2001

Relationship between early development of spelling and reading

Lorraine S. Hammond
Edith Cowan University

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by

Lorraine S. Hammond
B Ed., Dip. RSA (Distinction), M Ed. (SpLD)

A Thesis Submitted in Partial Fulfilment of the
Requirements for the Award of
Ph D Interdisciplinary

At the Faculty of Community Services, Education and Social Sciences
Edith Cowan University, Mount Lawley.

Date of submission: April, 2001

USE OF THESIS

ABSTRACT

The research reported in this thesis examined the relationship between beginning spelling and reading. More specifically, it focussed on the relationship between the development of early reading and spelling in a context where the approach to early reading instruction includes systematic phonological awareness and decoding instruction. A critical assumption made by proponents of developmental early literacy models is that transfer of skills and knowledge from reading to spelling will occur spontaneously and without formal instruction (Frith, 1980). By contrast instruction-centred approaches make the assumption that there are critical pre-requisite skills that can and should be taught explicitly (Carnine, Silbert & Kameenui, 1997). The difference between these approaches is highlighted in the treatment of invented spelling, a popular activity in Western Australian junior primary classes. A series of studies was undertaken to examine the effect on invented and standard spelling performance of teaching Year 1 children phonological awareness and the strategy of sounding out words. Data were gathered from a range of settings using different research tools. The relationship between phonological awareness and beginning reading and spelling performance was explored initially through a single case study. A post-hoc study was then undertaken with a cohort of students who had received systematic decoding instruction to examine whether proficiency in the decoding of non-words was related to spelling performance. This permitted an analysis of common sub-skills of decoding and encoding. In the main study the effect on different aspects of reading and spelling performance of using *Let's Decode*, an approach that includes explicit phonological awareness and systematic decoding instruction, was investigated. In addition, an analysis was made of whether students who received explicit instruction in skills known to contribute to beginning reading and spelling produced superior invented spelling samples. A qualitative analysis was made of the pre and post invented spelling tests of two pairs of students from the control and intervention groups matched on invented spelling and phonological awareness skills at the beginning of the year, and retested at the end of Year 1. The final research question involved a single-subject research design to examine the effect of explicit instruction in isolating phonemes in words and prompts to 'listen for sounds' prior to, and during, the process of spelling words. The single case study revealed a child who was regarded as a competent speller and reader but who could only read words in a familiar context and who had developed a strategy for spelling words based on copying an adult model. This was interpreted as evidence supporting the need for phonological awareness instruction as a pre-requisite for spelling. The post-hoc analysis of a class of students who had received systematic decoding instruction showed that no student classified as a 'good decoder' could also be classified as a 'poor speller'. This result was considered evidence of a strong link between the phonological knowledge that is required to decode and the role of alphabetic knowledge in spelling. The main study revealed phonological awareness and systematic decoding instruction was associated with superior invented and conventional spelling and reading performance on all reading and spelling measures. Of particular importance was the finding that students who commenced the study with very weak phonological awareness and who subsequently received systematic phonological and decoding instruction showed greater gains in invented spelling than matched students in the control condition. The single-subject design showed the effectiveness of phonological awareness individualised instruction on invented spelling for weak students from both intervention and control conditions. It was concluded that the ability to invent spelling is improved when students receive explicit instruction in phonological awareness and systematic decoding but that some students, namely those with persistent weakness in phonological awareness, also require explicit prompts to apply their alphabetic knowledge to spelling words. The implications for instruction of these findings are discussed.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education; and that to the best of my knowledge and belief it does not contain any material previously written by another person except where due reference is made in the text.

Signature

Date April 10th, 2001

ACKNOWLEDGMENTS

This project was made possible by the cooperation and assistance provided by teachers and principals of the Education Department and the Catholic Education Commission in Western Australia. I have the utmost respect for the dedication and enthusiasm of all school personnel who took part in this study. At times I believe I learned more about Year One literacy instruction by observing the exemplary practices of these teachers in their classrooms than they ever learned from me.

I have also been exceptionally fortunate to draw on the talents of my supervisor, colleague and friend, Dr Patricia Formentin. Trish's knowledge about beginning reading and research design is unparalleled and under her tutelage I have come to value the pursuit of academic excellence.

The completion of a doctoral thesis is a selfish pursuit that by its very nature intrudes on relationships with family and friends. As ever, those closest to me have been very supportive in this regard.

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CHAPTER 1
INTRODUCTION

The acquisition of literacy skills has in the past, and continues to be, a critical educational issue. In recent times not only reading, but also spelling achievement, has been recognised as a significant concern by educators, politicians and the general community. In response teachers have questioned how to teach reading and spelling against a backdrop of pressure to show improved literacy outcomes. Although reading and spelling continue to be a problem for many children into the later school grades and even into adulthood, it is young children who are the focus of attention here. In particular the focus is on the relationship between Year 1 children's reading and spelling development and how knowledge gained from the acquisition of one skill affects the growth of the other.

1.1 Context of the Study

In recent years literacy standards have featured regularly in the Australian media and have been the focus of current affairs programs and political agendas with the introduction of state and nationwide literacy testing (Hempenstall, 1997b). Blame for declining literacy has been variously shared by teachers, students and their parents. The group most harshly criticised is teachers who have faced mounting pressure from educational authorities to embrace particular instructional approaches and show improved literacy outcomes.

Concerns about literacy were raised in reports prepared by the House of Representatives Standing Committee on Employment Education and Training that outlined the extent of literacy problems in Australian society, and the need for schools to respond with appropriate measures of assessment and intervention. In 1991, the Committee's *Words at Work* inquiry noted that between 10 and 20 percent of Australia's adult population was functionally illiterate, with as many children leaving primary school experiencing difficulty with some aspects of literacy. Just under 12 months later the Committee released *The Literacy*

Challenge – A Report on Strategies for Early Intervention for Literacy and Learning for Australian Children (1992) and highlighted the importance of early intervention noting that "many adults with literacy problems were once children with literacy problems – problems which should have been identified and remedied at least a decade earlier" (p.1). The committee argued that it was the fundamental right of every child to learn to read and write by the end of primary school.

In 1997, prompted by research that indicated that as many as one in five children cannot read and write adequately when they finish school, the Federal Minister for Schools Dr David Kemp announced a testing program for Year 3 and Year 5 students to assess the literacy standards of Australian children against a national standard (Kemp, 1997a). The results of the National School English Literacy Survey (Australian Council for Educational Research, 1997) indicated that around 30 percent of students in Australian primary schools failed to reach draft minimum or 'benchmark' standards in reading and writing. Dr Kemp described the outcome as a "national disgrace" and called for literacy to be "reinstated as the focus of the curriculum, particularly in the early years of schooling" (Hewitt, 1997). The Federal Government provided government schools with an extra $2.3 billion in the four years to 2000 and Dr Kemp launched a national literacy plan. The aim of the plan was to ensure every child starting school in 1998 would be able to read, write and spell adequately by their fourth year of school.

Throughout 1997 Dr Kemp maintained his claims that literacy standards had not improved. Schools argued that insufficient funding was the issue and Dr Kemp responded by arguing that considerable funding had been "poured" into literacy and children were still failing. Dr Kemp suggested that what was needed was the "will" to raise standards and implored schools to be more accountable for their literacy funding and to remember that their "single most important mission was to provide every student with adequate literacy skills" (Kemp, 1997b). The frequency at which such comments were reported in the media ensured the issue of literacy instruction remained in the public arena and fuelled a heated debate in the print media between educators, parents and other members of the wider community.

In response, Commonwealth Literacy Funding was made available in 1998 to Western Australian schools with a high proportion of students considered educationally disadvantaged in terms of their literacy and numeracy outcomes. Schools were required to write a plan and report on the outcome of interventions. In keeping with Dr Kemp's call for "different strategies for different students" (Hewitt, 1997) schools selected interventions they considered appropriate. In Western Australia there was an expectation that government schools would implement existing Education Department literacy programs such as *First Steps* (Western Australian Ministry of Education, 1992a)

A number of new State initiatives that emphasise the importance of identifying literacy difficulties in the early years of schooling have also been introduced by the Education Department of Western Australia. The *Good Start* program was first launched in 1992 with the central goal of providing local access to pre-primary education for all four and five year old children. Similar to the *Head Start* program in America and *Start Right* in England, one component of the *Good Start* program was changing the entry age of school to increase the time children spent in pre-school education. Research suggesting younger children in class are more likely to be labelled 'at risk' of developing literacy difficulties was cited as justification for delaying formal schooling (Education Department of Western Australia, 1992). The program was underpinned by the belief that exemplary practice in the early primary school years would reduce the likelihood of educational failure.

In 1998, the *Literacy Net* (Education Department of Western Australia, 1999b) was introduced as a literacy monitoring tool to support the teaching resources developed by the Education Department of Western Australia, *First Steps* (Western Australian Ministry of Education, 1992a). The *Literacy Net* is a tool designed to help teachers measure children's progress against designated standards or 'Literacy Checkpoints', throughout primary school. The aim is to reduce the number of children 'falling through the net' and it makes specific links to *First Steps* strategies to support those children who fail to attain the literacy checkpoints.

While demands to raise literacy standards have lead to increased funding and new educational initiatives, teachers are ultimately responsible for improving children's literacy. In June 2000 *The West Australian* newspaper printed the sobering headline "OUR KIDS FAIL: Literacy shock in primary schools" and a front page article detailing findings from a report commissioned by Dr Kemp, Federal Minister for Schools, that at least one in five children struggles to read (Hewitt, 2000). The article noted that schools have a very short time frame to reverse literacy failure and very little evidence exists for the success of programs designed to correct literacy problems beyond the second year of schooling. Dr Kemp was reported to have claimed that students who fail to make progress in literacy during the first two years of schooling rarely catch up with their peers and are at risk of becoming low achievers who drop out of education at the earliest opportunity (Hewitt, 2000).

