ sound, whereas the -ed in loaded is more pronounced as an -ed ending. The sounds that are easier to isolate in derivational and inflectional morphemes were worked on first. The set of inflectional morphemes are the present progressive -ing, plural -s and past tense -ed. The set of derivational morphemes is made up of prefixes, suffixes and roots. The prefixes are *pro-*, *un-*, *super-*, and *re-*. The suffixes are *-er*, *-y*, *-able* and *-tion*. The roots are *-ject*, *-teach*, *-do* and *-fix*.
- 4) Finally some vowel contrasts are easier than others. Vowels can be classified as being front or back in the mouth as well as being high or low in the mouth. These positional contrasts also assist in hearing contrasts when the sounds are

made at opposite quartiles as shown below. Greater contrasts were used initially when teaching mono-syllables:

	-Back (in mouth)	+ Back
+ High	A E i	OO o
- High	I a e	O u

Capitals = long vowels. Lower case = short vowels.

In addition the following spelling rules were pre-taught and prompted as needed.

- 1) Long vowels using a final silent *-e*.
- 2) Doubling of consonants before adding an *-ing* or *-ed* ending.
- 3) Changing *-y* to *-i* and adding *-es*.
- 4) *-ay*.
- 5) soft and hard *-g*.

In the phonological awareness phase the spelling patterns did not need to be controlled as the participants were not asked to write the word.

Ethics Forms and Permission letters

A letter was sent out to parents asking them to allow their children to participate in the study (see Appendix C). An ethics permission form from the University of Victoria was completed (Appendix D) as well as the standard permission to conduct research form from the school district (Appendix E).

Measures

The number of correct and incorrect words spoken and written independently was counted from the program tests. These were plotted on graphs and tables for visual inspection and averages were counted to aid comparisons. The standardized test measures were calculated for standard deviations and percentiles. Results are reported in chapter 4.

Chapter 4

Results

Data was collected at several different times during the study using both standardized and non-standardized tests. The standardized tests used were the Woodcock-Johnson-3 Spelling subtest; the Phonological Awareness subtest from the Clinical Evaluation of Language Fundamentals – 4; and the 40-item Rosner Auditory Analysis Test. These tests were only used for pre- and post-tests. Other non-standardized tests were used for pre-test, post-test, baseline and probe measures. These tests contained one representative word from each of the lessons which taught a new pattern i.e. the first eight lessons of each phase. The words used in testing and teaching were never repeated. Pre-test measures and three post-test measures were administered. The post-tests were taken half way through the program after Phase I and II were both completed (approximately ten hours of instruction); at the end of the program after Phases III and IV were both completed (approximately 20 hours of instruction); and - for four of the six participants - 2 months after the end of instruction. H1 and H2 were not available for the third post-test.

A multiple baseline design was used for the study. Following the pre-test, baseline measures were taken for six sessions. Three probes were then given to measure progress in each of the four phases. The probe tests and baseline measures were the same format as those given in the pre-tests and post-test, but with different words, though each representative of the 24 patterns taught. A probe was taken randomly after lessons 1-3, 4-6 and 7-9 of each phase. All tests used as part of the

multiple baseline design had 32 words. Each word represented one of the patterns taught in the program, so all tests were balanced and no word was ever repeated. These tests were also included in the pre-tests and post-tests.

Three questions were asked in the research.

1. To what degree can students older than 7 years be taught phonological awareness?
2. To what extent does any obtained increase in phonological awareness skills transfer to written language including words, dictated sentences, and the student's own writing?
3. What improvements in spelling skills can be made with students, who have severe difficulties, with either 10 hours or 20 hours of intervention?

The results follow:

Question 1: To What Degree can Students Between 7 and 10 years be Taught Phonological Awareness Skills?

Instruction in phonological awareness skills was given specifically in the first phase lasting approximately 5 hours. Practice in phonological awareness skills and application to written words were targeted in the last three phases. The first phase was made up of nine lessons each with two segmenting tasks, one blending task and one reading task. The participants were not required to write in the first phase. The monosyllabic words in this phase became longer or targeted different sound contrasts in each lesson except the last lesson, which was a review. Examples of controlled sounds were long and short vowels; continuants e.g. *m*, *l* and *r* and stop sounds e.g. *p*, *t* and *k*; and consonant blends. The other three phases included using the

phonological awareness skills when writing monosyllables, multi-syllabic words and words with derivational and inflectional morphemes.

This program was of particular interest for several reasons. Firstly it targeted children seven to ten years old, which is older than is typically studied and it attempts to address the question posed by the National Research Panel as to whether older children can be taught phonological awareness skills. Secondly the program used the best practices outlined in the NRP (2000) document. The list of best practices indicated that the use of segmenting and blending tasks as well as incorporating written letters into the program was optimal, though writing, as already stated, was not included in the first phase.

The results of phonological awareness training are shown in Tables 1, 2 and 3. Table 1 shows the results of the probe 3 test taken randomly after the seventh, eighth or ninth Phase I lesson. Only the results of the first eight items pertaining to phonological awareness skills are given as the other items required written answers. The participants started at either 0 or 3 out of 8 correct responses and moved to a range of 4 to 8 out of 8. The average score on the pre-test was 1.5. Near the end of the first phase (Probe 3) this increased to 6.5 and then showed a slight increase of 7.7 and 7 respectively in the first and second post-tests. It can be seen below in Table 1 that a similar pattern was seen for the 4 participants who also took the third post-test with no change being seen in the final, third post-test. These results indicate that the first phase of the program was successful in teaching phonological awareness skills.

Table 1

Scores out of 8 on Phonological Awareness Tasks Representing the Range of Sound Combinations Taught in Phase I of the Program.

Participants	Test administration				
	Pre-test	Probe 3	Post-tests		
		approx. 5 hours	10 hours	20 hours	2 months
E1	3	8	8	8	8
E2	3	7	8	7	7
E3	3	7	7	7	7
F1	0	4	8	5	5
H1	0	7	8	7	
H2	0	6	7	8	
Average	1.5	6.5	7.7	7	
Average change		5	6.2	5.5	
Average for 4	2.25	6.5	7.75	6.75	6.75
Average change for 4		4.25	5.5	4.5	4.5

In Table 2 the results of the CELF-4 (Clinical Evaluation of Language Fundamentals-4) Phonological Awareness subtest are shown. In this table it can be seen that five of the six participants started below criterion and after approximately 10 hours of instruction (the completion of Phase II) all participants were above criterion. After Phase II, participants had practiced writing the mono-syllabic word patterns as well as segmenting and blending them as they did in Phase I.

Table 2

Criterion Measures on the Phonological Awareness Subtest of the Clinical Evaluation of Language Fundamentals -4.

Participants	Pre-test	Post-tests		
		10 hours	20 hours	2 months
E1	above	above	above	above
E2	below	above	above	above
E3	below	above	above	above
F1	below	above	above	above
H1	below	above	above	
H2	below	above	above	

Table 3 gives the Rosner Auditory Analysis Test (40 item) data, which shows pre-test and post-test results. Participants' pre-test scores range from -2 to -1 standard deviations. At the second post-test, when the Rosner was next administered, all participants scored at or above average ranging from 0 to +1.5 standard deviations. The average change for all six participants was 2.05 standard deviations at the end of the program (post-test 2) and 2.13 for the four participants who then maintained a 2.25 average change in post-test 3.

The results shown track the progress of phonological awareness acquisition. All tests could not be administered after Phase I because of test – re-test effects as well as consideration for minimizing participants' time out of the classroom.

At least for the participants in this study, the results given in Tables 1, 2 and 3 show that phonological awareness skills can be taught fairly quickly to age appropriate levels with children in the 7 to 10 year old age range with a history of difficulty acquiring this skill. Errors were, in particular, difficulty segmenting vowels,

Table 3

Standard Deviation Scores on the Rosner 40-item Auditory Analysis Test.

Participants	Pre-test	Post-tests	
		20 hours	2 months
E1	-1.5	0	0.5
E2	-1.5	0.5	1.0
E3	-1.0	1.5	1.5
F1	-2.0	0.5	0
H1	-1.0	1.0	
H2	-1.0	1.0	
Average	-1.3	0.75	
Average change		2.05	
Average for 4	-1.5	0.63	0.75
Average change for 4		2.13	2.25

especially from preceding consonants and in adding voicing to voiceless sounds such as /t/ -> /tuh/ .

Tables 1-3 also show that once taught, the participants were able to maintain their phonological awareness skills. The CELF-4 scores shown in Table 2 are particularly clear as they show the move from below criterion scores in the pre-test (all except one participant) to above criterion scores for all participants in all the post-tests.

Results in Table 1 show that for the first 8 items of the multiple baseline data pertaining to Phase I, the scores stayed fairly consistent across all the post-tests with a small – though negligible – increase. It may be noted from Table 1 and Table 3 that although the initial Phase I teaching specifically targeting phonological awareness was efficacious, further writing tasks did not seem to increase the skill particularly significantly, though may have served to maintain it.

It is worth examining whether there are any inconsistencies between the tests. The trend is that the tests are consistent in the results. This is of some interest as the three tests asked the participants to do different phonological awareness tasks. The multiple baseline test, formulated for the study, asked participants to segment the sounds in each word spoken by the examiner by placing a block in a square as they said each sound. The CELF-4 Phonological Awareness subtest took considerably longer than the other 2 tests to administer and asked the participants to do 17 different types of phonological awareness tasks (18 sections plus training items) including primarily segmentation, deletion, substitution and blending activities. The Rosner test contains 40 deletion items. It seems that, despite the different tasks, the same underlying skill of phonological awareness is being tapped. This is of particular interest to clinicians considering the different length of time to administer tests as well as the detail of the results, specifically criterion scores versus standard deviations. Of note, the CELF-4 subtest took the longest to administer, but gave the least detail.

There are clearly strong general trends in all the data, but one to one matches of participant scores across different tests are not reliable. This was evident both by comparing the rankings on each test and by examining the gains measured. The CELF-4 was different from the other tests in, for example, not identifying E1 as having phonological awareness difficulties in the pre-test. The other two tests showed E1 as having significant pre-test difficulty with phonological awareness skills. Both H1 and H2 scored 0 for the multiple baseline test, but had two of the stronger Rosner scores at -1 standard deviation in the pre-test. As a result, they had two of the three

lowest scores for the multiple baseline pre-test, but two of the three highest scores for the Rosner pre-test. With some participants the tests did concur. For example the Rosner and program test both showed F1 as having the most difficulty with the pre-test. There were also inconsistencies in measures of change. The program test results showed improvements from pre-test to post-test ranged from +4 (50%) to +8 (maximum possible), which is a large range. In contrast all participants improved +2 to +2.5 standard deviations with the Rosner and scored at or above average.

It may be of interest to note the predominant error patterns in the tests. These were constrained by the nature of the tasks. However, some of the most common difficulties were with: deleting a consonant from a consonant blend, a multi-syllabic word and from initial word position; sentence segmentation; rhyme production; and blending. Clearly the most difficult task of all was phoneme substitution, where one sound had to be deleted and then replaced with another sound.

Question 2: To What Extent does an Increase in Phonological Awareness Skills Transfer to Written Language Including Words, Dictated Sentences, and the Student's Own Writing?

Phonological awareness skills have no value as an end accomplishment, but they are an underlying skill for literacy development. This question addresses whether teaching phonological awareness skills alone enhances writing. The research data also allows evaluation of whether or not teaching phonological awareness with letter-sound correspondence enhances writing skills. The following figures give the data for each participant and will be referred to later in this chapter. The figures are helpful in allowing a visual examination of the influence or lack of influence of intervention in

one skill area on another. The baseline establishes little movement in skills, for the period when the skills are not being taught. For example, for the most part, it can be seen that once a skill is achieved it is maintained, but it usually has to be specifically taught before any significant achievement is seen. The figures show, using the baseline and probe data, that as a general trend each skill increases during the phase in which it is taught. At the end of Phase I, when phonological awareness skills are taught alone, there is little transfer to written words. It is only when the written word is specifically taught with the phonological awareness that writing improvement occurs. There seems to be some transfer of benefit, though generally small, in all writing tasks once writing instruction begins.

The first 3 probes measure Phase I; instruction in phonological awareness. Probes 4-6 measure Phase II; instruction in phonological awareness and written mono-syllables. Probes 7-9 measure Phase III; instruction in phonological awareness and writing multi-syllabic words. Probes 10-12 measure Phase IV; instruction in phonological awareness and writing words with inflectional and derivational morphology. When phonological awareness skills were taught in Phase I the skill increased rapidly and was maintained through the program and follow-up for all participants. In Phase II, skills requiring written mono-syllables increased substantially, although not to 100% accuracy, and then for the most part were maintained or continued to make small steady progress until scores of seven or eight out of eight were achieved for five of the six participants. Any sort of writing essentially includes practice at mono-syllables. In most cases skills at writing multi-syllabic words increased in Phase III and were maintained, but the variability and

instability in results was more noticeable for this phase. Some variable increases in writing multi-syllabic words had occurred for the first three participants after Phase II. There was some increase for most participants in Phase IV words after Phases II and III, but the most increase occurred after specific instruction in these words during Phase IV. This is predictable given that the words were both monosyllabic and multi-syllabic as well as having particular morphological patterns.

Inspection of the post-test scores shows in general maintenance of phonological awareness gains and some drop in writing scores, but maintenance of levels above the baseline.