Charged with the responsibility of improving literacy skills, teachers have been under immense pressure to find the most effective way to teach early reading and spelling. Deciding which method to use is problematic because there is no consensus on the best approach and no shortage of available programs. In some schools there is an expectation that state government initiatives such as *First Steps* (Western Australian Ministry of Education, 1992a) will be used. In other schools, teachers favour different approaches. While there is no doubt junior primary school teachers seek a common outcome, how they teach beginning literacy can differ markedly.

1.2 Development of the Study

The impetus for this study was based on a number of observations that stemmed in the first place from research on the role of phonological awareness and systematic decoding instruction on learning to read (Formentin & Hammond, 1997). While investigating the reading achievement of children who received systematic decoding instruction, and assisting schools generally to implement literacy intervention programs, this researcher was in a position to observe beginning reading and spelling instruction in many junior primary teachers' classrooms in Western Australia. In most instances, reading instruction took precedence over spelling, particularly in the first half of Year 1, and when spelling instruction occurred it was less formal and more likely to involve incidental teaching of alphabet knowledge and encoding. Children were encouraged to 'invent' and permitted to produce non-conventional spellings of words in order to foster early writing skills. Yet, in classrooms where teachers included systematic decoding instruction as a part of their reading program an unexpected outcome was reported, namely: the spelling of children who received decoding intervention was better than those children who did not. According to their teachers, the 'intervention' children produced longer stories, attempted to spell more unknown words, and applied their knowledge of sound-letter associations to produce better approximations of the target words than 'control' classes of Year 1 children. Research evidence has consistently shown superior reading achievement in these classrooms (Formentin & Hammond, 1997; Formentin, Summers, & Crawford, 1994), but no assessment of spelling was undertaken. This anecdotal observation lead to the initial question of whether, and how, phonological awareness and systematic decoding instruction was related to early spelling.

An issue that follows from the first question relates to the effect of using *Have-a-go-pads,* a strategy many Western Australian teachers employ to encourage children to invent spelling. A single student, known as 'Rosie' for the purpose of this research, and identified by her teacher as having superior reading and spelling skills, was found to be unable to segment words orally when participating in a phonological awareness demonstration lesson. While Rosie performed poorly on measures of phonological awareness, letter-sound knowledge and reading and spelling unknown words under test condition, she showed considerable resourcefulness in spelling during classroom writing activities.

Rosie's teacher had provided her with a *Have-a-go-pad*, a small teacher-made booklet with columns used to cue children to attempt to spell unknown words before they write them in their work. Children are encouraged to show their approximation to an adult who writes the correct word in an adjacent column. Although there is considerable variation in the presentation and use of *Have-a-go-pads* in Western Australian schools, they are used widely to promote invented spelling. In Rosie's case her approximations bore little resemblance to the target word, however her teacher or parents provided the correct spelling. According to Rosie, spelling was the process of locating correctly spelt words, "when I want to spell a word and I don't know that word, I just find it in my work or look for it in my *Have-a-go-pad*....if it's not in there I get the teacher to write it down for me". Rosie did not attempt to encode unknown words for herself and was reliant on adult support when she wrote her lengthy daily diary entries.

Rosie's use of her *Have-a-go-pad* raised questions about the implementation of this spelling approach. In particular, how are *Have-a-go-pads* monitored in classrooms? And is there a need to teach children the pre-requisite skills required to invent spellings? Encouraging children to invent spellings is an accepted practice in Western Australian schools, and indeed in many parts of the world. Could the addition of phonological awareness and explicit instruction in letter-sound correspondences to a process already encouraged by teachers, support beginning reading and spelling development?

The major difference between the instruction experienced by Rosie and children who received systematic decoding instruction appears in part to be linked to phonological awareness and letter sound knowledge. In this thesis, the relationship between these variables and beginning spelling and reading is central. In particular, the relationship between the development of early reading and spelling in children who use *Have-a-go-pads* but who receive either incidental or systematic exposure to critical phonological and alphabetical features of text is investigated.

Current pedagogy, of which invented spelling and *Have-a-go-pads* are a component, reflect the understanding of the interrelationship between reading and spelling which is evident in *First Steps*, a Western Australian approach to literacy instruction prevalent in most schools. The importance placed on interrelated learning experiences and purposeful reading and writing activities aligns *First Steps* (Western Australian Ministry of Education, 1992a) to meaning-emphasis rather than code-emphasis methods of literacy instruction, and the teaching of sound-symbol relationships is treated incidentally and embedded in meaningful language. In relation to the use of the *Have-a-go-pad,* the knowledge children bring to the task of invented spelling is based on incidental, in-context exposure to the alphabetic nature of written language.

As one literacy strategy that appears to be prevalent in Year 1 classrooms, irrespective of the location of the school or individual teachers' beliefs about literacy instruction, is the *Have-a-go-pad*, there is an opportunity to capitalise on the popularity of this activity and inform the practice of many teachers. By examining the importance of incidental versus explicit instruction in phonological awareness and letter-sound correspondences in relation to spelling development, it will be possible to clarify the value of teaching these pre-requisites. Furthermore these findings will contribute to evidence about the reciprocal nature of reading and spelling development and questions about the order in which to teach these skills to young children.

1.3 Purpose of the Study

The purpose of this study is to investigate the relationship between the development of early reading and spelling. This area of research is important because of the presumed dependence of one upon the other and the need to describe the stages of this interdependence and the instructional implications.

The research methodology of the present study permits the examination of the effect of phonological awareness and systematic decoding instruction. This is clearly articulated in the research questions and referred to in the Literature Review. For the purpose of setting the scene a brief summary is presented here.

First, by analysing the work samples of Rosie (a child perceived to have exemplary writing skills but with limited phonological awareness) the relationship between beginning reading and spelling, in particular, the role of isolating sounds in words is highlighted. A second component of the relationship between conventional spelling and the ability to decode is examined. Using a post-hoc research design, a cohort of children who, in another study received systematic decoding instruction in Year 1, were classified as 'Good Decoders/Poor Decoders' and 'Good Spellers/Poor Spellers' in order to identify any 'Good Decoders/Poor Spellers'. This permitted examination of the relative spelling and reading performance of these students and raises questions about the relationship between decoding ability and spelling performance. The main study involved an experimental and control group design in order to investigate experimentally the impact of providing systematic decoding instruction on the spelling performance of children in Year 1. Finally a multiple-baseline across-subjects design, replicated with two experimental and two control subjects, was used to evaluate the effect of teaching phoneme isolation explicitly to children identified as poor spellers in Term 4 of Year 1.

1.4 Research Questions

1.4.1 Stage 1 Research Questions

1 Given evidence of a single Year 1 child's competent reading of text and samples of her written work, considered by the school to be significantly better than her peers, what evidence is there that this child could decode simple Year 1 words in isolation, segment those words into phonemes and spell the same words without assistance?

2 Given that a cohort of Year 1 students received systematic decoding instruction in Year 1, will students classified as 'Good Decoders' (more than 1sd above the mean on Woodcock Reading Mastery Word Attack subtest) include any 'Poor Spellers' (more than 1sd below the mean on Wide Range Achievement Spelling Test) and if so, what evidence does their spelling performance show of the use of segmenting words into phonemes and letter-sound knowledge when spelling words?

1.4.2 Stage 2 Research Questions

3 Will two classes of Year 1 students who receive systematic decoding instruction including phonological awareness (Intervention Group) achieve significantly better standard scores at the end of Year 1 on the Word Attack subtest Woodcock Reading Mastery Test than those of two other classes who did not receive such instruction (Control Group)?

4 Will the Intervention Group achieve significantly better scores of invented spelling as measured by the Developmental Spelling Test than the Control Group?

5 Will the Intervention Group achieve significantly better scores of conventional spelling as measured by the Spelling subtest of the Wide Range Achievement than the Control Group at the end of Year 1?

6 Will the Intervention Group achieve significantly better standard scores on the Passage Comprehension subtest of the Woodcock Reading Mastery Test than the Control Group at the end of Year 1?

7 Will there be evidence of greater use of phoneme identification and letter-sound knowledge in the invented spelling samples of children in the Intervention Group compared to the Control Group?

8 Will four children (single-subjects) chosen on the basis of their pre-test Test of Phonological Awareness (TOPA) scores and classroom teacher's observations that they are poor spellers, two from the Intervention group and two from the Control group, show evidence of improved invented spelling following the introduction of explicit instruction in segmenting words into sounds combined with prompts to use these skills in spelling?

1.5 Definition of Terms used in Research Questions

The following terms; *phonological awareness, reading achievement, spelling achievement and systematic decoding instruction* require explicit definition because the research questions are based on these terms and concepts.

Phonological awareness

The term phonological awareness refers to a general appreciation of the sounds of speech as distinct from their meaning. Two phonological awareness skills are measured by the Test of Phoneme Awareness (Torgesen & Bryant, 1994), phonological blending and phonological segmentation. The ability to break spoken language into its constituent sounds is defined as phonological segmentation and the reconstitution of isolated sounds to approximate a spoken word is defined as phonological blending.

Reading Achievement

Carnine, Silbert and Kameenui (1997) defined reading as including either decoding or comprehension, or both. These two components of reading ability were examined in this study. Decoding is defined as "translating printed words into a representation similar to oral language, for example, reading 'I am hot' for the words *I am hot*" (p. 34). In the context of this study, decoding refers to the process whereby graphemic representations are converted into sounds, that is, a phonological representation of the target word. The ability to decode words was measured through children's performance on the Word Attack subtest from the Woodcock Reading Mastery Test-Revised (Woodcock, 1998). The Word Attack subtest requires students to read aloud a list of non-words. The non-words must be decoded because they are not real words and hence are unfamiliar to the child.

Reading comprehension is defined as the ability to understand translations of print and was measured through children's performance on the Passage Comprehension subtest from the Woodcock Reading Mastery Test-Revised (Woodcock, 1998). The Passage Comprehension subtest requires students to read aloud short passages of increasing difficulty and demonstrate understanding of the text by supplying a semantically appropriate deleted word

Spelling achievement

Assessing children's spelling achievement is underpinned by the belief that 'invented' spelling is an important stage of learning to spell that develops prior to and alongside conventional spelling. Invented spelling is defined as the production of one or more letters that a child indicates represents a word. In this study invented spelling was measured using the Developmental Spelling Test which features a partial scoring system that is sensitive to changes in the children's ability to approximate spellings (Tangel & Blachman, 1995).