Figure 2. E1 pre-test, baseline, probe and post-test program data

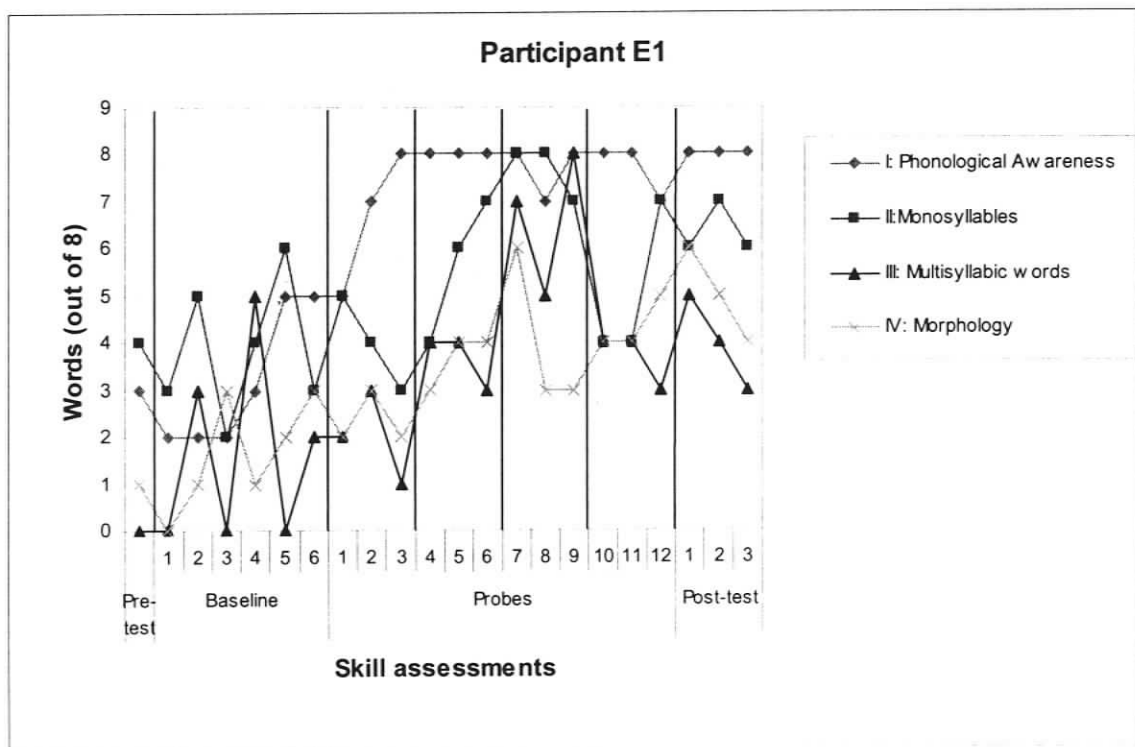


Figure 3 E2 pre-test, baseline, probe and post-test program data

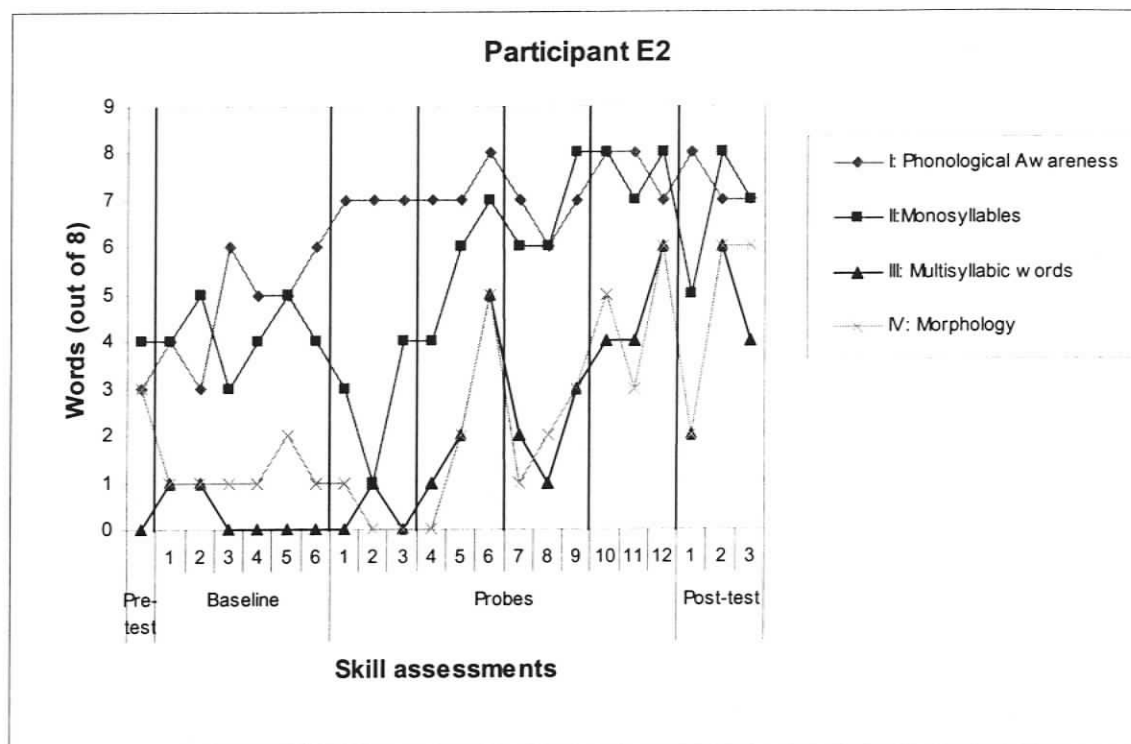


Figure 4 E3 pre-test, baseline, probe and post-test program data

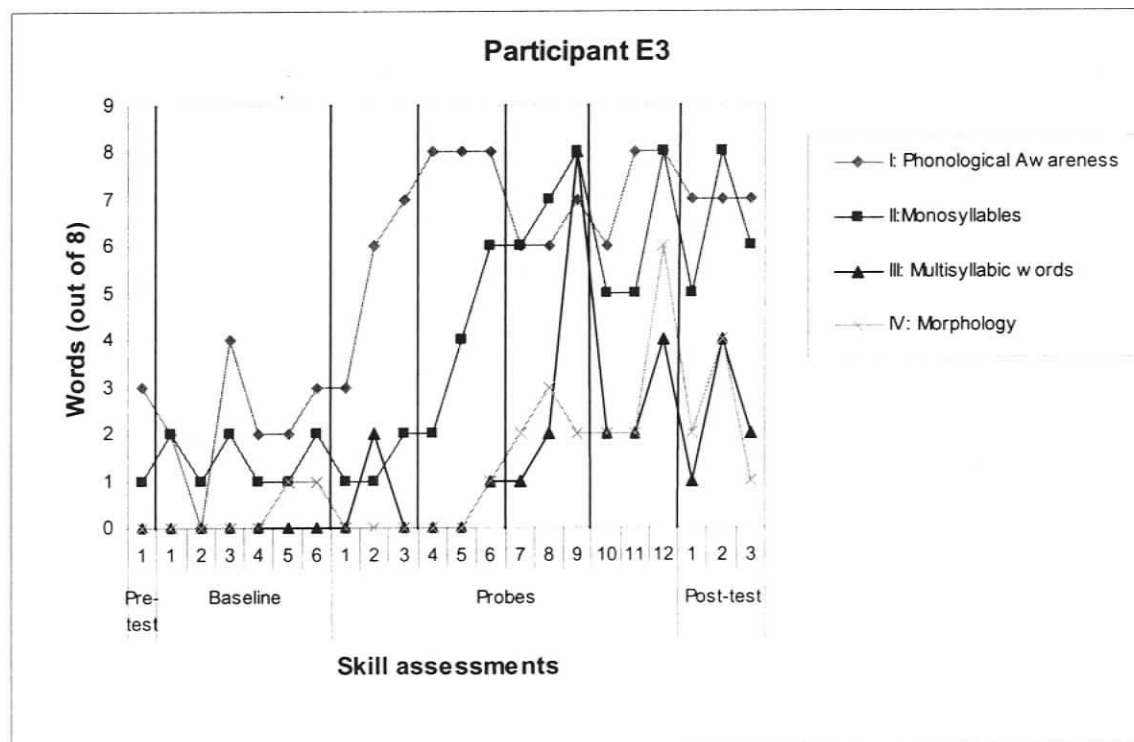


Figure 5 F1 pre-test, baseline, probe and post-test program data

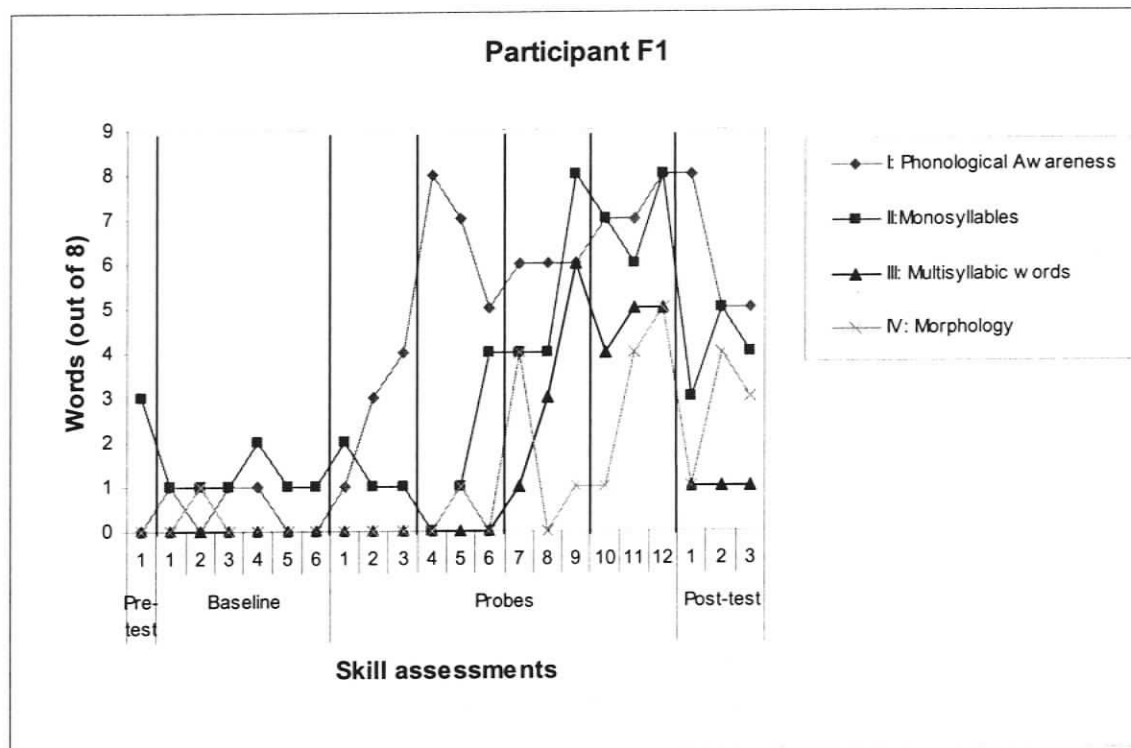


Figure 6 H1 pre-test, baseline, probe and post-test program data

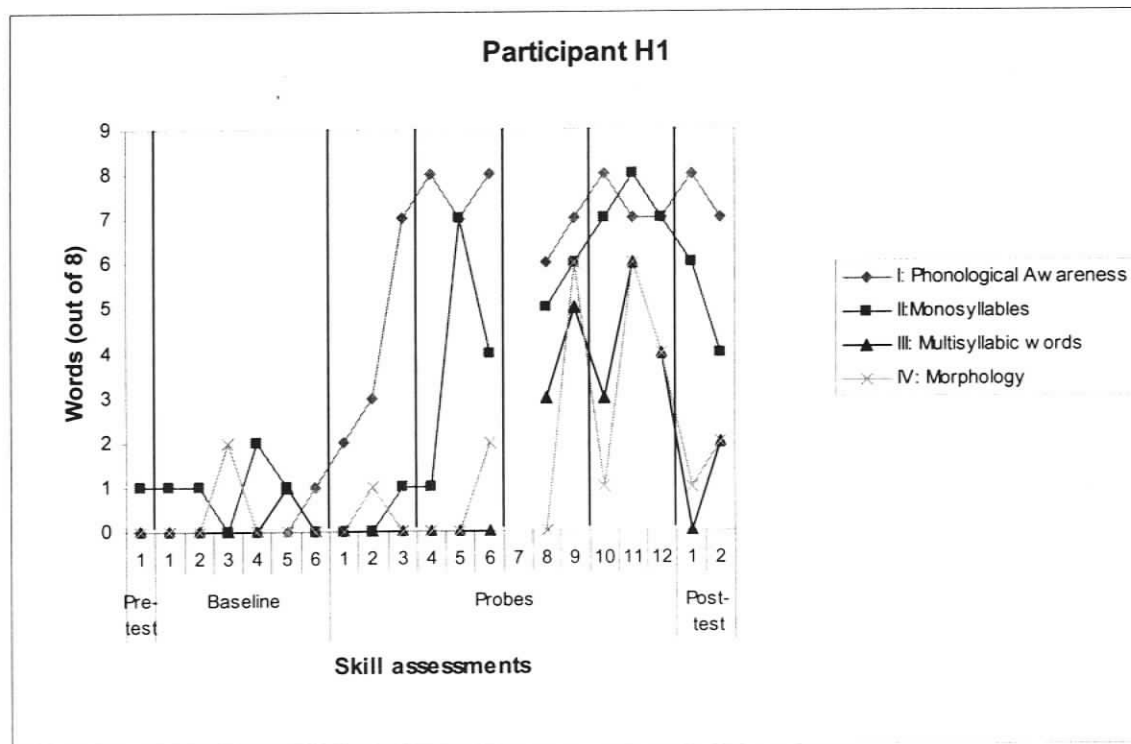
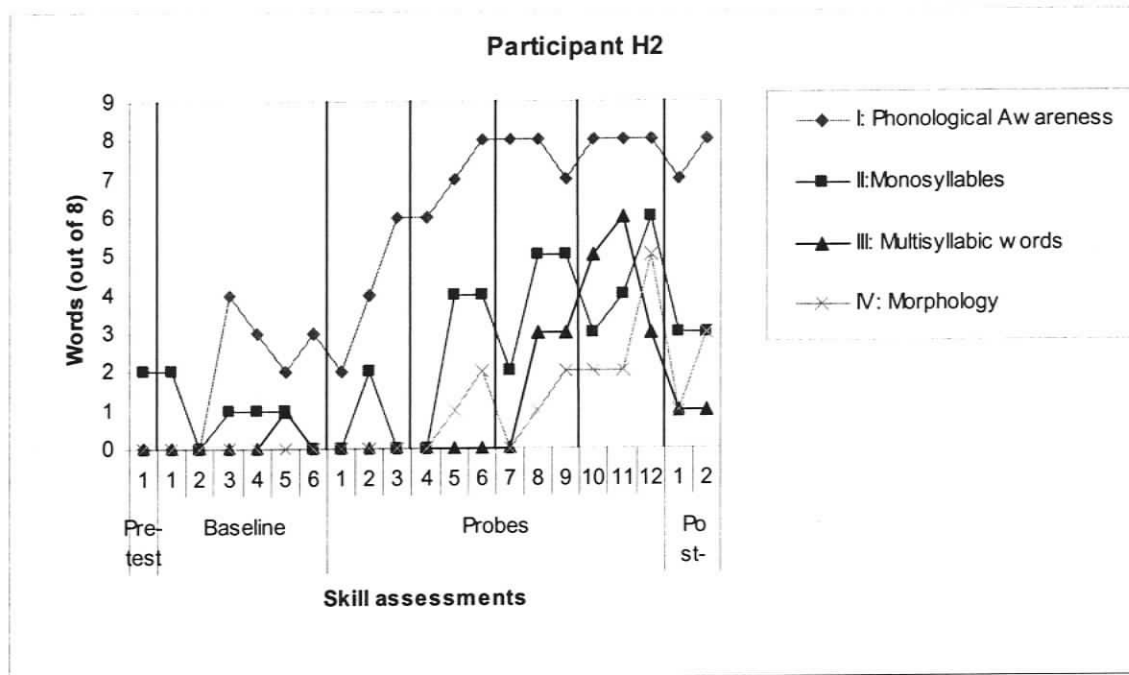


Figure 7 H2 pre-test, baseline, probe and post-test program data



Transfer to writing individual words

As the program had four phases, where different skills were taught, it is interesting to attempt to answer this question by looking at performance at the end of each phase. The only data taken at or towards the end of *every* phase was the probe data randomly collected after lessons seven, eight, or nine. The probe data assessed samples (not previously seen) from each lesson, so each probe task contained comprehensive and balanced samples of the skills taught. The results of the impact of teaching phonological skills on word learning can also be seen from the 6 figures above. Phonological awareness alone was taught in Phase I and results are given by the measures taken at probe 1, 2 and 3. The circles represent phonological awareness skills. A clear increase in phonological awareness skills during the first phase from the pre-test and baseline measures can be seen.

All participants significantly increased their phonological awareness skills when given the final probe at the end of Phase I as was shown earlier in the chapter. The results, however, indicate that phonological awareness training alone is not sufficient to improve word writing. This is evident from analyzing both the individual and averaged data. It can be seen in Table 4 and from visual inspection of Figures 1-6 that although phonological awareness skills increased an average of 5/8 none of the individual participant scores changed substantially on word writing tasks i.e. Phase II mono-syllables, Phase III multi-syllabic words or Phase IV words with derivational and inflectional morphemes.

Table 4

Participants' Performance Shown as Raw Scores after Phase I (Approximately 5 hours), Phonological Awareness Training. The Maximum Score is 8 (if the Pre-test had been 0).

Probe 3 results: measured as change from pre-test				
Participants	Phase I Phonological awareness	Phase II Mono- syllables	Phase III Multi- syllables	Phase IV +morphology
E1	3->8 (+5)	4->3 (-1)	0->1 (+1)	1->2 (+1)
E2	3->7 (+4)	4->4 (0)	0->0 (0)	3->0 (-3)
E3	3->7 (+4)	1->2 (+1)	0->0 (0)	0->0 (0)
F1	0->4 (+4)	3->1 (-2)	0->0 (0)	0->0 (0)
H1	0->7 (+7)	1->1 (0)	0->0 (0)	0->0 (0)
H2	0->6 (+6)	2->0 (-2)	0->0 (0)	0->0 (0)
Average	+5	-0.67	0.17	-0.33

Transfer of skills was only evident once the participants were asked to write the word after they have performed the phonological analysis. This was done during Phase II. Measures were taken again at the end of Phase II (approximately ten hours of training). By looking at individual data and the mean in Table 5, it can be seen that phonological awareness scores continued to improve a small amount from Phase I and some improvement was seen in writing mono-syllables – the skill that had been targeted. Transfer of these skills (sound-letter correspondence writing) to multi-syllabic words and words with more complex morphology (derivational and inflectional) was small or non-existent apart from E1 and E2, who did show some clear improvements in Phase III and Phase IV words.

Table 5

Participants' Performance Shown as Raw Scores after Phase II (Approximately 10 hours); Phonological Awareness Training Plus Writing of Mono-syllables. The Maximum Score is 8 (if the Pre-test had been 0).

Probe 6 results: measured as change from the pre-test

Participants	Phase I Phonological awareness	Phase II Mono- syllables	Phase III Multi- syllables	Phase IV +morphology
E1	3->8 (+5)	4->7 (+3)	0->3 (+5)	1->4 (+5)
E2	3->8 (+5)	4->7 (+3)	0->5 (+5)	3->5 (+2)
E3	3->8 (+5)	1->6 (+5)	0->1 (+1)	0->1 (+1)
F1	0->5 (+5)	3->4 (+1)	0->0 (+0)	0->0 (+0)
H1	0->8 (+8)	1->4 (+3)	0->0 (+0)	0->2 (+2)
H2	0->8 (+8)	2->4 (+1)	0->0 (+0)	0->2 (+2)
Average	+6	+2.7	+1.8	+2

Phase III teaches segmenting multi-syllabic words with consistent sound-letter correspondence to syllables and then writing them as well as blending words. So earlier skills are re-viewed and expanded on. At least from the small sample of participants in this study, Phase III (see Table 6) seems to be efficacious. E1 continued to make strong gains, but the gains were also large for most of the participants. As well, gains were seen in mono-syllabic words and words with more complex morphology. Phonological awareness skills held fairly steady.

Table 6

Participants' performance shown as raw scores after Phase III (approximately 15 hours); Phonological Awareness Training Plus Writing of Multi-Syllabic Words. The Maximum Score is 8 (if the Pre-test had been 0).

Probe 9 results: measured as change from the pre-test				
Participants	Phase I Phonological awareness	Phase II Mono- syllables	Phase III Multi- syllables	Phase IV +morphology
E1	3->8 (+5)	4->7 (+3)	0->8 (+8)	1->3 (+2)
E2	3->7 (+4)	4->8 (+4)	0->3 (+3)	3->3 (0)
E3	3->7 (+4)	1-> 6(+7)	0->8 (+8)	0->2 (+2)
F1	0->6 (+6)	3->8 (+5)	0->6 (+6)	0->1 (+1)
H1	0->7 (+7)	1->6 (+5)	0->5 (+5)	0->6 (+6)
H2	0->7 (+7)	2->5 (+3)	0->3 (+3)	0->2 (+2)
Average	+5.5	+4.5	+5.5	+2.2

The measures were taken again at the end of the program. The Phase IV scores increased as would be anticipated given that this skill had just been taught.

Phase I and Phase II scores remained fairly constant. However some individual variation was seen in score changes for Phase III words in particular. For example, E3 scored 8/8 for Phase III words after Phase III, but 4/8 for the same pattern of words after Phase IV. In contrast E2 scored 3/8 for Phase III words after Phase III, but 6/8 for Phase III words after Phase IV.

Table 7

Participants' Performance Shown as Raw Scores After Phase IV (approximately 20 hours); Phonological Awareness Training Plus Writing of Words with Derivational and Inflectional Morphemes. The Maximum Score is 8 (if the Pre-test had been 0).

Probe 12 results: measured as change from the pre-test				
Participants	Phase I Phonological awareness	Phase II Mono- syllables	Phase III Multi- syllables	Phase IV +morphology
E1	3->7 (+4)	4->7 (+3)	0->3 (+3)	1->5 (+4)
E2	3->7 (+4)	4->8 (+4)	0->6 (+6)	3->6(+3)
E3	3->8 (+5)	1->8 (+7)	0->4 (+4)	0->6(+6)
F1	0->8 (+8)	3->8 (+5)	0->5 (+5)	0->5 (+5)
H1	0->7 (+7)	1->7 (+6)	0->4 (+4)	0->4 (+4)
H2	0->8 (+8)	2->6 (+4)	0->3 (+3)	0->5 (+5)
Average	+6	+4.8	+4.2	+4.5

In conclusion it seems from these results that phonological awareness skills do not transfer to writing single words unless the skill was specifically applied to written words while is being taught. There is no evidence from this study that teaching

phonological awareness skills automatically transfers to improved single word writing.

Transfer to writing dictated sentences

A representative sample of word patterns were incorporated into sentences which were dictated to the participants to write. Eight sentences were dictated at each of the pre-tests and post-tests with two target words in each sentence. These target words were then analyzed for accuracy.

The first measure taken was for overall spelling accuracy. A correct or incorrect mark for whether or not the word was spelled accurately was given. Table 8 shows an average of 3.3 (20.8%) words spelled accurately on the pre-test with a range of 1 (6%) to 9 (56%) on the individual scores. On average scores doubled from the pre-test to the post-test after 10 hours. The range was from 1 (6%) to 11 (69%) words with minor shifts in ranking and an average score of 6.5 (40.7%) words. At the second post-test, after approximately 20 hours, there was an average increase of 0.8 (5.3%) to 7.3 (46%) correct words from the first post-test. This shows a large gain after the first two phases, but a much smaller gain after the second two phases.

Analysis of individual data showed a large difference in outcomes.

Participants E1 and H2 made no gains in skills after 10 hours of training, but an increase of 1 (7%) and 3 (19%) words respectively after 20 hours of training. The lack of progress, after the first two phases, in these two participants is especially interesting as one started with the highest score and one with the lowest. It is possible that E1 did not benefit from the first part of the program as she already had these skills and H2 was still unable to learn them. Whatever the reason, they were both still

Table 8

Dictated Sentences – Raw Score and % (in brackets) Correctly Spelled Words Plus Average Change from Pre-test.

Participants	Pre-test	Post-tests		
		after 10 hours	after 20 hours	2 months post-test
E1	9 (56)	9 (56)	10 (63)	10 (63)
E2	5 (31)	11 (69)	10 (63)	8 (50)
E3	1 (6)	6 (38)	7 (44)	5 (31)
F1	2 (13)	8 (50)	8 (50)	7 (44)
H1	2 (13)	4 (25)	5 (31)	-
H2	1 (6)	1 (6)	4 (25)	-
Average	3.3 (20.8)	6.5 (40.7)	7.3 (46)	
Average change		3.2 (19.9)	4 (25.2)	
Average for 4	4.25 (26.5)	8.5 (53.25)	8.75 (55)	7.5 (47)
Average change for 4		4.25 (26.75)	4.5 (28.5)	3.25 (20.5)

Note. Dash indicates that data was not collected.

able to benefit – albeit only slightly - from the later part of the program. These results in particular point to the need to assess individual learning needs as well as the potential for the program to assist children with different starting skills. The other participants made gains in a positive direction after 10 hours of training, ranging from 2-6 (12-38%) words. After approximately 20 hours of training the individual scores changed from the 10 hour post-test by -6% to +6% and by 7% to 37% from the pre-test.

The second measure taken of performance on words in dictated sentences was the percentage of letters correct. The program focused on segmenting sounds and

attaching a letter to the sounds. The second measure was more sensitive to the program goals and to what the participants were actually achieving with letter sound correspondence. For example a word with three letter errors would not be scored differently than a word with one letter error using the previous measurement. The second measure gives more marks per word and so one might intuitively expect higher scores. Conversely though participants could accrue several zero scores in just one word, if they got more than one letter wrong.