Conventional spelling, that is correct spelling, was measured by the Wide Range Achievement Test-Revised Spelling subtest (Jastak & Wilkinson, 1984) and scored as either accurate or inaccurate.

Systematic decoding instruction

The systematic decoding instruction employed in this study as the intervention procedure is based on the model of decoding instruction presented by Carnine, Silbert and Kameenui in 1997. The basis of Carnine et al's model of decoding instruction is that children receive explicit and systematic instruction in component reading skills. For example, in the initial stages children are taught explicitly to convert letters into sounds and then blend the sounds to form recognisable words. As only a limited number of words can be decoded using the most common sounds of letters, Carnine et al's model (1997) includes strategies for reading irregular words, practice decoding regular word types of increasing complexity (e.g., VC, CVC, CCVC and CCVCC), phonic analysis including VCe rule and letter combinations, structural analysis and semantic analysis. In the later stages of reading development Carnine et al's model of decoding instruction also includes the strategies for sight word reading to develop reading fluency. Practice is an essential element of systematic decoding instruction and Carnine et al (1997) emphasise the importance of providing beginning readers with texts that contain controlled vocabulary to practise decoding skills.

CHAPTER 2
REVIEW OF LITERATURE

In this chapter research related to theories of beginning reading and spelling and the impact of these theories on models of instruction in Western Australian classrooms will be critically reviewed.

2.1 Theories of literacy acquisition and their impact on literacy instruction

The history of reading and spelling instruction is the history of conflicting views and discarded theories about how reading and spelling takes place (Jackson, 1992). The debate that has accompanied the teaching of reading and writing for well over 100 years is due, in part, to lack of consensus about a single issue. Is learning to read and write a natural, biological process, akin to learning to talk, or is the acquisition of literacy skills no more a natural process than learning to play golf (Hempenstall, 1997a) or learning to tie one's shoe laces? (Pinker, 1994) This issue is important because the instructional approach educators choose to teach reading and spelling will be shaped by their beliefs about how children become literate. In turn, system wide and school based policies and the availability of support materials will also be based on these assumptions. As the two methods of teaching beginning literacy presently in Western Australia are based on different assumptions about the 'naturalness' of learning to read and spell, an examination of research describing language and literacy acquisition is both the starting point, and a recurrent theme in this review of relevant literature.

2.1.1 Defining and describing language acquisition

There is some variation in the way the concept of language acquisition is described and understood. When linguists and psychologists talk about 'language' they are usually describing spoken language. When educators refer to 'language' they usually mean reading and writing, that is, secondary derivatives of speech. A critical issue is the implication that derives from assuming speech and language are fundamentally similar processes. If it is assumed that speech and written language are the same language process, beliefs about how children learn to write or spell may be erroneous (Kamhi & Catts, 1989). The following positions on how children acquire spoken and written language highlight this issue.

Researchers are unsure about when humans acquired the power of speech, but it is assumed that spoken language in some form evolved at least 100,000 years ago and perhaps much earlier than that (Rayner & Pollatsek, 1989). It is generally agreed, because speech is innate, that children will learn to talk without formal instruction. Current research describes language as a kind of instinct that exists in humans, as web spinning does in spiders (Pinker, 1994). This view was put forward by Charles Darwin:

> Language is an art, like brewing or baking; but writing would have been a better simile. It certainly is not a true instinct, for every language has to be learned. It differs, however, widely from all ordinary arts, for man has an instinctive tendency to speak, as we see in the babble of young children; while no child has an instinctive tendency to brew, bake or write (Darwin, 1874, p.18).

In this century, the most famous argument that language is instinctive came from Noam Chomsky, an eminent linguist. Chomsky (1957) argued that all human beings are endowed with an innate ability to acquire language as they are born able to speak in the same fashion, albeit according to the tongue of their culture, environment, and parents. He maintained that children possess all the rules which govern how language is spoken, and they possess and express language in accordance with innate grammatical rules.

Chomsky highlighted two fundamental facts about language. First, virtually every sentence that a person utters or understands is a unique combination of words, therefore, the brain must have the capacity to build an unlimited number of sentences from a finite list of words. Second, as children are able to arrange and understand a finite set of words, without formal instruction, they must be innately equipped with a plan common to all the grammars of all the languages. Chomsky (1957) referred to this as the 'Universal Grammar'. By analysing sentences ordinary people accept as part of their first language, Chomsky developed a theory of the mental grammars underpinning people's knowledge of particular languages, and from that extrapolated a theory of universal grammar.

Evidence, from different fields of research supports the view that language acquisition is a kind of instinct driven by physiology, genetics and human evolution. Joseph (1993), a neuropsychologist took a similar view when he argued that:

> ...regardless of culture, race, environment, geographical location, parental verbal skills, or attention, children the world over go through the same steps at the same ages in learning language. Unlike reading and writing, the ability to talk and understand speech is innate and requires no formal training. One is born with the ability to talk, as well as the ability to see, hear and feel. However, one must receive considerable training in reading, spelling, and mathematics as these abilities are acquired only with some difficulty and much effort. On the other hand, just as one must be exposed to light or one will lose the ability to see, one must be exposed to language or one will lose the ability to talk or understand human speech (pp. 246-247).

By contrast, for many years researchers have maintained that secondary derivatives of speech, such as reading and writing, are acquired no more automatically by the brain than telling the time. These literacy skills are comparatively new and arbitrary human abilities, for which specific biological adaptations do not exist (Lieberman, 1973). As Bormuth (1975) noted, problems arise when reading is viewed from a naturalistic perspective, because "reading is an artefact of man and not a product of nature" (p.65).

This study is underpinned by a critical assumption: that learning to read and spell are not biologically determined. That is, the ability to read and write is produced by cultural influences, not biology. As the main difference between speaking and reading is the system of visual symbols employed to convey or record messages, it follows that children must learn the particular conventions of their culture's writing system. The next section describes how cultures have developed different writing systems. Each writing system is historically significant to its inventors, yet unique, and as such must be learned by anyone who intends to use it. A discussion of the peculiarities of written English, as an alphabetic system, follows because alphabetic languages place different demands on the beginning reader and writer. English is also considered one of the hardest to master.

2.2 Writing systems

According to Pinker, there are upwards of 5,400 languages spoken in the world most of which have a written system (Pinker, 1994). All writing systems at some point make contact with the spoken language at the level of the 'sign' (Shankweiler & Liberman, 1976). Ferdinand de Saussure, a linguist, emphasised that the relation between the 'sign' and the thing to which it refers is arbitrary (de Sassure, 1974). In all known writing systems the symbols, or arbitrary signs, of the script designate one of three kinds of linguistic structure: morpheme, syllable or phoneme (Adams, 1990). Each system places different demands on the learner, but the universal task of all languages is to learn how the writing system represents language.

Mesopotamian cuneiform, Egyptian hieroglyphs, Chinese logograms, and Japanese kanji use pictorial 'one-word-one-symbol' representations (Ellis, 1993). The Chinese writing system is the only logographic system in common use today (Rayner & Pollatsek, 1989; Taylor, 1981). Adams (1990) noted that while Chinese is not purely logographic, readers of Chinese must learn an enormous number of characters. These logograms can be tedious to reproduce accurately and remembering them as unique symbols places considerable strain on the memory. Adams cited Martin (1972) who noted that the Chinese writing system contains as many as 40,000 basic logograms, of which most Chinese adults have a working familiarity with only about 4000 to 5000. Ellis (1993), observed that Chinese children spend a considerable amount of time learning Chinese characters at home in order to amass between 500 and 600 per year during primary school. As well as the requirement to recall visual images, Chinese readers are faced with the added task, due to the absence of an alphabetic coding system, of working out a rare or new word by its symbolic representation. Spoken Chinese includes many homophones and if Chinese were written as an alphabet, homophones would all be spelled the same way, whereas a logographic system is able to represent each concept with a visually distinctive image (Ellis, 1993). Logograms enable Chinese speakers with different dialects, and arguably mathematicians of different nationalities, who couldn't ordinarily communicate with each other, to read and understand a common script, but pronounce words differently (Temple, Nathan, & Burris, 1982).

Syllabaries are representations of spoken language that have been broken into syllables. Cherokee, Ancient Cypriot and Japanese kana are syllabic systems. The understanding that symbols can represent syllabic 'sound chunks' of language rather than pictorial referents marked a tremendous leap in abstract thinking (Joseph, 1993) and moved some cultures closer to alphabetic systems. While syllabaries enable the reader to apply a system to converting written language to speech, the number of syllables in any language is considerable and each symbol must be memorised. Spoken English has approximately 5000 syllables, fewer than logographic languages, but still representing a cumbersome task for the beginning writer to learn (Adams, 1990).

As writing systems continued to develop they were refined gradually so that whole syllables began to be represented by one symbol or letter. Based on the Phoenician syllabary, with whom they traded, the Greeks produced the first unambiguously alphabetic script consisting of 23-25 characters that singly, or in combination, represented all the phonemes of their spoken language. After some adaptation to account for the problematic vowel representation of the Phonecian system the full Greek alphabet was born around the ninth century B.C. The

Greeks separated consonants and vowels so that each letter represented one sound in their language (Taylor, 1981). Every letter had a different name and anyone who knew the alphabet could write. In early times all letters were capitals and writing was set down from left to right in continuous letters not separated into words. The alphabet was introduced to England by the Romans, who had in turn borrowed it from the Greeks, but with one marked change. Instead of adopting letter names, the Romans used the sound of each vowel to serve as its name and for each consonant they used the letter itself to serve as its name accompanied by a vowel sound. This short cut to naming the letters most probably lent weight to the falsehood that the names of the letters are their sounds.