Results are shown in Table 9

Table 9

Dictated Sentences – Raw Scores and % Correct (in brackets) Letters Plus Average Change from Pre-test

Participants	Pre-test	Post-tests		
		after 10 hours	after 20 hours	2 months post-test
E1	68 (85)	69 (84)	70 (89)	74 (94)
E2	66 (83)	74 (90)	73 (92)	68 (86)
E3	50 (63)	63 (79)	62 (78)	65 (81)
F1	36 (45)	69 (84)	66 (84)	62 (78)
H1	44 (55)	48 (61)	64 (78)	
H2	46 (58)	44 (56)	54 (68)	
Average	51.7 (64.8)	61.2 (75.7)	64.8 (81.5)	
Average change		9.5 (10.9)	13.1 (16.7)	
Average for 4	55 (69)	68.8 (84.3)	67.8 (85.8)	67.3 (84.8)
Average change for 4		13.75 (15.25)	12.8 (16.8)	12.3 (15.8)

N.B. Raw score and percentage relationships change slightly when test words had different numbers of letters.

The scores for letters were indeed as much as two to three times higher than the scores for words. These results show a similar though smaller increase in skills over the course of the program with the largest increase in scores after the first two phases. Some sentences had words with a different number of letters so percentage scores may allow a more reliable comparison for this measure.

Table 9 shows an average of 51.7 (64.8%) letters used accurately on the pre-test with a range of 36 (45%) to 68 (85%) on the individual scores. The average is three times higher than the individual word score. The average change in scores from the pre-test to the post-test after 10 hours was only 9.5 (10.9%), so much smaller in real and relative terms from the whole word analysis in Table 8. The range of individual scores was from 44 (56%) to 74 (90%) with again minor shifts in ranking and an average score of 61.2 (75.7%) correct letters. At the second post-test, after approximately 20 hours, there was an average increase of 3.6 (5.8%) letters from Post-test I to 64.8 (81.5%) and by 13.1 (16.7%) letters from the pre-test. E2, E3 and H1 showed little if any change in their scores from the first post-test. The first half of the program seemed to be the most efficacious.

Analysis of individual data showed a similar, relative difference in outcomes to whole word measures. Generally gains were small and four score changes of 0 to -2 (-2 %) were noted in the first two post-tests. Participants F1 and H1 made the most gains with 33 (39%) letters and 20 (23%) letter increases from pre-test to post-test 2 respectively. For all participants, the changes after 10 hours of training, ranged from -2 (-2%) to 33 (39%) letters correct. After approximately 20 hours of training the individual scores changed from the 10 hour post-test by -1 (-1%) to 16 (17%) letters

correct. Both measures show some drop in skills at post-test 3 to scores at or below those at post-test 2.

Ironically the measure of letters correct, while capturing in more detail what the participants were doing, gave smaller differences in scores. The word measure shows participants may get small recognition (lower scores) for the many skills they have, which are more clearly shown when letters are counted.

Transfer to the students' own writing.

When the number of words correctly spelled in the participants' own writing was looked at (Table 10), the numbers were higher than the dictated sentences particularly for the pre-test. This could be explained by the participants choosing to use easier more familiar words. A small gain of 26 (9.65%) words was seen after the first post-test and 10.3 (14.3%) words after the second post-test from the pre-test with a drop of 3 (2.7%) words at the third post-test for the four participants. The pattern is similar to the dictated sentences.

Analysis of individual data showed a wide range of differences and in many cases the patterns of change in each participant were not similar to the patterns of change in the dictated sentences. For example, F1 showed a drop in skills from the pre-test and E2 showed a greater increase in scores in spontaneous writing than in dictated sentences.

It was not possible to count correct letters in spontaneous writing as it was not always clear what the word was that had been attempted. The number of words attempted was counted as an increase in output could be considered an improvement

Table 10

Spontaneous Writing – Raw Scores and % (in brackets) Correctly Spelled Words Plus Average Change From Pre-test

Participants	Pre-test	Post-tests		
		after 10 hours	after 20 hours	2 months post-test
E1	15 (60)	26 (65)	27 (67.5)	25 (67.6)
E2	1 (7.1)	18 (60)	24 (63.2)	17 (56.7)
E3	11 (47.8)	20 (46.5)	19 (45.2)	20 (46.5)
F1	9 (60)	6 (33.3)	25 (55.6)	17 (50)
H1	29 (51.8)	34 (60.7)	26 (61.9)	
H2	11 (28.2)	18 (47.4)	17 (47.2)	
Average	12.7 (42.5)	20.3 (52.2)	23 (56.8)	
Average change		7.6 (9.7)	10.3 (14.3)	
Average for 4	9 (43.7)	17.5 (51.2)	23.8 (57.9)	19.8 (55.2)
Average change for 4		8.5 (7.5)	14.8 (14.2)	10.8 (11.5)

in writing skill and it is also possible that an increase in the number of words attempted might make errors more likely to occur.

Looking at Table 11, it can be seen that the number of words attempted did increase on average 8.8 at the first post-test from the pre-test and 11.8 at the second post-test. For the four participants who had a third post-test the number of words changed by 13.6 at the first post-test from the pre-test; by 22.1 at the second post-test from the pre-test and by 16.7 at the final 2 month post-test from the pre-test. These increases seem quite substantial. It is possible that the participants were more confident in their writing with their new skills. They were only given 8 minutes to write.

Table 11

Spontaneous Writing – Number of Words Plus Average Change from Pre-test

Participants	Pre-test	Post-test		
		after 10 hours	after 20 hours	2 months post-test
E1	25	40	40	37
E2	14	30	38	30
E3	23	43	42	43
F1	15	18	45	34
H1	56	56	42	
H2	39	38	36	
Average	28.7	37.5	40.5	
Average change from pre-test		8.8	11.8	
Average for 4	19.3	32.8	41.3	36
Average change from pre-test		13.6	22.1	16.7

Question3: What Improvements in Spelling Skills can be Made with Students After Either 10 hours or 20 hours of Intervention?

Improvements in spelling skills were measured using the Woodcock-Johnson III Spelling subtest and the results from the program pre-tests and post-tests. 10 hours and 20 hours are approximate instruction times and refer to the end of the first two phases of the program and the full four phase program respectively. The times are only approximate as groups completed the phases in different lengths of time. In particular the first two phases were usually completed in less than 10 hours. The measures were taken at 20 hours to capture any changes as a result of the program; at 2 months post-test to try to capture the long term effects of the program; and after 10 hours to describe if the first half of the program was worth administering should there

be only limited resources as is often the case in schools. It was also beneficial to investigate whether 20 hours of instruction produced significantly more benefit than 10 hours.

In tables 13 and 14 the results of a standardized test, the Woodcock-Johnson III Spelling subtest are reported for the pre-test, after approximately 10 hours (first two phases), after approximately 20 hours (the full four phase program) and 2 months post-test. The two month post test was only given to the first four participants because of the intervening summer holiday. The Woodcock-Johnson III is a commonly used standardized test. The results show on average a small increase in spelling skills after 10 and 20 hours with a great deal of individual variability. Contrary to what would have been predicted, there is a drop in the average scores after 20 hours from the scores after 10 hours. The score after 2 months actually drops below the pre-test score. Individual scores ranged widely with some participants showing little change, such as H1 and H2, and other participants such as E3 and F1 making improvements only to lose them later.

It is possible that teaching sound-letter correspondence actually makes spelling worse on words with spelling rules and spelling anomalies as it is a strategy that will not work for those words. Also performance on only a few words on this test has a significant impact on scores. Words are not systematically controlled through the test for letter-sound correspondence, spelling rules or spelling anomalies. For example, each word the participant has to write changes the score by about a 2 month age equivalent. Items 17 to 22, around where many participants were starting to have difficulty, exemplify these points: my, book, had, bee, yet and cake.

Table 12

Percentile Results of the Woodcock-Johnson Spelling Subtest

Participants	Pre-test	Post-tests		
		after 10 hours	after 20 hours	2 months post-test
E1	21	26	18	9
E2	12	11	19	9
E3	22	44	41	23
F1	9	17	9	8
H1	23	25	23	
H2	10	10	8	
Average	16.17	23.8	19.7	
Average change		7.63	3.53	
Average for 4	16.88	24.5	21.75	12.25
Average change for 4		7.62	4.87	-4.63

Table 13

Standard Score Results of the Woodcock-Johnson Spelling Subtest (mean = 100; Standard Deviation +/- 15).

Participants	Pre-test	Post-test		
		after 10 hours	after 20 hours	2 months post-test
E1	88	90	86	80
E2	83	81	87	80
E3	88	98	96	89
F1	80	86	80	79
H1	89	90	89	
H2	81	81	79	
Average	84.83	87.67	86.17	
Average change		2.84	1.34	
Average for 4	84.75	88.75	87.25	82
Average change for 4		4	2.5	-2.75

As the scores of the spelling test revealed no clear trend, the results were compared directly with the program test (omitting the first 8 words as they did not require any writing). Tables 14, 15 and 16 allow a straight comparison between writing words with a direct sound-letter correspondence (program test) and writing words that also have spelling rules and spelling anomalies.

Table 14

Skill Increase From Pre-test to Post-test 1 (at the End of the 10 hour Program)

Comparing Raw Scores

Participants	Letter-sound correspondence (out of 24)	Spelling Woodcock-Johnson III (out of 24 for 1 st 24 words)
E1	5 -> 17 = 12	22 -> 24 = 2
E2	7 -> 9 = 2	20 -> 20 = 0
E3	1 -> 8 = 7	17 -> 22 = 5
F1	3 -> 5 = 2	21 -> 24 = 3
H1	1 -> 7 = 6	20 -> 22 = 2
H2	2 -> 5 = 3	18 -> 19 = 1
Average	3.2 -> 8.5 = 5.3 (13.3% -> 35.4% = 22.1%)	19.5 -> 21.8 = 2.2 (81.3% -> 90.8% = 9.5%)

In an attempt to make the comparison more meaningful the raw score results for the first 24 items of the Woodcock-Johnson III are also reported. The raw scores should only be studied as a general indicator. Although raw scores can be misleading the advantage is that changes in standard deviations and percentiles that are skewed by things like a participant moving into another age range are less marked.

It can be seen from a comparison of these two measures that:

1. There is a great deal of individual variability.
2. The highest scoring participants are not consistently the highest scoring participants on both tests and the same can be said of the lowest scoring participants in general, although E3 shows the most gains on both tests.
3. The results on one test do not predict success on the other test. For example, at the end of the 20 hour program, there was no increase in gross spelling skills for three of the participants; small gains (5%iles and 8%-iles for two participants and a large gain for one participant (26%iles). Gains for letter-sound correspondence on the hand ranged from 13 – 54% with an average increase of 41%.; and
4. The gains for sound-letter correspondence seem to be much greater than for the overall spelling test. The sound-letter correspondence words improved 22% after 10 hours, almost double to 41% after 20 hours and were 15% improved at the 2 month post-test. The overall spelling skills as measured by the Woodcock-Johnson III showed an increase of 9.5% after 10 hours, 9% after 20 hours and 4.2% at the 2 month follow-up.

Table 15

Skill Increase from Pre-test to Post-test 2 (at the End of the 20 hour Program) using Raw Scores

Participants	Letter-sound correspondence (out of 24)	Spelling Woodcock-Johnson III (out of 24 for 1 st 24 words)
E1	5 -> 16 = 11	22 -> 23 = 1
E2	7 -> 20 = 13	20 -> 23 = 3
E3	1 -> 16 = 15	17 -> 22 = 5
F1	3 -> 10 = 7	21 -> 22 = 1
H1	1 -> 8 = 7	20 -> 22 = 2
H2	2 -> 7 = 5	18 -> 19 = 1
Average	3 -> 13 = 10 (13 -> 54 = 41%)	19.7 -> 21.8 = 2.2 (82 -> 91 = 9%)

Table 16

*Skill Increase from Pre-test to Post-test 3 (2 Months After the 20 hour Program)
using Raw Scores*

Participants	Letter-sound correspondence (out of 24)	Spelling Woodcock-Johnson II (out of 24 for 1 st 24 words)
E1	5 -> 13 = 8	22 -> 21 = -1
E2	7 -> 17 = 10	20 -> 21 = 1
E3	1 -> 9 = 8	17 -> 20 = 3
F1	3 -> 8 = 5	21 -> 22 = 1
Average	4 -> 7.8 = 4.8 (17% -> 32% = 15%)	20 -> 21 = 1 (83.3 -> 87.5 = 4.2%)

Conclusion

In conclusion the results suggest significant improvements can be made in the skill areas specifically taught. The first question addressed the ability of older children to learn phonological awareness skills. This program, at least for the participants involved, proved to be both efficacious and efficient in teaching phonological awareness skills. No significant progress was made in writing skills from phonological awareness teaching alone. This finding supports earlier studies (NRP, 2000) and shows that at least in this regard writing differs from reading. Progress was made in specific writing skills as they were taught with some evidence of a small interaction in writing skills. There seemed to be little benefit in overall spelling from the program, certainly by the 2 month follow-up. There were significant benefits in both the ten and 20 hour programs. These findings indicate the need for explicit instruction in the deficit areas. The individual variability in the results shows the need for adaptations of programs to individual participants' needs.

Chapter 5

Discussion

Introduction

The study examined whether phonological awareness and spelling skills could be taught to children between seven and ten years of age in approximately twenty hours. Six participants were studied using a multiple baseline design. The results, for the six participants studied, indicated that older children experiencing difficulty acquiring literacy skills can learn skills efficiently in that period of time and may benefit from more explicit and systematic instructional methods than younger children. The participants were able to learn age-appropriate phonological awareness skills within the first five hours of the program and some spelling skills, over the 20 hours, which were specifically taught. Limited carryover of skills to other writing tasks was seen. As well as teaching skills, the program addressed limited resources in schools by using a 20 hour program and taking measurements after 10 and 20 hours. The results showed what skills could and could not be taught in a limited period of time and addressed the relationship between phonological awareness and spelling. The results will be discussed in more detail as well as other factors which influenced the program and outcomes. Suggestions for further research will be made.

Phonological Awareness

Phonological awareness skills increased consistently and rapidly in the program within the first five hours - and the skills were maintained after the program in the 2 month post-test. The participants were all significantly delayed in their

phonological awareness skills at the start of the program. The significant gains in phonological awareness were anticipated from clinical practice, though not the efficiency of the gains. Efficiency, as in the rapidity of the increase, was unexpected as the participants' acquisition of literacy skills had appeared to be delayed up to the beginning of the program. The explanation for this unexpected finding may be in the explicit rigour of the research program. The participants had been exposed to sound segmentation teaching, at least incidentally to some degree, during a minimum of two and a half years of classroom teaching. The findings of the present study demonstrate that children between seven and ten years of age are able to learn phonological awareness skills in a structured, explicit program with multiple opportunities to practice, despite having low scores in this area at the onset of the study. There is no reason to suppose that phonological awareness skills are any less useful for older children than younger children, when they are developing early literacy skills. The results indicate that even a group of children that has failed to develop phonological awareness skills typically can develop these skills fairly quickly with explicit instruction.

The program differed from many others by teaching phonological awareness in a way that was more challenging for older children. Many phonological awareness programs deal only with simple mono-syllabic words, whereas the research program used words with multiple consonants and applied the phonological awareness skills to writing words with multiple syllables and complex morphology. Although it did not deal with explicitly teaching writing beyond the word level, it did stretch the ability to learn and apply phonological awareness skills in some of the most complex word

environments. This was deemed important as these skills need to be over-learned, semi-automatic and robust beyond a simple word level. Sometimes the early tasks seemed too easy for the participants, but appeared to help the confidence of many children in that they were finally doing a literacy task that they found easy.

Transfer from Phonological Awareness

Although sound-letter correspondence writing skills improved with explicit instruction, the improvements only occurred once the skills were taught. A significant finding of the study, which the multiple baseline design showed clearly, was that improvements in phonological awareness skills did not seem to cause improvements in writing any of the words sampled from Phases II, III and IV. After Phase I, which taught only phonological awareness skills, the scores for each of the 3 sets of words in the study - mono-syllables, multi-syllabic words and words with derivational and inflectional morphology - only changed on average, for the 6 participants, -0.67 (-8%), 0.17 (2%) and -0.33 (-4%) respectively. Despite the very large gains in phonological awareness skills, there seemed to be no measurable, automatic transfer to writing words. Clearly improvements in spelling only occurred once writing words was included in the lessons.

The results were surprising for two reasons in particular: firstly, some improvement of writing skills might be expected from phonological awareness teaching alone as is seen with reading (Vellutino & Scanlon, 1987); and secondly, some of the spelling words tested consisted of words with letter-sound correspondence – just the words most likely to benefit from phonological awareness training. The finding was, however, consistent with findings from the NRP meta-

analysis (2000), that showed phonological awareness training does not help spelling in students with learning disabilities and that this population of students finds the acquisition of spelling skills particularly difficult. As children need to be able to segment the sounds in words in order to be able to write, it can still be argued that teaching phonological awareness segmenting skills is a necessary precursor to teaching spelling.

Some small transfer of skills was measured in some cases from one writing task to another, for example when writing multi-syllabic words was taught there was some transfer to writing words with more complex morphology. There was also some transfer to writing sentences, but the gains were not sustained in all cases. There was also some increase in the number of words written spontaneously. From the results of this study it seemed that specific skills, for the most part, needed specific teaching and practice before they were acquired, although some transfer effects were measured. Similar findings have been reported when teaching reading to children with severe learning disabilities (Torgesen et al, 2001).

Words

As predicted each of the three word patterns taught: mono-syllabic words, multi-syllabic words, and words with derivational and inflectional morphemes, improved after they were explicitly targeted during each of the last three phases of the program. After Phase II, there was some increase in all three areas, though the greatest increase was with the writing of mono-syllables, which were being targeted. Phase III results showed consistently good increases in writing multi-syllables, with a significant increase in writing mono-syllabic words (Phase II patterns). Phase IV

seemed to only have a positive effect on writing the words being targeted on average, that is words with derivational and inflectional morphology.

In general, it would be prudent to conclude that skills need to be specifically taught. Given the large gains of 2.7/8 to 4.5/8 (22.5%) in writing mono-syllabic words and 1.8/8 to 5.5/8 (46.25) in writing multi-syllabic words when multi-syllabic words were taught, the results also suggest that older children benefit from the use of harder tasks that are more intellectually and academically appropriate for their age, whilst still practicing basic literacy skills. The difficulty in transferring skills experienced by this population suggests there is benefit to teaching words of increasing length as systematically and explicitly as teaching the simpler words that are the more usual focus of early literacy programs.

Spelling words tested using the Woodcock-Johnson III spelling subtest showed less improvement after Phase II than the program word tests. The average percentage increase for program words with primarily letter sound correspondence was 22.1% (it should be noticed that there was a small difference between the percentage of test item words from Probe 6 - towards the end of Phase II - and the first post-test, which was directly after Phase II), whereas the average for the Woodcock-Johnson spelling subtest was 9.5%. The difference was likely because, on the Woodcock-Johnson III, there were few items that contained letter-sound correspondence words and there were also words with spelling rules and spelling anomalies. This finding indicates that problems with transfer are pervasive, that is not only from phonological awareness to writing, but from spelling task to spelling task. This again supports the case that individual skills may need to be isolated and

specifically taught to children with learning difficulties. Some caution has to be used in interpreting the results, as the first 24 items of the Woodcock Johnson were used so that a comparison could be made, but the pre-test Woodcock-Johnson score was higher than the program test score and so arguably may have shown less improvement, because the scores were already nearer the ceiling and so possibly less sensitive to any gains made. The initial average score on the test items was 3.2/24, whereas the initial average score on the first 24 items of the Woodcock-Johnson III spelling subtest was 19.5/24.

Dictated Sentences

The intervention did not address writing skills beyond the word level, though some testing of dictated sentences and spontaneous writing was done as an initial exploration of transfer of skills. The transfer was limited. Performance when writing specific words in dictated sentences was measured. The greatest benefit in writing words in dictated sentences seemed to occur after the second phase, particularly for three of the participants. Some improvement was measured after Phases III and IV combined, but it was much less than after the second phase. The two month post-test showed a small drop in scores, which is discouraging because developmental and educational influences alone would be predicted to cause some positive change. There were very large individual differences on this measure. Word counts rather than letter counts gave much larger ranges in the data, though it can be argued that letter counts are more sensitive to the actual skills of the participants.

Spontaneous Writing

There were average gains of 9.7% after the first post-test (10 hours instruction), and 14.3% after the second post-test for the number of correctly spelled words in spontaneous writing. There was still an 11.5% gain from the pre-test, in correctly spelled words, for the four participants given the 2 month post-test. This indicates some quite positive changes and transfer to spontaneous writing – though quite possibly not enough to be noticed anecdotally by a teacher with a class of 20-30 children. The number of words written also increased by 8.8%, 11.8% and 16.7% respectively from the spontaneous writing pre-test. Spontaneous writing improved more than dictated sentences, which is surprising given that the dictated words measured were based on taught patterns and following dictation. This had been presumed easier than writing spontaneously. It is possible that the open-ended ability to choose words, which the participants had in the spontaneous writing task, mitigated any benefit of the dictated sentences. These findings and transfer of skills need further study, particularly as the task used was a limited time story re-telling task. Other tasks may elicit quantitatively and qualitatively different results (Westerveld, Gillon & Miller, 2006). Further investigation of how to teach transfer of skills rather than simply monitoring, as was done in this study, is warranted because ultimately it is the improvement of skills in spontaneous writing that is the target. Anecdotal reports from teachers of the participants, indicated improved confidence and reading skills rather than spelling. In fact one child who had cried daily with frustration stopped crying. Understanding what level of spelling improvement would be needed in class

to typically receive approbation from a teacher would be of interest as the levels in this study did not seem sufficient.

Conclusion Regarding Spelling Intervention

The results of the study indicate that spelling skills are fairly resistant to change, though sound letter correspondence writing as well as accuracy and quantity of spontaneous writing did show clear gains. It may be more helpful to consider spelling skills as having three components, especially when addressing the needs of children with learning challenges. These components are letter-sound correspondence, spelling rules and spelling anomalies. The present study only addressed letter-sound correspondence. In this area significant improvements were measured, but the skill was not remediated as decisively as phonological awareness. In some ways it is easy to understand why an automatic transfer of spelling skills was not seen as the three main components of spelling skills do make quite different demands on the writer. On the other hand, transfer of skills from one domain to another can be seen from phonological awareness to reading. The finding of lack of transfer within writing, points to the need for research to clearly separate the different aspects and increments of all spelling skills which need to be taught. Differentiation of the different spelling skills and writing tasks should be made when results are reported. This is not typically done. It also suggests the need to explicitly teach each skill set separately, at least to children with learning difficulties in this area.

Program Length

Given the limited resources in many schools, the results do indicate that significant benefit can still be made with short periods of intervention. When

resources are limited it is helpful to be able to use all time so that it has benefit and is accountable. Sometimes children are unable to do a task, but there is insufficient documentation to judge whether the child needs further teaching or whether other strategies or instructional methods should be implemented.

Progress in the research program occurred in a fairly time efficient manner. Despite fluctuations, progress was measured in all areas specifically targeted in the program. It is clear from this program, which skills required more intervention, which skills were acquired and which skills were not covered by the program, but needed to be addressed. There was also monitoring of skills, such as application to spontaneous writing, which were not specifically addressed in the program, but were the ultimate goal of the skill development. The advantage of this careful documentation is that it becomes very clear where the next skill practice should be focused. This is important for efficient use of children's time and school resources. It is also helpful if the service is being provided in blocks with breaks in service as it helps educators to know where service should re-commence, when it is available.

Participants not only showed benefits from the 20 hour program, but for several measurements the most gain was made in the first 10 hours of the program. The ten hour measure was taken because sometimes there may not be the resources to carry out the full 20 hour program and so the question was included to explore whether ten hours alone was beneficial. Phonological awareness skills were all at or above average after the first five hours. All participants responded with significant gains, except F1, to the second phase, which taught writing of mono-syllables, with some transference in a few cases such as E2 to other word writing. With most

participants the largest gains in writing dictated sentences and in spontaneous writing occurred in the first ten hours of instruction. It therefore seems that not only is ten hours of instruction efficacious it can stand alone as a useful program of instruction.

For phonological awareness the changes were very clear. Every participant moved from a significantly low score to a score at or above average. For the other measurements both starting skill level and change vary from nil to large on many of the assessments. These results invite replication. Apart from phonological awareness and the writing of mono-syllables, all other skills were still far from being fully acquired by the end of the program. Further instruction was clearly still required for some of the skills taught.

The Nature of Spelling

The findings did point out that the question was too broad in asking whether spelling can be improved. Despite the many measured gains, stable improvement in overall spelling skills as measured with the Woodcock-Johnson III spelling subtest was not seen. When the participants were asked to spell words with spelling rules and spelling anomalies, which they had not been taught, they did not show any consistent improvement and indeed if they had applied strict sound-letter correspondence rules, which had been taught, may even have regressed in their approach to spelling some of those words. This finding suggests that spelling skill assessment and instruction should be approached differentiating these three skills. The study had already separated several components of the writing skill such as syllable length and morphological complexity as well as writing beyond the word level.

Group size

The program was given to children in groups of two or three, which worked extremely well as gains in skill acquisition were made, while adult teaching time was kept to two or three times less than it would have been with individual instruction. The children seemed to learn from each other and sometimes some healthy competition occurred spontaneously. An advantage of grouping children is that it is an efficient use of teaching time, so that ten or less hours of instruction needed to be allocated per child and if only the first two phases were given then less than five hours would be needed per child. This time allocation would be available in most settings. The word lists were re-used throughout each session: three lists of ten words were cycled through activities and participants during each lesson. This had originally been done because there were not always enough words for each target pattern to generate any more word lists. Anecdotally the children seemed to benefit from having several exposures during the lesson to each set of words. Repeating words seemed to make the task easier and instill confidence.

Individual Differences

In all areas there were quite large individual differences and relative rankings did not hold across conditions. Individual progress was generally uneven from time to time although trends were consistent (in terms of direction) across children. The advantage of single subject, multiple baseline designs is that it allows an in depth look at individual progress, which not only increases understanding of learning challenges, but can also help in understanding the need for resources for remediation, both for content and amount of remediation needed.

Tests

The Rosner Test of Auditory Analysis (40-item) was relatively quick and easy to administer. The administration time took less than 15 minutes and each of the 40 items was a deletion task. Results were standardized and gave both grade averages and standard deviations. It was a much easier and quicker test to give than the CELF-4 Phonological Awareness subtest. This latter sub-test took up to 40 minutes to administer, used a range of phonological awareness tasks and only gave a criterion referenced measure. As a result the Rosner 40-item test would most likely be better suited to school testing situations. A standardized spelling test which looked at sound-letter correspondence would have been helpful, although it was interesting to look at more generalized spelling skill results and the sound-letter correspondence data was available from the tests that were generated from the program.