English was written for the first time in the seventh century by English missionaries who selected Latin letters to represent English sounds. The principle of an alphabet is to represent each phoneme with one grapheme, but the English alphabet and orthography is less than ideal (Taylor & Martlew, 1992). In the first instance, only 26 letters are available to represent 40 or so phonemes. Second, one letter can represent a number of sounds, and different letters can represent the same sound. This has occurred because for at least the last three hundred years English spelling has changed little, while at the same time pronunciation has changed a great deal. The influence of other languages has also confounded the process of writing English. Veltman (1992) and Moats (1995) argued that English orthography is a highly predictable and logical system that represents not just phonemic, but also lexical, morphemic and phonetic information, provided one takes into account the layers of language represented in the orthography. Both writers were referring to the fact that English is a polyglot, that is an amalgam of many languages (Calfee, 1998). Anglo-Saxon is the foundation of written English and a source of many over represented high frequency irregular words such as *said*, *does* and *who*, that today are spelt the way they used to be pronounced. While spoken English has easily accommodated the influences of different languages, (French, Latin, Scandinavian, Spanish, Germanic and Greek contributions that in more recent times have been infused with British and American influences) the orthography of written English has remained constant. Despite this, for about eighty four percent of English words spelling is completely predictable using the most common sound of the each letter (Bryson, 1990) and, as Read (1986) pointed out, English is spoken in many different dialects and with so many different accents that it could never be totally phonemic for all speakers, even if it were not so irregular.

The development of an alphabetic script is considered by some to be "one of mankind's fundamental intellectual advances" (Levine, 1986, p. 48) and although early alphabets reduced the number of symbols to be learned by its user the representation of spoken language brought with it different cognitive demands. In order to write down speech, words must be isolated in the speech stream and further broken down into phonemes, the smallest sound units. For those scripts such as English that evolved from the Greek script and are not perfectly alphabetic, some words do not necessarily map one to one onto phonemes.

Spatial representation of the temporal features of speech is another difficulty facing an individual learning to read and write a new language. Left to right order of print is by no means universal. The written form of Hebrew, Arabic and other Semitic languages are written from right to left. Chinese was organised traditionally into columns, with a column of symbols read from top to bottom from right to left. In modern day China a horizontal system predominates. In Japan, roughly half of all modern printed books are printed with vertical lines, while the other half have horizontal lines. No matter which system is to be learned by the novice, the rules of spatial arrangement are not based on a logical system that can be induced, indeed conventions governing the spatial arrangement of writing systems are subject to change.

Another issue related to the arbitrary nature of writing systems are the symbols or the alphabet letters used to represent sounds. Children learning to read and write must learn to recognise upper and lower case letters written in different fonts and styles. In Western Australia 'Victorian Modern Cursive' is the style of handwriting taught to children and it is unlike the way letters are printed in books, with the formation of some letters varying considerably. For example, as well as the letters *a* and *g* that are usually different formations in print, the letters *p* and *b* are not 'stick and ball' figures. The letters *p, b, n, r, h* are regarded by most teachers as difficult for young children to form and recognise in Victorian Modern Cursive script. Further, given none other than historical reasons why letters represent particular sounds children must learn to recognise letters as unique symbols that were not designed with "an eye toward visual distinctiveness or memorability" (Adams, 1990, p.346). One of the potential sources for confusion in English orthography are the letters *a/o/e*, *p/d/b/q,* *m/w* and *u/n.* The primary way of discerning the difference between these letters is by the spatial orientation of each, however when one letter is flipped over it becomes another. This rotation of symbols in space is contrary to a child's understanding of the world. A chair is always a chair whether it is held upside down or placed on its side, but some alphabet letters change meaning if rotated about the vertical or horizontal axis (Adams, 1990).

Despite the difficulty of learning the complexities of a writing system, another task faces young children learning to read and write is considered by some to be the most onerous: learning how spoken language is coded in print. The mapping of speech onto print in order to read and write presents the novice with challenges relevant to the main questions addressed by this study: specifically, the part phonological awareness, the alphabetic principle, and letter-sound knowledge, play in learning to read and spell.

2.2.1 The demands of learning to read and write English

On the surface the noticeable irregularity of English orthography has earned written English the reputation of being an enormous developmental task for children (Varnhagen, Mc Callum, & Burstow, 1997), notoriously difficult for foreign language learners (Manguel, 1996; Upward, 1992), or in the words of one writer, noting the inconsistencies of the English language, the world's most 'awesome mess' (Pei, 1955). However the real complexity of written English is rooted in the fundamental task of the beginning reader and writer: constructing a link between speech and the arbitrary signs of script. In order to fully realise the potential of an alphabetic coding system, the child must first know, quite explicitly, what speech segments are represented by the strings of letters. This is problematic because isolating individual sounds in words is a different task when applied to speaking and listening, than it is for written communication. In order to speak a word the individual need not know how the word is spelled, or even that the word can be written down. Reading or spelling a word is a different matter altogether.

During spoken communication humans are capable of uttering thousands of different sounds all of which are easily detected by the human ear. The number of English phonemes is estimated to be between 44 and 52 with difference in calculations arising from the fact that speech sounds are produced with variations in different phonemic contexts (Moats, 1995). Joseph (1993) noted up to five million English words can be generated using less than one third of known phonemes. Appreciation of the flexibility of the English language escapes its users because in order to speak a word all the person must do is think of the word, and the speech specialisation automatically selects and co-ordinates the linguistically significant gestures that form the appropriate phonological structure (Liberman & Liberman, 1990, p.351). It is only when writing words down that the complexity of the English language becomes apparent. Luria, a neuropsychologist, described the process:

> In contrast to spoken speech, which usually proceeds automatically and without conscious analysis of phonetic composition, from the very beginning written speech is a voluntary, organised activity with the conscious analysis of its constituent sounds (1980, p.528).

A group of researchers led by Isabelle Liberman in the early 1970s proposed that in order to achieve reading and spelling mastery in an alphabetic writing system an individual must become aware that words could be segmented into a sequence of phonemes (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967; Liberman, 1971; Liberman, 1973; Liberman & Liberman, 1990; Liberman & Shankweiler, 1979; Liberman & Shankweiler, 1985; Liberman, Shankweiler, Liberman, Fowler, & Fisher, 1977; Shankweiler & Liberman, 1976). They noted the ability to analyse the internal structure of a word into its constituent phonemes is an intellectual achievement that is distinct from the universal human ability to learn and use spoken language – an ability that, unlike reading, develops in every normal child. Put simply, even very young children can comprehend the difference between words that differ by a single phoneme (ie. show me your *tummy* / show me your *mummy*) but they cannot explain why the two words are different, nor do they need to in order to communicate. This is because the processes by which we perceive the phonological structure of words conveyed by speech go on automatically and are carried out below the level of consciousness by evolutionary old and highly adapted auditory perceptual processes (Lieberman, 1973). While an unconscious awareness of the phonological properties of spoken language is sufficient for comprehending and producing speech, in order to read and write words using an alphabetic system children must make explicit what occurs implicitly when they talk and reflect on the sound structure of words.

It was not until the spectrograph, a machine that analyses sound, was invented that researchers fully understood the difficulty of the segmentation task facing the beginning reader and writer of an alphabetic writing system (Liberman et al., 1967; Liberman, 1971). Frith (1978) explained:

> Speech can be made visible on a spectrograph, but such a picture reveals no natural segments that might correspond to single letters. These sounds units (phonemes) are an abstraction, and can only be regarded as types of sounds, not actual sounds. They do not reflect context dependent variations occurring in normal speech (p.279).

The isolation of speech sounds is not a straightforward task because consonants and vowels are not discreetly present in the speech signal, but overlappingly represented in the syllable, a condition that has been called 'encodedness' (Liberman et al., 1967) and 'coarticulation' (Kamhi & Catts, 1989; Temple et al., 1982). The word *spun*, for example, has four phonetic segments but only one acoustic segment and breaking this word into segments, is likely to yield something like, depending on pronunciation, the phonetic segments *suhpuhuuhnnuh*, which are arguably very different to the single acoustic segment of *spun.* The phonological overlap that characterises the spoken word, in particular, the combination of *sp,* makes it difficult to produce consonant segments in isolation. Further, phonological analysis must occur quickly because the speaker of the word did not produce the phonological units one at a time. Instead, one sound pulse or 'acoustic segment' contain a series of overlapping and merging phonemes constructed to represent a word, which when perceived by the listener at the rate of 10 to 20 phonemes per second are most likely sandwiched together in a kind of rapidly accumulating seamless sentence 'speech stream' (Liberman & Liberman, 1990). The inherent difficulty in consciously breaking words into phonemes is heightened because there is a mismatch between isolated phonemes and the sounds letters of the English alphabet represent. According to Pinker, "no writing system has symbols for actual sound units that can be identified on an oscilloscope or spectrogram, such as a phoneme, as it is pronounced in a particular context or a syllable chopped in half" (1994, p.189).

Liberman (1979) and her colleagues argued the lack of one to one correspondence between component phonemes and the acoustic structure of words made it difficult for young children to become aware of the phoneme, and thus difficult to grasp the relationship between the alphabet and reading and spelling. Liberman coined this concept the 'alphabetic principle', that is the insight that words are distinguishable from each another by the phonological structure that the alphabet represents, and maintained that the appreciation of this concept was the primary problem facing young children learning to read and write.

While isolating speech into phonemes is characterised as one of the inherent difficulties of written English, matching sounds to letters alone is insufficient to spell words. The position of certain consonants and adherence of the English language to the morphological basis of spelling makes segmentation difficult. For example, the letter *b*, is unvoiced when articulated in isolation, but takes on the phonetic properties of vowels that follow in words, such as bed *(behduh),* bad *(bahduh)* and bug *(buhguh)*. The same is true for some consonants, for example, the letter *c*, which when followed by the letter *a* makes a different sound than when followed by the letters *y*, *oo*, or *o*. The letter *v* is the only letter that always and everywhere maps onto the single phoneme (Gough & Walsh, 1991). Furthermore, English is regarded as a deep orthography or 'morphophonemic' (Pinker, 1994) because it is a writing system that compromises phonological representations in order to reflect morphological information (Adams, 1990). Put simply, English spelling balances the phonetic with the semantic demand to represent words consistently. For example, the following words derived from the root word *scire* 'to know' are morphologically related, but pronounced differently: *science, conscience, conscientious, omniscience.*

Although the English alphabet is roughly a cipher on the phonemes of speech, albeit strewn with ambiguities and orthographic idiosyncrasies, the preceding examples show learning to read and spell is not just a matter of acquiring and applying letter-sound correspondences (Shankweiler & Liberman, 1976). In order to read and spell individuals must first appreciate the abstract relationship between sounds in the speech stream and individual phonemes. Learning the formations of letters and associated sounds of the alphabet is potentially confusing because of the arbitrary nature of the task. Further, the lack of one to one correspondences between the sounds and letters of the English language is a secondary, but significant issue beginning readers and spellers must also appreciate.