Frequent testing of children seems to be helpful in measuring progress and ascertaining how much more skill development instruction is needed and when a skill can be considered acquired. Tests cannot be re-administered too frequently or accuracy is compromised. Children will not tolerate too frequent testing and time out of the regular classroom has to be considered with children who are otherwise integrated.

For the dictated sentences both words correct and letters correct were tallied. The words correct gave scores that had much larger ranges than the letters correct scores. The words correct could therefore be argued to be a more sensitive measure and a more accurate measure of the ultimate skill acquisition that is being targeted, that is word spelling. Conversely the letters correct scores can be argued to be a more

accurate, detailed measurement of skills as it captured exactly what each child was doing.

As is the case with many single subject design experiments, large fluctuations occurred in the results even though trends were generally clear and consistent. Fluctuations in results were likely the result of genuine skill strengths and weaknesses, item selection and participant characteristics such as attention and level of cooperation. The fluctuations also seemed to capture the fragility of some of the skill acquisition. This conclusion may be drawn for two reasons. Firstly, the results for phonological awareness skills were much more stable. These skills were highly responsive to remediation and were at or close to 100% accuracy. Secondly, the other spelling skills were all partially attained, therefore making them more vulnerable to fluctuation.

Administration of the Program

The program was administered three or four times a week by a speech-language pathologist and a special student assistant trained in giving the program. It is a program that needs to be given as a pull-out service by an educator. The administration of the program can be learned in approximately one hour. Lessons could have been done less frequently, such as once a week, but over a longer period of time. Despite the drill-like nature of the program, the children seemed to enjoy it. Each session was expected to last half an hour. In fact the sessions went a lot more quickly for the first phase and more slowly for the last two phases. The total program did ultimately take about 20 hours. The session lengths were also affected by whether

there were two or three children in the group and the attention and behaviour of those participants.

Voiceless Sounds

Although the children fairly quickly learned to differentiate and use voiceless sounds, it remained one of the most common areas of difficulty. It is also one of the least intuitive for adults and should be explicitly taught to and practiced by adult administrators. Voiceless sounds should not be voiced when teaching spelling as incorrect use of sounds can be quite misleading. For example the *c* and *t* in *cat* are voiceless and would be heard as *cuh* and *tuh* if voiced, thereby leading to the spelling of *cat* as *cuhatuh*!

Strengths of the Program

The program is able to give children an opportunity to catch up on developing phonological awareness and letter-sound skills, which they should have learned in Kindergarten and Grade 1. They may not have done this because they were either not given the instruction or were not given it in a sufficient and systematic enough manner to be learned. All the children who participated in the program made significant gains in their phonological awareness and letter-sound skills. Interestingly all children seemed able to develop age appropriate phonological awareness skills and improve their skills regardless of their starting skill level. Despite a range of delayed abilities in this area, phonological awareness seems to be an easily learnable skill at least for the children studied.

The program is very time efficient especially as it can be given in groups, which means a relatively small time commitment if calculated per child. It can also be

administered by an assistant after approximately one hour's training and some supervision during each phase the first time it is administered. These two factors, in particular, make the program highly cost effective.

Self-esteem was anecdotally reported to increase by teachers and parents for many children, probably for three reasons. The first is because the incremental nature of the program allowed participants success, which they had typically not experienced in literacy learning. Secondly the participants were taught strategies for decoding and encoding which allowed them to tackle in-class assignments when they had typically in the past felt stuck. Lastly the program used long words and complex vocabulary. This gave the participants a sense of accomplishment knowing that they could now read and write many words which would be too hard for many other children in their class.

The program is stimulating enough and demanding enough with the more complex vocabulary to be challenging for children of all ages and could probably be carried out with adults. Most programs teaching phonological awareness and letter-sound correspondence use simple vocabulary and with mono-syllables. This research program included vocabulary which was uncommon such as *brine* and used four and five syllable words such as *astronomer*.

Another advantage of the program is that it is explicit in both what is taught, how well it is learned and how well it is applied at the word level. The program systematically adds complexity. For example, consonant-vowel-consonant-patterns are taught initially and then initial consonant blends are added in a following lesson. Some children will have difficulty at this point in the program. It is quite clear to see

where the difficulty lies and usually sufficient practice is given for the child to learn at least a reasonable level of mastery of the skill. Some other phonological awareness programs teach skills, but do not require manipulation of more than consonant-vowel-consonant words. This is often appropriate as the programs are developed for younger children (Kozminsky & Kozminsky, 1995; Warrick, Rubin, & Rowe-Walsh, 1993), however it limits their utility for older children. There is sometimes an assumption that children will transfer skills from simple mono-syllables to mono-syllables with many consonants or multi-syllabic words. This cannot be assumed. Even when children have basic phonological awareness skills they will not necessarily transfer them to more complex tasks, especially when multiple processing demands are involved.

Surprisingly most children enjoyed the program. They seemed to enjoy success and the pacing of the lessons and phases. They would also be spontaneously competitive with themselves and each other. This was only discouraged if there were negative outcomes such as children worrying about low marks. Food reinforcers were given on some occasions. They were offered as the program was heavily drill based. It was evident during the program that success was intrinsically motivating and the food reinforcers may not have been necessary in most cases. Treats in special education classrooms are common place, so it was not unusual. In one case, one of the boys was disruptive to the group and his cooperation could be increased if he was rewarded with a treat.

The advantage of a multiple baseline, single subject design is that it allows in depth analysis of individual performances. Better understanding of individual

remediation needs is important even though programs cannot necessarily be tailored for each individual. Such detail helps understand what skills need to be taught explicitly, for what period and at what intensity. It also helps understanding of the likelihood of maintenance and transfer as well as individual differences and prognosis. Larger studies do not always capture the range of individual needs that are particularly relevant to instruction of children experiencing difficulty. It was clear from the results of this program that some participants needed more work in the areas targeted. The method used in this study is consistent with the response to intervention (RTI) model, which emphasizes the importance of ongoing evaluation of children with learning disabilities and specific literacy skill instruction.

Limitations

Caution has to be exercised in drawing conclusions from a study with only six participants even though the multiple baseline design does allow distinct trends to be noted. The participants were typical of children with spelling difficulties as they were randomly selected from over 30 children who were identified as having difficulties with spelling acquisition from testing and teacher report. The trends, in particular, noted in single subject designs invite further study. Inspection of individual scores is helpful as ultimately programs should be designed as much as possible to suit individual learning needs. Contrariwise individual data can be misleading as is exemplified by looking at the differences in scores in Table 1. At ten hours and beyond all participants except F1 achieved scores of 7/8 or 8/8. F1 achieved 8/8 at 10 hours but all other later scores for F1 were at or below 5.

The participants were randomly selected from a group identified by teachers as needing help with literacy. The study was only carried out in one school. Also the participants, identified by random selection, were skewed towards the younger end of the 7 to 10 years age range. Replication with a large number of participants, also looking at different ages would glean useful information.

There was a limit to the amount that could be achieved in a 20 hour program. Specific skills could be measured as showing improvement, but these skills may not have been enough to be easily identifiable in classroom writing tasks. It was hoped that the participants would learn more spelling rules and spelling anomalies even though they were not specifically taught simply by becoming more competent at noticing letter patterns. The complexity of spelling skills required to become a proficient speller became apparent as the study progressed: in particular the difference between words needing skills with sound-letter correspondence and/ or spelling rules and/ or spelling anomalies. The program merely touched on carry over of skills to spontaneous writing. It is likely that this skill would need to be practiced as a skill in itself. The theme of the need for explicit teaching and intense practice is consistent with the findings of Torgesen et al. (2001). Anecdotally, the most reports from teachers and parents of improvements were in the areas of reading ability and confidence in literacy tasks.

Some useful additional information, such as standardized test results after ten hours, was not taken because of re-test factors and the need to reduce time out of the classroom. With a different research design, such as one with a ten hour intervention program, this data could be gathered.

Children Most Likely to Benefit from the Program

Children seven to ten years of age can benefit from this program. The skill level – at least for the last two phases – would be too difficult for students below mid-Grade 2. Lipka, Lesaux, & Siegal (2006) discuss the later identification of students in Grade 4 as having reading difficulties as a result of poor phonological processing. They suggest that these students have not been identified earlier as their memory and guessing skills have masked their phonological difficulties. These results support the need to continue to teach phonological skills in later grades, but also point to a possible need for more routine monitoring of phonological skills in later grades. A better understanding of identification as well as intervention is needed

Suggestions for Further Study

Further research could investigate which children are most likely to benefit from the program. It is clear that the population studied i.e. children who are at or below minus one standard deviation in phonological awareness and spelling benefited from the study. There are also children whose literacy skills are below their expected achievement levels given their intelligence scores, yet are within typical scores for literacy measures. If their difficulties include relatively low phonological awareness scores and problems with letter-sound correspondence, then these children also would be expected to benefit from the program.

It was originally intended for the study to last approximately five hours for each phase with each lesson taking approximately half an hour. In fact the lessons generally took less than half an hour in Phase I and took considerably more than half an hour for some of the later lessons, especially in Phase III. The length of time for

each lesson also varied depending on the group's ability, age and compliance. The time estimate had been based on pilot studies. It would be interesting to actually time sessions as this may be important for allocation of special education time.

The program could be modified. In particular the reading part of Phase I was difficult and possibly should be omitted. Phase IV did not seem to add so much to the program as the other phases and the skills it addressed should probably be taught more systematically in a more in depth, separate program.

It would be useful to run shorter studies with just Phases I and II and just Phases II and II. This would be valuable for two reasons. Firstly most gains were seen in the first ten hours of the program so that further study of the most efficacious use of ten hours instruction is of interest to maximize the benefit of that instruction. Secondly more testing could be done in that period to assess effects as there would be less need to control test/re-test variables.

Different content in programs for older rather than younger children needs to be better understood. The program described had a blending component which was easier for the participants than the segmentation tasks. Blending may not be as important a task for older students as for younger students where not only blending tasks, but also control of other variables, such as neighbourhood density (the change by a single factor from other words), are influential to overall performance (Roth, Troia, Worthington, & Handy, 2006).

From the results of this study it seems that older children both benefit from learning phonological awareness skills and benefit from practicing applying these skills in harder words. As the sample is small this could be studied further. It would

be interesting to know if learning phonological awareness skills explicitly as was done in this study is an optimal use of instructional time with older more accomplished readers than in the present study. On the one hand it may be that literacy instruction for more advanced readers and writers already includes sufficient opportunities to develop facility with sound manipulation. Contrariwise it may be that literacy instruction might be more successful if the underlying weakness of difficulties with sound manipulation was directly impacted.

Conclusion

The instruction of phonological awareness and spelling skills to children with learning difficulties in an efficient and efficacious manner is of great interest to each individual child experiencing difficulties and to remedial education in general. These findings show that it is possible to teach children successfully using a systematic, explicit approach (Foorman & Torgesen, 2001). The program was successful in fully remediating phonological awareness deficits and in improving the sound-letter writing skills of the study participants. It did show that more practice would be needed in the writing skills taught as well as in spelling skills not taught and in transfer to spontaneous writing. It is encouraging that progress could be measured, despite the short period of instruction, in a population of children having significant difficulty with classroom instruction. Replication with more children is indicated and further study of similar instruction for the other skills identified is indicated. The exact relationship of phonological awareness skills to spelling warrants further investigation.

Bibliography

- Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press
- Adams, M. J., Foorman, B. R., Lundberg, I., & Beeler, T. D. (1998). The elusive phoneme: Why phonemic awareness is so important and how to help children develop it. *American Educator*, 22, 18-29.
- Allington, R. L., & Cunningham, P. M. (2002). *Schools that work: Where all children read and write*. Boston: Allyn & Bacon.
- Baron, J., & Strawson, C. (1976). Use of orthographic and word-specific knowledge in reading words aloud. *Journal of Experimental Psychology, Human Perception and Performance*, 2, 386-393.
- Becker, W., Dixon, R., & Anderson-Inman, L. (1980). *Morphographic and root word analysis of 26,000 high frequency words*. Eugene, OR: University of Oregon College of Education.
- Bennett, L., & Ottley, P. (1994). *Launch into reading success: Through phonological awareness training*. Vancouver, B.C.: Creative Curriculum Incorporated.
- Berninger, V. (1998). *Process assessment of the learner (PAL): Guides for reading and writing intervention*. San Antonio, TX: Psychological Corporation.
- Berninger, V. (1999). Coordinating transcription and text generation in working memory during composing: Automatic and constructive processes. *Learning Disabilities Quarterly*, 22, 99-112.
- Berninger, V. W. (2000). Development of language by hand: Its connections with language by ear, mouth, and eye. *Topics in Language Disorders*, 20, 65-84.
- Berninger, V., Vaughn, K., Abbott, R., Abbott, S., Brooks, A., & Rogan, L. (1998). Early intervention for spelling problems: Teaching spelling units of varying size within a multiple connections framework. *Journal of Educational Psychology*, 90, 587-605.
- Blachman, B. (1994). What have we learned from longitudinal studies of Phonological processing and reading, and some unanswered questions: A response to Torgesen, Wagner and Rashotte. *Journal of Learning Disabilities*, 27, 287-291.