2.2.2 The differences between written and spoken language and the implications of this on learning to read and spell

Debate about the acquisition of spoken and written language is confounded by what appears to be many obvious similarities between speaking and writing. Central to this debate is the role of speech. Some researchers have argued that learning to talk and learning to read and spell are ostensibly the same process (Goodman, 1989; Smith, 1985; Walshe, 1981). Other researchers, notably Isabelle Liberman, argued for many years that one cannot understand literacy if one ignores what speech is. According to Liberman and Shankweiler (1979) reading is "parasitic on speech in as much as speech is a primary language system, the alphabetic writing system is a more or less phonetic representation of language and speech appears to be an essential foundation for the acquisition of reading" (p.109). Unlike other writers, Liberman was not referring to the simple convergence between spoken and written language and the vocabulary they share (Brady & Shanweiler, 1991). With her colleagues, Liberman demonstrated that lack of invariant acoustic cues for phonemes imposes serious constraints on the acquisition of reading and spelling in an alphabetic system (Liberman et al., 1967). While the brain analyses speech in order to comprehend spoken language, the act or encoding speech into print and subsequently reading text is not as direct. This is a major difference between written and spoken language.

Liberman and Liberman (1990) argued there are at least four other reasons why learning to talk and learning to read and write are not the same process. First, while all communities have a spoken language, only a minority exists in written form. Second, spoken language is historically prior to reading and writing in the development of the human race, ontogenetically prior to the life of the individual and logically prior in the relation of written symbols to their speech referents. Third, writing systems are artefacts and vary enormously between languages and must be learned by each user. Finally, in order to develop speech, normal children need only be in an environment where language is spoken whereas reading generally requires instruction. These differences illustrate why learning to read and spell are not simple derivatives of spoken language and indicate potential difficulties children may experience becoming literate, in particular, the inherent challenge moving from an implicit to explicit understanding about spoken language then utilising this information to read and write.

As this study is based on the premise that learning to read and spell are 'unnatural acts' (Gough & Hillinger, 1980), it follows that children require particular skills and knowledge in order to become literate. This issue will be examined in two ways. First, by reviewing the stages of reading and spelling development children are believed to follow as they acquire literacy skills. Second, by reviewing the literature on skills and knowledge considered essential for beginning literacy, including how these are thought to be acquired, and whether and how these skills interact in the development of reading and spelling.

2.3 Stage models of reading and spelling development

> Visual word recognition can flourish only when children displace the belief that print is like pictures with the insight that written words are comprised of letters that, in turn map to speech sounds. Even as children begin to learn about spellings, they must also develop more sophisticated understandings of the forces beyond pictures and individual words that direct meaning (Snow, Burns, & Griffin, 1998, p.45).

It is generally accepted that children do not proceed from being non-readers and non-spellers to proficient readers and writers instantly. Instead, children appear to move through a predictable series of broad overlapping stages of reading and spelling achievement that parallel age-related developmental timetables. Developmental models are grounded in Piagetian theory and assume an orderly and innate unfolding of cognitive abilities (Brown, 1990). Reported instances of similar stages learning to read and spell in spite of different educational and family backgrounds and rate of learning have strengthened the legitimacy of stage models (Moats, 1995). While the characteristics and divisions between stages may differ subtly, the attainment of some skills and understandings, such as the crucial role phonological awareness plays in beginning literacy, are common to virtually all models (Ellis, 1994). A central theme investigated by this study is the relationship between beginning reading and spelling, and as a consequence common pre-requisites will be investigated. It must be noted that the reading research literature generally outweighs that reported about spelling and most spelling stage models are parasitic on models of reading development (Pattison & Collier, 1992). This imbalance appears to reflect the importance ascribed to one skill over the other, and is indicative of the view held by some that learning to spell is a by-product of learning to read.

2.3.1 Stages of reading development

Gray (1925) was one of the earliest writers to describe the reading process in discrete periods of development: getting ready to read; acquiring initial skills; rapidly perfecting skills; applying reading skills; and refining reading practices, tastes and attitudes. While Gray's stages indicated the progression children made from novice to competent readers, the stages were signalled by very general reading behaviours. A number of models have emerged in recent times that attempt to chart, more precisely, children's knowledge of how print works.

Gough and Hillinger (1980) proposed a two stage model of beginning reading that identified and explained the shift between young children's ability to recognise familiar words in context and unfamiliar words out of context. These writers isolated two components of reading, word recognition and systematic decoding. They argued most children develop insights into the nature and functions of print by being read to and interacting with books and writing. From this, children become aware that print encodes language and thus are able to enter the first stage of the reading process by learning to recognise words through the strategy of selective association, the pairing of partial stimulus cue, such as a single letter, or the shape of the word, to a response (Gough & Hillinger, 1980). In a study that followed, Gough, Juel and Griffith (1992) reported that children with no means of remembering words other than visual cues tend to associate words with their meanings with whatever salient cue is available, which in the case of that particular study was a thumbprint on the corner of a flashcard!

Frith (1985) defined this stage of reading as the logographic phase. A commonly cited example to illustrate this stage is children 'reading' the word *McDonalds*, the name of the fast food chain, because of the distinctive yellow arches or location of the restaurant. However if written in black and white typeface children at the first stage of reading described by Gough and Hillinger (1980) would be unable to identify the word *McDonalds* without its gross identifying features (Adams, 1990; Frith, 1985; Snow et al., 1998). The research of Masonheimer, Drum and Ehri (1984) showed beginning readers accurately identify logos, even those subject to distortion, as pictures and do not analyse them as sequences of letters.

Gough and Hillinger argued that normal progress in learning to read occurs only if the child makes the transition to the next stage of acquisition, the cipher stage. This stage describes the process by which a child is able to approximate the pronunciation of an unknown word by systematically applying letter-sound relationships. Entry to this stage requires the conscious awareness of the relationship that exists between alphabet letters and phonological segments, and facilitates the process of decoding words. Unlike the first stage, where the child may subconsciously associate a spoken word with some particularly salient visual cue, Gough and Hillinger argued that the cipher stage is not a naturally occurring phenomenon and understanding the alphabetic code that maps the spoken onto the printed word requires adult intervention to ensure the development of analytic processing. The alphabetic phase has been identified by other writers as a critical stage of reading development because children can, without help, read unfamiliar texts (Ferreiro & Teberosky, 1982; Frith, 1985; Perfetti, 1985).

Another stage model of reading development that emphasised the importance of decoding was put forward by Marsh, Friedman, Desberg and Saterdhal (1981a). Four stages were proposed to describe the increasingly complex strategies children employ to recognise words: linguistic guessing, discrimination net guessing, sequential decoding, and hierarchical decoding. Marsh et al noted that the shift between the first two stages and the level of sophisticated analysis required to decode words was dependent on the acquisition of the alphabetic principle.

One of the most frequently cited and comprehensive stage models of reading in the literature was developed by Jeanne Chall (1983). Chall drew parallels between stages of reading development and Piaget's stages of cognitive development and argued that reading stages have a precise structure and hierarchal progression with higher stages requiring attainment of lower order skills. Chall described six stages of reading that most children move through as they progress from novice to skilled readers. She outlined the major qualitative characteristics of each stage and how each was acquired.

The characteristics of the pre-reading stage (Stage 0) described by Chall (1983) are very similar to the first part of Gough and Hillinger's (1980) two stage model of beginning reading. Children acquire a basic sense of language, develop an initial awareness of the printed word, and may begin to recognise some alphabet letters and familiar signs by partial visual cues or the shape of words. Chall noted that at this stage children may engage in 'pseudo-reading' and pretend to read books by pictures, from memory or what they think the text ought to be saying, rather than what it actually does.

During the next stage (Stage 1), children begin to learn phoneme-grapheme correspondence rules and apply this knowledge to sounding out words. This stage corresponds with part two of Gough and Hillinger's model in which Chall also recognised the 'unnaturalness' of acquiring alphabet knowledge and that children attain this knowledge through direct instruction in letter-sound relations and practice in their use. Chall argued that to reach the end of this stage children must understand the nature of the spelling system, in particular, the relationship between speech, phonemes and the alphabet. She observed that children at this stage build a vocabulary of words recognisable by sight, but their oral reading remains typically slow and dysfluent. Frith (1985) and other writers have referred to this stage as the phonetic or alphabetic stage.

In the following stage (Stage 2) Chall described children continuing to build their rapidly increasing sight vocabulary in order to read more quickly and efficiently. At the same time children continue to consolidate and automatize their basic decoding skills and learn more advanced rules of phonics. This stage corresponds to Frith's (1985) orthographic phase, in which the child directly recognises words on the basis of orthographic patterns, that is, the spellings of words.

The next three stages of development described by Chall are of less relevance to this study, because they mark a shift from learning to read, to reading to acquire new knowledge. From the time children are in late primary school to high school and beyond, the linguistic sophistication of what they read overtakes the content of everyday speech. Children devote less attention to the mechanical aspects of reading to allow for the comprehension of text in detail from multiple viewpoints.

Ehri (1987, 1995) adapted Chall's (1983) model and proposed three stages in the development of word reading; visual cue reading, in which words are processed as visual forms in the same way as pictures; phonetic cue reading, which is partial processing of words and involves associating only some of the word's letters (typically the initial or boundary letters) to generate one or more sounds in the word and narrow the range of choices for contextual guessing; and cipher reading, which is a more complete processing task, including matching letters to sounds and decoding words. These early stages of reading development described by Ehri are of particular interest to this study. First, because Ehri isolated the cipher or 'sounding-out' phase as a critical step towards independent reading, and second because Ehri argued that in the process of attaining efficient and automatic word reading, children must change strategies at least twice: from processing whole words, to using partial letter cues, to applying letter-sound correspondences.