- Boder, E. (1973). Developmental dyslexia: A diagnostic approach based on three atypical reading-spelling patterns. *Developmental Medicine and Child Neurology*, 15, 663-687.
- Bradley, L., & Bryant, P. E. (1978). Difficulties in auditory organization as a possible cause of reading backwardness. *Nature*, 21, 271, 746.
- Bryant, P. E., & Bradley, L. (1985). *Children's reading problems: Psychology and education*. Oxford: Blackwell.
- Bruck, M., & Waters, G. (1988). An analysis of the spelling errors of children who differ in their reading and spelling skills. *Applied Psycholinguistics*, 9, 77-92.
- Burgess, S. R., Donahue, J., Garon, T. (1997). Changing causal relations between phonological processing abilities and word level reading as children develop from beginning to fluent readers: A five-year longitudinal study. *Developmental Psychology*, 33, 468-479.
- Carlisle, J.F. (1988). Knowledge of derivational morphology and spelling ability in fourth, sixth and eighth graders. *Applied Psycholinguistics*, 9, 247-266.
- Catts, H. W., & Kamhi, A. (1999). *Language and reading disabilities*. Boston: Allyn & Bacon.
- Clay, M. (1979). *Reading: The patterning of complex behavior*. Auckland, New Zealand: Heinemann.
- Compton, D.L. (2006). How should "Unresponsiveness" to secondary intervention be operationalized? It is all about the nudge. *Journal of Learning Disabilities*, 39, 170-173.
- Coyne, M. D., Kame'enui, E. J., & Simmons, D. C. (2001). Prevention and intervention in beginning reading: Two complex systems. *Learning Disabilities Research and Practice*, 16, 62-73.
- Crealock, C. & Bachor, D. G. (1995). *Instructional strategies for children with special needs*. Scarborough, Ontario: Allyn & Bacon.
- Cronnell, B. (1978). Phonics for reading vs. phonics for spelling. *Reading Teacher*, 32, 37-340.

- de Weck, G., Fayol, M., Chalard, M., Collay, S., Vuilleumier, S.K., & Siegrist, M., (2002a). *Is the effect of writing tasks identical in normal children with spelling difficulties?* Poster session presented at the Joint Conference of the IX International Congress for the Study of Child Language and the Symposium on Research in Child Language Disorders, Madison, WI.
- de Weck, G., Fayol, M., Chalard, M., Collay, S., Vuilleumier, S. K., & Siegrist, M., (2002b). *The effect of writing tasks on spelling capacities in school aged children.* Poster session presented at the Joint Conference of the IX International Congress for the Study of Child Language and the Symposium on Research in Child Language Disorders, Madison, WI.
- Drake, D. & Ehri, L. (1984). Spelling acquisition: Effects of pronouncing words on memory for their spellings. *Cognition and Instruction, 1*, 297-320.
- Ehri, L. (1992). Reconceptualizing the development of sight word reading and its relationship to decoding. In P. Gough, L. Ehri, & R. Trieman (Eds.), *Reading acquisition* (pp. 107-143). Hillsdale, NJ: Erlbaum.
- Ehri, L. (2000). Learning to read and learning to spell: Two sides of the same coin. *Topics in Language Disorders, 20*, 19-36.
- Ehri, L. (2001). Learning to read and learning to spell: Two sides of a coin. *Topics in Language Disorders, 20*, 19-36.
- Ehri, L., & Saltmarsh, J. (1995). Beginning readers outperform older disabled readers in learning to read words by sight. *Reading and Writing: An Interdisciplinary Journal, 7*, 295-326.
- Ehri, L. & Wilce, L. (1987). Does learning to spell help beginners learn to read words? *Reading Research Quarterly, 22*, 47-65.
- Elkonin, D. B. (1963). The psychology of mastering the elements of reading. In B. Simon & J. Simon (Eds.) *Educational Psychology in the U.S.S.R.* (pp. 165-179). London: Routledge & Kegan Paul.
- Fergus, P.M. (1983). *Spelling improvement: A program for self-instruction.* New York: McGraw-Hill Publishing Co.
- Fisher, F. W., Shankweiler, D., & Liberman, I.Y. (1985). Spelling proficiency and sensitivity to word structure. *Journal of Memory and Language, 24*, 423-441.
- Fletcher, J, Morris, J, & Reid Lyon, G. (2003). Classification and definition of learning disabilities: An integrative perspective. In H.L. Swanson, K.R. Harris & S. Graham (Eds.). *Handbook of Learning Disabilities.* New York: Guilford Press.

- Foorman, B., Francis, D., Novy, D., & Liberman, D. (1991). How letter-sound instruction mediates progress in first-grade reading and spelling. *Journal of Educational Psychology, 83*, 456-469.
- Foorman, B., & Torgesen, J. (2001). Critical elements of classroom and small-group instruction promote reading success in all children. *Learning Disabilities Research and Practice, 16*, 203-212.
- Freyd, P.P., (1981). *Individual differences in acquisition and use of English Derivational morphology*. Unpublished doctoral dissertation, University of Pennsylvania.
- Freyd, F., & Baron, J. (1982). Individual differences in acquisition of derivational morphology. *Journal of Verbal Learning and Verbal Behavior, 21*, 282-295.
- Frith, U. (1980). *Cognitive processes in spelling*. London: Academic Press.
- Frith, U. (1985). Beneath the surface of developmental dyslexia. In K. Paterson, J. Marshall, & M. Coltheart (Eds.), *Surface dyslexia (PP. 301-330)*. London: Erlbaum.
- Fry, E. (1994). *Phonics patterns: Onset and rime word lists*. Laguna Beach, California: Laguna Beach Educational Books.
- Goswami, U. (1988). Children's use of analogy in learning to spell. *British Journal of Developmental Psychology, 6*, 21-33.
- Gough, P. B., Ehri, L.C., & Treiman, R. (Eds.). (1992). *Reading acquisition*. Hillsdale, NJ: Erlbaum Associates.
- Gough, P., & Tunmer, W. (1986). Decoding, reading and reading disability. *Remedial and Special Education, 7*, 6-10.
- Hatcher, P., Hulme, C., & Ellis, A. (1994). Ameliorating early reading failure by integrating the teaching of reading and phonological skills: The phonological linkage hypothesis. *Child Development, 65*, 41-55.
- Henderson L, Chard J. (1980). The reader's implicit knowledge of orthographic structure. In: Frith, U. (Ed.), *Cognitive processes in spelling* (pp. 85-116). London: Academic Press.
- Justice, L.M. (2006). Evidence-based practice, response to intervention and the prevention of reading difficulties. *Language, Speech and Hearing Services in Schools, 37*, 284-292.

- Kamhi, A. & Hinton, L. N. (2000). Explaining individual differences in spelling ability. *Topics in Language Disorders, 20*, 37-49.
- Kazdin, A.E. (1982). *Single-case research designs: Methods for clinical and applied settings*. Oxford: Oxford University Press.
- Kintsch, W., & van Dyck, T. (1978). Toward a model of text comprehension and production. *Psychological Review, 85*, 363-394.
- Kozminsky, L., & Kozminsky, E. (1995). The effects of early phonological awareness training on reading success. *Learning and Instruction, 5*, 187-201.
- Ladefoged, P. (1975). *A course in phonetics*. New York: Harcourt Brace Yovanovich.
- Lennox, L. S., & Siegel, L. (1996). The development of phonological rules and visual strategies in average and poor spellers. *Journal of Experimental Psychology, 62*, 60-83.
- Liberman, I.Y., & Liberman, A.M. (1990). Whole language vs. code emphasis: Underlying assumptions and their implications for reading instruction. *Annals of Dyslexia, 40*, 51-76.
- Liberman, I.Y., Shankweiler, D., & Liberman, A.M. (1989). The alphabetic principle and learning to read. In D. Shankweiler & I.Y. Liberman (Eds.). *Phonology and reading disability: Solving the reading puzzle* (pp. 1-33). Ann Arbor: University of Michigan Press.
- Lindamood, C. H., & Lindamood, P. C. (1984). *Auditory Discrimination in Depth*. Austin, TX: PRO-ED.
- Lipka, O., Lesaux, N. K., & Siegel, L. S., (2006). Retrospective analyses of the Reading development of Grade 4 students with reading disabilities: Risk status and profiles over 5 years. *Journal of Learning Disabilities, 39*, 364-378.
- Locke, J. (1990). *Phonological acquisition and change*. New York: Academic Press.
- Lovett, M. W., Borden, S. L., Lacerenza, L., Benson, N. J., & Brackstone, D. (1994). Treating the core deficits of developmental dyslexia: Evidence of transfer of learning after phonologically- and strategy- based reading training programs. *Journal of Educational Psychology, 30*, 805-822.
- Lundberg, I., Frost, J., & Peterson, O. (1988). Effects of an extensive program for stimulating phonological awareness in pre-school children. *Reading Research Quarterly, 23*, 263-284.

- Manis, F.R., Custodio, R., & Szeszulski, P.A. (1993). Developmental phonological and orthographic skill: A 2-year longitudinal study of dyslexic children. *Journal of Experimental Child Psychology, 56*, 64-86.
- Marzollo, J. (1994). *My first book of biographies: Great men and women every child should know*. New York: Scholastic Inc.
- McCardle, P., Scarborough, H. & Catts, H. (2001). Predicting, explaining, and preventing children's reading difficulties. *Learning Disabilities Research and Practice, 16*, 230-239.
- McCracken, M. J., & McCracken, R. A. (1996). *Spelling through phonics* (2nd ed.). Winnipeg: Pegasus.
- McGuiness, C., McGuiness, D., & McGuiness, G. (1996). Phono-Graphix: A new method for remediating reading difficulties. *Annals of Dyslexia, 46*, 73-96.
- McReynolds, L. V., & Kearns, K. P. (1983). *Single-Subject Experimental Designs in Communicative Disorders*. Baltimore: University Park Press.
- Meichenbaum, D. (1982). *Teaching thinking: A cognitive-behavioural approach*. Austin, TX: Society for Learning Disabilities and Remedial Education.
- Miles, E. (1989). *The Bangor Dyslexia Teaching System*. London: Whurr Publishers.
- Morais, J., Cary, L., Alegria, J., & Bethelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition, 8*, 323-332.
- National Reading Panel (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (NIH Publication No. 00-4769). Washington, DC:U.S. Government Printing Office.
- Olofsson, A., & Lundberg, I. (1983). Can phonemic awareness be trained in Kindergarten? *Scandinavian Journal of Psychology, 24*, 35-44.
- Perfetti, C. (1986). Cognitive and linguistic components of reading ability. In B. Foorman & A. Siegel (Eds.), *Acquisition of reading skills* (pp.1-41). Hillsdale, NJ: Erlbaum.
- Perfetti, C. (1997). The psycholinguistics of spelling and reading. In C. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell: Research, theory, and practice Across languages* (pp. 107-143). Hillsdale, NJ: Lawrence Erlbaum Associates.

- Perfetti, C., & Zhang, S. (1996). What it means to learn to read. In M. F. Graves, P. Van den Broek, & B. M. Taylor (Eds.), *The first R: Every child's right to read* (pp.37-61). New York: Teachers College Press.
- Reid Lyon, G., Gray, D. B., Kavanagh, J. F., & Krasnegor, N. A. (Eds.) (1993). *Better understanding learning disabilities: New views from research and their implications for education and public policies*. Baltimore: Paul H. Brookes Publishing Co.
- Reitsma, P. (1983). Printed word learning in beginning readers. *Journal of Experimental Child Psychology*, 75, 321-339.
- Rosner, J. (1979). *Helping children overcome learning disabilities*. New York: Walker.
- Rosner, J., & Simon, D. (1971). Auditory Analysis Tests. *Journal of Learning Disabilities*, 4, 40-48.
- Roth, F. P., Troia, G. A., Worthington, C. K., & Handy, D. (2006). Promoting Awareness of Sounds in Speech (PASS): The effects of intervention and stimulus characteristics on the blending performance of preschool children with communication impairments. *Learning Disabilities Quarterly*, 29, 67-88.
- Santa, C., & Hoiem, T. (1999). An assessment of early steps: A program for early intervention of reading problems. *Reading Research Quarterly*, 34, 54-79.
- Schumaker, J. B., & Deshler, D. D. (1992). Validation of learning strategy Interventions for students with learning disabilities: Results of a programmatic research effort. In B. Y. Wong (Ed.), *Contemporary intervention research in learning disabilities: An international perspective*. (pp.22-46). New York: Springer-Verlag.
- Semel, E., Wiig, E. H., & Secord, W. (2003). *Clinical Evaluation of Language Fundamentals-4*. (4th Ed.). San Antonio, TX: The Psychological Corporation.
- Shankweiler, D., & Crain, S. (1986). Language mechanisms and reading disorders. A modular approach. *Cognition*, 24, 136-168.
- Siegel, L. S. (1989). IQ is irrelevant to the definition of learning disabilities. *Journal of Learning Disabilities*, 22, 469-478.
- Skinner, C. H. (Ed.) (2005). *Single-Subject Designs for School Psychologists*. New York: The Haworth Press.