Ehri's emphasis on the changing application of strategies is also evident in Chall's model and marks a significant shift from 'top down' to 'bottom-up' processes. Chall (1983) noted that during the 'pseudo-reading' stage reading is based primarily on prediction and memory, which are 'top-down' processes. This changes in Stage 1 of Chall's model when children focus on word perception and decoding, which are 'bottom-up' processes (p.33). An examination of the importance of the alphabetic period, and the skills necessary to decode words is reviewed in another section of this literature review.

2.3.2 Stages of spelling development

In the past memorisation was thought to be key to spelling mastery, however as models of spelling have emerged that typically describe children as moving through phases during which there are changes in the strategies they use to spell words, this view has changed (Henderson, 1985). Despite the variation in stage enumeration and description; Ehri (1986, 1995) began with three then updated her model to four steps, Gentry (1982) and Moats (1995) include five; and Beers and Henderson (1977b) suggest six, spelling stage models have a great deal in common, particularly at the beginning stages. It is generally accepted that when children first put pen to paper they progress from pictorial representation of spoken language to the use of the alphabet to write words (Beers & Henderson, 1977b; Ehri, 1989; Frith, 1980; Gentry, 1982; Levine, 1998; Marsh, Friedman, Desberg, & Saterdhal, 1981b).

At the earliest stage, generally referred to as the pre-communicative stage (Ehri, 1995; Moats, 1995), children are aware that writing consists of written symbols. Spelling at this stage may consist of scribbles, upper and lower case letters and numerals for words (Gentry, 1982). Although these early productions may not include any conventional letters, some gross features of writing, such as linearity, are usually present. When children progress to spelling at the semi-phonetic stage or letter-name stage (Bissex, 1980; Gentry, 1981; Henderson, 1985; Treiman, 1998) they are aware of the phonological structure of words and may use letter names and letters to represent some of the phonemes in words. Spelling at the phonetic or alphabetic stage (Ehri & Wilce, 1980; Gentry, 1982) is usually attained when children gain more experiences with print, develop letter name knowledge and some letter-sound correspondences and are encouraged to write. Phonetic spelling is characterised by the successful representation of all phonemes in words. At the transitional or morphemic stage children no longer rely exclusively on sounds and begin to apply orthographic knowledge of letter strings and spelling rules to spell words (Temple et al., 1982). Beers (1980) described this stage of spelling as children "moving further away from the idea that pronunciation is the major control on English spelling" (p. 40). Most writers agree that children at the correct, or final stage of development, utilise extensive phonological, orthographic and morphographic knowledge to spell words.

Each of the different spelling models describes a stage at which children are first able to produce phonetic or alphabetic spellings. In order to reach this stage it is assumed children must be able to segment words into constituent sounds and transcribe identified sounds to print. Moats (1995) commented that children's analyses rely so heavily on sound segmentation and articulatory feedback that this stage is best described as 'spelling by mouth' rather than simply spelling by sound.

2.3.3 Criticisms of stage models

While stage models illustrate basic developmental changes and provide a framework for understanding the process of literacy acquisition, these models have been criticised for over simplifying development, failing to acknowledge the influence of instruction and obsçuring individual differences. Ehri (1991) acknowledged stage models are at best a 'rough blueprint' because the rate of progress differs considerably between children and some never attain the more advanced levels. Moats (1995) showed children's spelling development is highly sensitive to instruction. She noted that while children's progress is mediated by their concepts of phonology and knowledge of the English writing system, spelling development is accelerated by explicit instruction. Moats' review indicated that with specific training both horizontal and vertical improvements in children's spelling could be observed. For example very young children may apply a single strategy to spell complex words, or be trained to employ a range of different spelling strategies to spell unknown words. In a recent study, Treiman (1998) showed that when taught letter-sound correspondences beginning spellers may in fact utilise information thought only to be accessed by older children.

This finding challenges the very nature of stage models that depict the incremental acquisition of different behaviours in a child's progression from emergent to conventional spelling. Alternative ways of describing the development of reading and spelling have emerged that focus on children's application of different strategies and acquisition of knowledge at various levels of literacy proficiency. Treiman (1998) and Goswami (1998) cited their previous research and argued that children do not necessarily move through reading and spelling stages in a linear fashion, instead children employ strategies continuously from the beginning depending on their background knowledge, skill level and experience. For example, Treiman argued that first grade spellers rarely use *ck* at the beginning of words because they draw on sophisticated orthographic knowledge gleaned from experience with print (Treiman, 1998). Despite this advanced knowledge, the same beginning spellers will continue to approximate the spelling of most words using letter-sound correspondences. This pattern of behaviour has also been observed in adults. Taylor and Matthew (1992) showed that competent adult spellers will continue to use phonetic spelling, albeit with a greater level of appreciation of English orthography than young children, when presented with a novel word to spell. At the same time Goswami has consistently argued that young children are able to bypass the alphabetic phase and to use analogies to words learned earlier to read and spell (e.g., Goswami, 1988, 1998).

What is important in relation to the differences in stage and strategy models is the significance both place on children understanding and applying knowledge, such as phonological awareness or letter-sound correspondences, to decode and encode words.

2.4 Invented spelling research

One issue in relation to spelling development that has received a great deal of attention, and is central to this study, is the point at which children first begin inventing the spellings of words. This production of 'talking letters' (Temple et al., 1982) refers to beginner's spelling of words using symbols they associate with sounds they hear in words and wish to write. The term 'invented spelling' is synonymous with alphabetic spelling, in as much as novice spellers who have limited experience of written language are obliged to abstract sound-letter associations to write words down, but may only succeed in representing some sounds in a word and not use the correct letter(s). Researchers have observed children inventing spelling as early as age four (Huxford, Terrell, & Bradley, 1992) although is it acknowledged that the precise age will depend on factors such as teaching method, underlying ability and social factors (Moats, 1995).

Up to five distinct stages of invented spelling have been differentiated by factors such as children's developing phonological awareness, alphabetic knowledge and experience with print (Beers & Henderson, 1977a; Gentry, 1978, 1982; Temple et al., 1982). Children's invented spellings are judged on the completeness of spellings and number and representation of particular phonemes. It is generally accepted that children will first represent words with an initial phoneme, with or without a random string of letters. At this stage the writers themselves may be the only ones who can read what they have written (Gillet & Temple, 1990). The next stage usually involves the inclusion of an appropriate letter to represent the final phoneme. Medial letters which are usually vowels and constitute the greatest challenge for children are the last to be included, and take the longest to spell conventionally. This progression in phonological segmentation and representation parallels those noted by Adams (1998), Yopp (1988) and Badenhop (1993).

Research findings support the view that just as learning to read is a complex task involving a series of processes, such as alphabet recognition, memory, visual processing, and application of letter-sound correspondences (e.g., Ehri, 1991; Hoover & Tunmer, 1993), so is emergent writing. In order to reach the level of fluency required to comprehend text efficiently, children must change strategies from whole word recognition based on visual features or 'top down' process to the cipher stage or 'bottom up' process of reading. The weight of research indicates the process of inventing spellings is equally complex and also involves switching strategies. A clear distinction can be made between weak and good invented spellers on the basis of the process they use to represent language in print (Moats, 1995). In the early stages children may draw pictures, or produce random strings of letters that are primarily visual processes. In order to become alphabetic spellers children must attend to the phonological properties of words and apply their knowledge of English orthography. This represents a shift from 'top down' to 'bottom up' processes. To make this shift children must reflect on the phonological properties of spoken language, a topic Charles Read has researched extensively.

2.4.1 The research of Charles Read

The work of Charles Read has had a significant impact on present interest in encouraging young children to begin inventing spellings (Read, 1971, 1975, 1980, 1981, 1986; Read & Ruyter, 1985). A linguist, Read is credited with the discovery that children as young as three years and six months attend to English phonology in an abstract way and implicitly categorise the sounds of English. Read was interested in which sounds children were able to discern from spoken language, however his evidence of pre-schoolers' phonological knowledge came from the spelling system for English the children had 'invented' on their own, influenced little by the standard system. His assertion that children devised similar strategies and made the same phonological judgements about the sounds in words and the letters to represent those sounds was received with reserved interest and scepticism. It was only when replicated with less talented and older children that Read's research became widely accepted (Moats, 1995).

When Read (1971, 1975) reported that preschool children's invented spellings were not bizarre or random errors, but rule-governed early attempts to apply the alphabetic principle to the sounds of the English language, educators began to regard the task of learning to spell from the perspective of a young child. Read maintained that whereas adults have memorised orthographic patterns and entire words, young children who have limited experience with print, must use the only system with which they have any experience: knowledge about spoken language. In order to understand children's invented spellings, Read had to convince literate adults to conceptualise words as they are spoken, rather than the way they are represented in print and other researchers have reported this occurrence (Ehri, 1984; Moats, 1995; Treiman, 1985b). Read showed that to a greater extent than older children or adults, young children when left to their own devices "spell by representing speech sounds individually rather than by learning the spellings of whole words or morphemes" (Read, 1986, p.1). Thus, while a literate adult may conceptualise the word *pitch* as a five letter word, a young child may hear three phonemes and spell the word as *pich* and omit *t* (Ehri, 1984). Read also noted that sometimes invented spelling deviates from standard spelling because children perceive oddities of pronunciation which adults do not. Words like *tree* and *train* are commonly pronounced as if they start with *chr*. While adults read *tree* but say *chree* it is because they have seen the *tr* in print and believe this is what they have been saying.