- Slavin, R. E. (1994). School and classroom organization in beginning reading. In R. E. Slavin, N. L. Karweit, & B. A. Wasik (Eds.), *Preventing early school failure: Research, policy, and practice* (pp. 122-142). Boston, MA: Allyn & Bacon.
- Smith, S. T. (1971). *Understanding reading: A psycholinguistic analysis of reading and learning to read*. New York: Holt, Rinehart & Wilson.
- Snow, C. E., Burns, S. M., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.
- Snowling M. J. (1994). Towards a model of spelling acquisition: The development of some component skills. In G. D. A. Brown & N. C. Ellis (Eds.) *Handbook of spelling: Theory, process and intervention* (pp. 111-128). Chichester, England: John Wiley & Sons.
- Snowling, M. J. (2000). Language and literacy skills: Who is at risk and why? In D. V. M. Bishop & L. Leonard (Eds.). *Speech and language impairments in children: Causes, characteristics, interventions and outcome* (pp. 245-260). Philadelphia: Psychology Press.
- Stanovich, K. E. (1988). Explaining the differences between the dyslexic and the garden-variety poor reader: The phonological-core variable-difference model. *Journal of Learning Disabilities, 21*, 590-604.
- Stanovich, K. E. (1997). Toward a more inclusive definition of dyslexia. *Dyslexia: An International Journal of Theory and Practice, 2*, 154-166.
- Stanovich, K., & Siegel, L. (1994). The phenotypic performance profile of reading disabled children: A regression-based test of the phonological-core variable-difference model. *Journal of Educational Psychology, 86*, 24-53.
- Tallal, P. & Piercy, M. (1973). Defects of non-verbal auditory perception in children with developmental aphasia. *Nature, 241*, 469.
- Templeton, S. (1992). Theory, nature and pedagogy of higher-order orthographic development in older students. In S. Templeton, & D. R. Bear (Eds.). *Development of orthographic knowledge and the foundations of literacy: A memorial Festschrift for Edmund H. Henderson* (pp.253-277). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Torgesen, J. K. (1993). Variations on theory in learning disabilities. In Reid Lyon, G., Gray, D. B., Kavanagh, J. F., & Krasnegor, N. A. *Better understanding learning disabilities: New views from research and their implications for education and public policies*. Baltimore: Paul H. Brookes Publishing Co.

- Torgesen, J. K. (2000). Individual differences in response to early interventions in reading. The lingering problem of treatment resisters. *Learning Disabilities Research & Practice, 15*, 55-64.
- Torgesen, J. K. (2003, December). *Operationalizing the response to intervention model to identify children with learning disabilities: Specific issues with older children*. Paper presented at the National Research Center on Learning Disabilities Responsiveness-to-Intervention Symposium, Kansas City, MO
- Torgesen, J. K., Alexander, A. W., Wagner, R. K., Rashotte, C. A., Voeller, K. K. S., & Conway, T. (2001). Intensive remedial instruction for children with severe reading disabilities: Immediate and long term outcomes from two instructional approaches. *Journal of Learning Disabilities, 34*, 33-58.
- Torgesen, J. K., & Mathes, P. G. (2000). *A basic guide to understanding, assessing, and teaching phonological awareness*. Austin, TX: PRO-ED.
- Treiman, R. (1993) *Beginning to spell: A study of 1st-grade children*. Oxford: Oxford University Press.
- Treiman, R., & Bourassa, D.C. (2000). The development of spelling skill. *Topics in Language Disorders, 20*, 1-18.
- Treiman, R., & Cassar, M. (1997). Spelling acquisition in English. In C. A. Perfetti, L. Rieben, M. Fayol (Eds.). *Learning to spell: Research, theory and practice across languages* (pp. 61-80). Mahwah, NJ: Lawrence Erlbaum Associates.
- Treiman, R., Cassar, M., & Zukowski, A. (1994). What types of linguistic information do children use in spelling? The case of flaps. *Child Development, 65*, 1310-1329.
- Troia, G. A. (1999). Phonological awareness intervention research: A critical review of the experimental methodology. *Reading Research Quarterly, 34*, 28-52.
- Tunmer, W., & Hoover, W. (1993). Phonological recoding skill and beginning reading. *Reading and Writing: An Interdisciplinary Journal, 5*, 161-179.
- Warrick, N., Rubin, H., & Rowe-Walsh, S. (1993). Phoneme awareness in language delayed children: Comparative studies and intervention. *Annals of Dyslexia, 43*, 153-173.
- Vellutino, F. R., & Scanlon, D. (1987). Phonological coding, phonological awareness and reading ability: Evidence from a longitudinal and experimental study. *Merrill Palmer Quarterly, 33*, 321-363.

- Vellutino, F. R., Scanlon, D., Small, S., & Fanuele, D. P. (2006). Response to Intervention as a vehicle for distinguishing between children with and without reading disabilities : Evidence for the role of Kindergarten and first-grade interventions. *Journal of Learning Disabilities, 39*, 157-169.
- Venezky, R. L. (1980). *The American way of spelling: The structure and origins of the American English orthography*. The Guilford Press: New York.
- Westby, C. (1999). Assessing and facilitating text comprehension problems. In H. Catts & A. Kamhi (Eds.). *Language and reading disabilities*. Boston: Allyn & Bacon.
- Westerveld, M., Gillon, G. & Miller, J. (2006). *Morpho-syntactic language measures obtained in personal narrative versus story-retelling conditions*. Paper presented at the meeting of the American Speech and Hearing Association, Miami, Florida.
- Wilkins, G.S. (1993). *Wide Range Achievement Test*. Wilmington, DE: Jastak Associates.
- Wing, A. M., & Baddeley, A. D. (1980). Spelling errors in handwriting: a corpus and distributional analysis in Frith, U (Ed.) *Cognitive Processes in Spelling*, London: Academic Press.
- Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III Tests of Achievement*. U.S.A.: Riverside Publishing Company.
- Ysseldyke, J. E. (1983). Current practices in making psycho-educational decisions about learning disabled students. *Journal of Learning Disabilities, 16*, 209- 219.
- Ysseldyke, J. E., & Algozzine, B. (1995). *Special education: A practical approach for teachers*. Boston: Houghton Mifflin.

Appendix A

Example of Test used for Pre-test, Baseline, Probes and Post-test

	Phase I	Phase II	Phase III	Phase IV
1	odd	it	total	jumping
2	shod	fed	pocket	finches
3	tail	wide	basket	blends
4	faith	here	finest	unfit
5	click	bled	husband	table
6	grave	track	benefit	program
7	wink	self	estimate	frosted
8	shift	stank	activity	invade

Sentences

1. The *piles of paper* are big.
2. I put a *plaster* on the *sting*.
3. I will *visit* the *west*.
4. He can *find* a *dragon*.
5. I *like* to *win*.
6. I *astonish* *superman*.
7. That is a *splendid trick*.
8. The *singing* was *fine*.

Appendix B

Lesson Examples

C = consonant; C (c) = continuant consonant; C (s) = stop consonant;
 V = vowel; V (s) = short vowel; V (l) = long vowel
 V (a) = large vowel contrast (apart); V (n) = small vowel contrast (near)

Phase I: Phonological awareness

Task 1& 3: Segment; Task 2: Blend; and Task 4: Read

10 items for each task

Pattern for each task

Lesson 1. C V, V C, V C C, C (c) V (s) (a) C (c)

Examples: then, act, lass

Lesson 2. C V (s) (a) C + 2 from previous lessons

Examples: rot, bin, leg

Lesson 3. C V (l) (a) C + 2 from previous lessons

Examples: phone, loon, mean

Lesson 4. C V (l) (n) C + 2 from previous lessons

Examples: hive, been, pike

Lesson 5. C C V (s) (n) C + 2 from previous lessons

Examples: slick, snag, snip

Lesson 6. C C V (l) (n) C + 2 from previous lessons

Examples: snide, froze, green

Lesson 7. C V C C + 2 from previous lessons

Examples: rink, lunch, left

Lesson 8. C C V C C (or any 4+ C) + 2 from previous lessons

Examples: twist, glint, grant

Lesson 9. All of above (words repeated from previous lessons)

Phase II: Phonological awareness and spelling mono-syllables

Task 1& 3: Segment and spell; Task 2: Blend; and Task 4: Read

10 items for each task

Pattern for each task

Lesson 1. C V, V C, V C C, C (c) V (s) C (c)

Examples: vim, dim, dash

Lesson 2. C V (s) (a) C + 2 from previous lessons

Examples: god, Ted, bun

Lesson 3. C V (l) (a) C + 2 from previous lessons

Examples: pipe, wove, pace

Lesson 4. C V (l) (n) C + 2 from previous lessons

Examples: like, side, safe

Lesson 5. C C V (s) (n) C + 2 from previous lessons

Examples: trick, grip, crush

Lesson 6. C C V (l) C + 2 from previous lessons

Examples: tripe, flute, grade

Lesson 7. C V C C + 2 from previous lessons

Examples: hunch, runt, must

Lesson 8. C C V C C + 2 from previous lessons

Examples: drink, blimp, strap

Lesson 9. All of above

Lesson 10. Dictated sentences and spontaneous writing

Example: I have a *hunch* he *sold* it.

Phase III: Phonological awareness and spelling (multi-syllables)

Task 1& 3: Segment and write; Task 2: Blend syllables including hard to pronounce words; and Task 4: Read

Pattern for each task

10 items for each task

Lesson 1. 2 syllables with 2-3 consonants

Lesson 1. 2 syllables with 2-3 consonants

Examples: later, hotel, memo

Examples hard to pronounce: athlete, mischievous, recognize

Lesson 2. 2 syllables with 2-3 consonants + 2 from previous lesson

Examples: naval, waver, haven

Lesson 3. 2 syllables with 4 consonants + 2 from previous lesson

Examples: deplore, clever, booster

Lesson 4. 2 syllables with 4 consonants + 2 from previous lesson

Examples: churlish, furnish, burnish

Lesson 5. 2 syllables with 5 consonants + 2 from previous lesson

Examples: glider, stagnant, pumpkin

Lesson 6. 3 syllables + 2 from previous lesson

Examples: critical, pitiful, visitor

Lesson 7. 3 syllables + 2 from previous lesson

Examples: important, Toronto, Canada

Lesson 8. 4 syllables + 2 from previous lesson

Examples: observatory, publicity, operator

Lesson 9. All of above

Lesson 10. Dictated sentences and spontaneous writing

Example: *Grandfather is in hospital*

Phase IV: Phonological awareness, derivational and inflectional morphology and spelling

Task 1& 3: Segment and write and task 4; Task 2: Identify morpheme; Task 4 Read.

Pattern for each lesson

Lesson 1. present progressive *-ing*

Examples: testing, nesting, flashing

Lesson 2. plural *-s (/s/, /z/, /es/)* + 2 items from earlier lesson(s)

Examples: bales, lunches, spots

Lesson 3. present tense *s (/s/, /z/, /es/)* + 2 items from earlier lesson(s)

Examples: frets, sits, hits

Lesson 4. past tense *-ed (/t/, /d/, /ed/)* + 2 items from earlier lesson(s)

Examples: choked, smoked, liked

Lesson 5. prefix *pro-, super-, sub-, be-* + 2 items from earlier lesson(s)

Examples: prohibit, prognosis, product

Lesson 6. prefix *un-, re-, dis-, un* 2 items from earlier lesson(s)

Examples: reenter, reform, retake

Lesson 7. suffix *-er, -y, -able, -ible* + 2 items from earlier lesson(s)

Examples: kindly, pesky, sulky

Lesson 8. suffix + *-ent, -ant, -tion, -ate*, 2 items from earlier lesson(s)

Examples: nutrition, donation, vacation

Lesson 9. All

Lesson 10. Dictated sentences and story

Example: The dishes are on the rafts

Appendix C

*Letter of Permission to Parents*1st October 2003

Dear Parent,

The school is offering a phonological awareness and spelling program lasting 20 hours for small groups of children. Your child has been identified as one of the children who may benefit from this program. The program will be run by Melanie Houston (speech-language pathologist) and XX (special student assistant). Phonological awareness is the ability to segment and sequence the sounds in words. Children have difficulty developing reading and writing skills without this skill at a fluent level. There is another sheet in this package, which explains the program in more detail.

The district referral form is attached for you to sign if you would like your child to participate in the program. This referral form is a standard requirement by the district for speech-language pathology services.

A separate form is included for you to sign if you give permission for your child's data to be used anonymously as part of Melanie's Ph.D. graduate work at the University of Victoria. Melanie is an interdisciplinary doctoral student at the University of Victoria studying with Dr. D Bachor. If your child participates in the research component of this program it will involve an extra approximately 2 hours of data collection. The additional data will provide baselines and a language profile, which will be useful to accurately measure the program's success, but would not normally be taken in a school program. Any data used for research purposes is coded so that it cannot be traced to an individual or the school.

It is important to increase the understanding of programs that are most helpful in teaching literacy skills and that can be applied within the limited resources of a typical school. The knowledge gained from this program can be shared with other educators to help with the development of literacy programs, if you give permission for your child's data to be used. Your child may still participate in the program if you do not give permission for the data to be used. There are no known risks to your child's participation in this program. The benefits are expected to be increased phonological awareness and writing ability. You can withdraw your child from the program at any time. Withdrawal from the program will not affect typical services to your child in any way. It is anticipated that the program will be finished no later than May 30, 2004.

If you would like more information about the project you can meet with Melanie at the school on Wednesdays or leave a message at 595 7511 (504). The study will be run under the ethical guidelines of the University of Victoria.

We would appreciate a prompt response as we would like to begin the groups as soon as possible.

Sincerely,

Melanie Houston M.Sc., P.G.C.E., S-L P ©
Registered Speech-Language Pathologist

Permission to include the child named below in the research part of the spelling and phonological awareness program.

Your signature below indicates that you understand the above conditions of participation in this study and that you have the opportunity to have any questions answered by the researcher.

Name of participant

Signature

Date

Name of participant's parent/ guardian

Signature

Date