Read analysed and described children's errors, and in doing so promoted the diagnostic value in this activity to ascertain developmental levels. Henderson (1985) shared Read's interest in invented spelling and likened this stage of spelling development to a 'window' on a child's knowledge of words. The notion that there was something to be learned from emergent writing represented a philosophical shift because previously spelling mistakes were considered evidence children had not learned to spell. Read conducted his first systematic study of invented spelling with a group of 20 pre-school age children (1971). After analysing their spontaneous productions Read concluded that children at certain levels of language development perceived certain sounds as related and certain sounds as more salient than others. He observed there was little evidence of random spelling errors and concluded that orthographic knowledge is acquired systematically and not haphazardly. Read based his conclusion on evidence that most of the children he studied arrived at the same system for spelling words.

The representation of vowel sounds is known to cause beginning spellers the most difficulty and amongst his many observations Read noted this was because vowels are "continuous with, and heavily influenced by neighbouring sounds, so it is not obvious how or whether they can be isolated" (Read, 1986, p.4). Read (1971) explained that despite difficulties segmenting and categorising sounds children's peculiar representation of vowels was based on a systematic phonological basis. Read described vowels in terms of the position of the tongue during articulation: front, back, mid, high or low. 'Tenseness' and 'laxness' of vowels referred to complex articulatory properties. Read revealed why children use letter names to represent vowel sounds. The names of the letters *a, e,* and *i* correspond directly to the tense vowels in b*ai*t, b*ee*t and b*ite*. Thus, children typically spell *day* as *DA* or *like* as *LIK*. Read also noted the consistent, but unusual, spelling of lax vowels as in *pit, pet* and *pot*. Children pair lax vowels with tense vowels on the basis of phonic relationships and short vowel sounds are represented by the similar sounding names of other vowels. For example, *pit* becomes *pEt, pet* is written as *pAt*, and pot becomes *pIt*. Read also illustrated why children frustrate adults by "violating an apparent principle of English, that each syllable contains a vowel" when they write *muthr* for *mother*, *brd* for *bird* and *sodnly* for *suddenly* (1971, p.22). When the letters *r*, *l*, *m*, or *n* occur in an English word between two consonants or at the end of a word after a consonant, they constitute a sonority peak, that is they reach maximum loudness, and this is perceived as a separate syllable. Read argued that while adults know that the peak of most syllables is a vowel and possibly influenced by the conventional spelling, they perceive a vowel before the liquid of nasal. Adults usually perceive this vowel as *e* and include it before or after the syllabic segment, as in *candle* or *open*, while children do not represent such a vowel and are likely to write *candl* or *opn*.

Read also discussed the representation of consonants such as the use of letter names to represent words such as *B* for *be*. He defended the logic in children's spelling of *pretty* as *PREDE* and *better* as *BEDR* because in both words the letter D in these words represents a phonetically correct perception. There is no contrast between the sounds *t* and *d* when they occur between vowels because both become a tap of the tongue against the alveolar ridge behind the upper teeth. As this sound is voiced it is closer to *d*. The same pattern is evident in children's phonetically correct perception, but unconventional spelling of *chrane* for *train*. The sounds are similar in their articulatory position and are the logical best 'fit'.

Read argued that as he had gathered spelling data from pre-schoolers with no formal reading and spelling instruction, memorisation of words at this early stage was unlikely. Read also ruled out direct instruction and copying. Based on these observations and analysis that showed most words were spelt consistently incorrectly by different children in the sample, Read claimed that phonemic segmentation and categorisation as well as other cognitive processes applied to language exerted the greatest influence on beginning spelling:

> Whatever variations there may be in individual development, the crucial conclusion remains that children can, (and to some degree, must) make abstract inferences about the sound system of their language before they learn to read and write (Read, 1971, p. 32).

Read also reasoned that children's consistent error patterns could not have been the result of adult intervention because children are unlikely to be exposed to models of incorrectly spelt words. This view is shared by Pinker (1994) who argued that children have the skill to work out how language works, infer grammatical rules, and by extension generate their own spellings of works based on their limited knowledge of the alphabet.

Read's subjects were pre-schoolers living in the Boston area and despite his attempts to justify the validity of his data, his research drew criticisms from researchers who claimed that his sample were precocious children not representative of the general population. Unabated, Read (1980, 1986) continued to analyse pre-school children's invented spellings and publish data, which prompted others to conduct similar studies. Subsequent studies of invented spelling not only validated Read's findings but found remarkably consistent spelling systems across much larger samples (e.g., Beers, 1980; Downing, Coughlin, & Rich, 1986; Ehri & Robbins, 1992; Henderson, 1985; Lombardino, Bedford, Fortier, Carter, & Brandi, 1997; Richgels, 1986; Temple et al., 1982; Treiman, 1993).

Read's research almost certainly inspired the popular activity found in junior primary classrooms today known as 'invented spelling'. Young writers are encouraged to use a strategy that has come to be known as 'inventing spelling' or 'having-a-go' so they can focus on what they have to say without stopping for, or looking up, spellings. When Burns and Richgels (1989) defined invented spelling as "children's ability to attend to sound units in words and associate letters with those units in a systematic though nonconventional way before being taught to spell or read" (pp. 1-2), they highlighted an implicit assumption. Children are thought to produce invented spellings spontaneously and without formal instruction.

2.5 Reading and spelling pre-requisites

In order to examine the relationship between beginning reading and spelling development it is necessary first to consider which skills children require to read and write words they have not seen before. In the context of this study 'reading' is defined primarily in terms of identifying words that are unknown to the child. Random guessing or reliance on picture or semantic cues does not constitute reading. This study is based on the premise that learning to read involves the attainment of particular subskills and the assimilation of these subskills into the act of decoding words (Carnine et al., 1997). At the same time it is accepted that children may use other cues depending on their level of reading ability and pre-literacy experiences. Such beginning reading strategies may include using a salient feature of a word or a cluster of letters to recognise a word (Ehri, 1991), segmentation at the point of onset-rime to identify the rime in new words by analogy to known words (Goswami, 1998), or the application of letter-sound correspondences to decode a word systematically (Carnine et al., 1997). An associated component of this research concerns reading comprehension and it is assumed that if children are to understand readily what they read automatic decoding of words is necessary (Carnine et al., 1997).

The process of 'spelling' unknown words is defined in the context of this study as the application of letter-sound correspondences which approximate the spoken form of the word. This may result in a string of letters, the first of which corresponds to the target word, a phonetically acceptable misspelling or the correct version of the word. Looking up the spelling of a word or copying words off a wall chart or from previous writing samples does not, in this context, constitute 'spelling'. At the same time it is acknowledged that children may apply visual and lexical spelling strategies depending on their level of literacy development (Moats, 1995).

An examination follows of those skills known to contribute to literacy acquisition, in particular those common to reading and spelling.

2.5.1 Print awareness

Well before children begin to learn to read and spell they have accrued different experiences with print. Most children are exposed to everything from cereal boxes to street signs while others are read to and encouraged to look at books in the home. 'Print awareness' refers to general understandings of the nature and function of print, rather than knowledge about specific letters or words. Clay (1979), highlighted the importance of teaching children how to hold a book, which way to turn the pages and in which direction to read the words. She explained children must also understand that it is print that represents speech, not the white spaces between words or the illustrations. Print awareness has been shown to have a moderate correlation with reading ability in the primary grades (Snow et al., 1998).

Read (1986) noted the process of learning to write rested on some general cognitive foundations, such as the conceptions of the nature and purpose of writing, and some specific ones, such as the knowledge that spellings correspond to speech sounds. Clay (1975) explained that children need to understand that writing is purposeful and expect that adults will read their early attempts. Clay maintained that when children appreciate the broad view of print they are better equipped to understand the relationship between individual letters and sounds which are the basic tools of reading and spelling. Treiman (1993) investigated this issue when she observed that even very young children appear to adhere to the conventions of English orthography. She showed that children in their first year of schooling usually, if not always, honour the orthographic patterns of English and concluded that children notice the patterns in the printed words they see, even before they begin to read and write.

Adams (1990) highlighted the discrepancy between the levels of pre-literacy experiences of children when she reported that in some homes children accrued up to 1700 hours of being read to, watching educational television shows and participating in reading, writing and language activities before entering formal schooling. In contrast, Adams cited Teale (1986) who visited low-income homes and reported that some children entering Year 1 bring less than 25 hours of storybook experience and "perhaps 200 hours of general guidance about the form and nature of print" (Adams, 1990, p.90). Adams concluded that while a teacher could make up the difference in children's print awareness, without intervention, such 'experience impoverished' children would struggle to succeed. Underpinning Adams' comments is the view that whether instruction occurs informally in the home, from television shows or in the classroom, children need to be taught about the functions of print.

In a related longitudinal study, Crain-Thoreson and Dale (1992) reported that frequency of story reading in the home and children's level of engagement with print at 24 months predicted children's language ability and knowledge of print conventions at age four years and six months. Although the children in the study were considered verbally precocious, they did not demonstrate precocious reading. Crain-Thoreson and Dale argued that exposure to instruction in letter names and sounds was a stronger predictor of children's knowledge of print conventions, invented spelling and phonological awareness than advanced speech development alone. This further endorses the view that unlike speech development learning to read is not innate, and if supposedly advanced 'early talkers' from literate households require instruction in alphabet knowledge in order to read and spell, children with limited print awareness will need immediate support when they begin school. One factor related strongly to beginning literacy achievement is 'metalinguistic awareness'.

2.5.2 Word awareness

Metalinguistic awareness describes the ability not just to use language, but to think about it, play with it and talk about it, analyze it componentially and make judgements about acceptable versus correct forms (Pratt, Tunmer, & Bowey, 1984). A level of metalinguistic awareness is necessary to examine words as objects of thought, rather than solely for the semantic properties conveyed. One aspect of metalinguistic awareness critical to the decoding of words and generation of invented spellings is the concept of 'word'. While young children can identify isolated words that name objects, individual words are not as clearly marked in the normal flow of speech. Children must acquire the ability to identify individual words in the context of other words if they are to comprehend spoken language or segment words into their composite phonemes in order to write them down. In short, unless children understand what a 'word' is, and can isolate words in a sentence, they will be unlikely to be able to isolate individual phonemes (Carnine et al., 1997).

In the sentence: *the dog barked*, the listener may, on one level, comprehend the information conveyed by the meaning of the words in the sentence. On another level, the listener may reflect on how the structure and composition of the sentence represents the thoughts of the speaker. Word awareness is a critical component of phonological awareness, because to isolate the word *dog* from the stream of speech, the concept of a sentence as a sequence of words must be understood.

In 1980 Henderson and Beers edited a volume of research devoted entirely to the concept of word and concluded, "a mature concept of word underlies a writer's ability to produce, and to spell correctly, the vast lexicon of English" (p.6). They maintained that concept of word was the most important reading and spelling pre-requisite because it provided the conceptual framework into which letters, sounds and syllables fit. According to Henderson and Beers, beginning readers and spellers must first understand that text represents language in order to point out individual words as they 'read' a memorised text. They concluded this was because "lacking a stable concept of word as a bound figure with a beginning and an end, children cannot know where to focus their attention" (Henderson, 1980, p.10).

In the same volume Templeton (1980), drew parallels between children's attainment of the concept of 'word' and Piagetian theory of cognitive development. Pre-operational children aged between two and one half and seven years are bound by the literal and grounded in the present. They are unable to pull back from the present and reflect on matters or concepts such as words comprising of letters or sounds. During the next stage of development, referred to by Piaget as 'concrete operational', children are able to think about language as an object of study in itself, and are able to approach it analytically. When Templeton concluded that "print freezes the continuous stream of speech into perceptually manipulable blocks and begins to pull a child's tacit knowledge about words to the surface where an explicit knowledge can begin to develop" (1980, p.30), he was justifying the centrality of concept of word, and alluding to the critical role the isolation of individual sounds plays in the reading and spelling process.

The abstract concept of words as the building blocks of phrases and sentences, and as linguistic units whose sounds are arbitrarily related to their meanings, is thought to be gradually attained during the preschool years (Tunmer, Herriman, & Nesdale, 1988). A number of studies have investigated children's grasp of the concept of word and showed young children find it difficult to make the distinction between the word itself and the object or action to which it referred (Chaney, 1989; Tunmer, Pratt, & Herriman, 1984). In summary, children were unable to separate the concrete from the abstract because when asked to identify 'snake' as a long or a short word reported it was a 'long' word. Similarly, the word 'caterpillar' was judged to be a 'short' word. In a similar study with grade three reading disabled children, Katz, (1986) reported children with reading problems were less aware of word length than normal readers. Some researchers have argued that while a well-defined concept of word is probably not a necessary pre-requisite to reading and writing, a basic understanding clearly supports initial instruction and is an indicator of the child's level of metalinguistic awareness (Ehri, 1979; Sulzby, 1986). At the same time, these writers accept that children may learn about the concept of word adequately during the process of learning to read and write (Adams, 1990).

2.5.3 Phonological awareness

The terms 'phonological awareness' and 'phoneme awareness' are used synonymously and are understood as types of 'metalinguistic' awareness that develop independently from, and later than, basic speaking and listening skills (Tunmer et al., 1988). Phonological awareness describes the different ways that oral language can be divided into smaller components and manipulated. Researchers have argued phonological awareness skills fall on a continuum of complexity with less sophisticated activities such as segmenting sentences into words and initial rhyming at one end and the most difficult level of phonological awareness, blending and segmenting individual phonemes at the other (Adams, 1990; Chard & Dickson, 1999; Schatschneider, Francis, Foorman, Fletcher, & Mehta, 1999; Yopp, 1988). Others have categorised the ability to manipulate sounds into two developmentally different measurable levels of phonological awareness: implicit and explicit awareness (Ellis & Cataldo, 1992; Valtin, 1984). Children's initial awareness of the sound properties of language through spontaneous play with nonsense rhyming words is considered unconscious and thought to indicate a general implicit awareness of the sound content of words. As children become consciously aware of the sound properties of words their ability to manipulate smaller units of sound develops.

As early as 1972 Shankweiler and Liberman (1972) suggested that difficulties in phonological awareness were the foundation of reading problems and since then research has accumulated steadily to confirm this relationship (e.g., Bradley & Bryant, 1983; Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987). Evidence that pre-literate children (Bradley & Bryant, 1983; Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987), illiterate adults (Liberman, Rubin, Duques, & Carlisle, 1985; Morais, Cary, Algeria, & Bertelson, 1979; Read & Ruyter, 1985) and many children with learning disabilities (Shaywitz, 1996), experience difficulty with some aspect of this skill, has strengthened the link between phonological awareness and reading success. When it was reported that a deficit in phonological awareness contributed to the reading difficulties experienced by otherwise normally developing school age children (Frith, 1981; Liberman &

Shankweiler, 1985; Wagner & Torgesen, 1987), Stanovich argued that individual differences in phonological awareness distinguished between children, with and without confounding learning issues, who will experience difficulties learning to read (1988). In short, the presence of phonological awareness is thought to be a characteristic of good readers, while its absence is considered a consistent characteristic of poor readers irrespective of the age and intelligence of the individual (Smith, Simmons, & Kameenui, 1998) provided they are learning an alphabetic text. Cultures whose written language represents speech at the level of whole words or syllables, such as Chinese and Japanese, have difficulty segmenting speech into individual sounds (Mann, 1986; Read, Zhang, Nie, & Ding, 1987). This suggests that explicit sound awareness is an understanding that develops as a consequence of learning an alphabetic script. Indeed, reading disability is relatively unknown in Japan and China and this is explained on the grounds that only 10 percent of reading difficulties are thought to be visually based, and these reading systems do not rely on phoneme-grapheme correspondences (Butterworth, 1999). Learning to read and write English, by contrast, depends on the ability to analyse sounds in words, and a causal relationship between phonological awareness and learning to read alphabetic languages has been confirmed by many correlational and intervention studies (Lundberg, Frost, & Petersen, 1988; The National Reading Panel, 2000; Stahl & Murray, 1998).

Comparatively less research has been conducted into the relationship between phonological awareness and spelling, yet at the same time a growing number of writers have argued that phonological ability plays an even greater role in spelling than it does in reading, particularly at the early stages of development (Ellis & Cataldo, 1992; Goulandris, 1992; Munro, 1998; Perin, 1983). This research has stemmed from the view that alphabetic spelling depends on phonological coding and deficits in phonological processing are often associated with spelling difficulties (Snowling, Stackhouse, & Rack, 1986; Treiman, 1993). A meta-analysis conducted by the National Reading Panel (2000) of the overall effect of phonological awareness training on reading and spelling found spelling outcomes ($\underline{d}$=.59) were slightly higher than reading ($\underline{d}$=.53), but the effect of training children to isolate sounds in words differed between three classifications of students. Effect sizes on spelling for normal (d=.88) and at risk (d=.76) reading groups were high, whereas for those children classified as 'disabled readers' (d=.15) the effect size was not significantly different from zero. The National Reading Panel explained that the disabled readers were older, mostly through grades two to six, were relatively more advanced in phonological awareness skills with less room for gains than beginning readers and were less likely to show improved spelling outcomes because spelling was a much harder task than reading. The National Reading Panel recognised that measures used to assess spelling probably included irregular words, rendering alphabetic strategies ineffective. However even if the phonological awareness of the 'disabled readers' improved as a result of intervention, the dichotomous nature of the spelling test would have been insensitive to subtle changes in the number of phonemes correctly represented because of the focus on standard spelling. The Panel concluded that "for normally developing readers below grade two and children at risk of future reading problems PA training does improve spelling" (2000, p.2.26).

The 'reciprocal-causal' relationship between children's sensitivity to the many levels of sound structures of spoken language and reading and spelling development has also been investigated (e.g., Perfetti, Beck, Bell, & Hughes, 1987; Snow et al., 1998; Stanovich, 1986). Stahl and Murray (1998) proposed that simple through to complex phonological awareness skills developed in parallel with stages of reading development (e.g., Chall, 1983; Ehri, 1991; Frith, 1985). The writers proposed that partial segmentation of words into rhymes preceded complete segmentation of sounds, which when coupled with alphabet knowledge supported phonetic cue reading and eventual decoding. This view was shared by Bentin and Leshem (1993) who argued that exposure to the alphabet 'triggers' phonological awareness and promotes an appreciation of the alphabetic principle. A similar relationship between different phonological awareness skills and spelling has been described by researchers who have drawn attention to the importance of rhyming as a precursor to the segmentation of individual sounds in words and phonetic spelling (Goswami, 1998; Nation & Hulme, 1997; Perin, 1983).

When Adams described the discovery of phonological awareness "as the single greatest breakthrough in reading pedagogy in this century" (1991a, p.392) she was foreshadowing the impact of early identification and intervention programs for children with poor phonological awareness skills. It is now accepted that if phonological awareness prepares children for later reading instruction, including instruction in phonics, word analysis and spelling (Adams et al., 1998; Chard & Dickson, 1999) it should be a part of the junior primary school curriculum (Smith et al., 1998; Snow et al., 1998). A meta-analysis of phonological awareness studies reported that training children to be sensitive to the sound properties of spoken language was highly effective ($\underline{d}$=.86), but highlighted the need to identify the successful components of teaching programs that best exploit the instructional potential of this skill (The National Reading Panel, 2000). These factors included the optimal length of instruction, which and how many phonological awareness skills could effectively be taught to children and the role of alphabet knowledge in teaching phonological awareness. As the research on precisely how to teach phonological awareness has attracted far less attention than research outlining the risks for students who do not have such skills (Thomson, 1999), these and other issues are important.

Stahl and Murray (1998) raised concerns related to the use of definitions of phonological awareness as a 'single concept' because such research findings failed to isolate the specific phonological skills that contributed to literacy development and could result in the reporting of ambiguous statistical data. This was illustrated by Snow, Burns and Griffin (1998) in a review of the predictive correlational relationship between a set of phonological awareness skills and future reading ability. The writers examined 24 studies and reported that, "on average, phonological awareness (r=.46) was as strong a predictor of future reading as memory for sentences and stories, confrontation naming, and general language measures" (p. 112). This result provides minimal support for a relationship between children's phonological awareness and reading achievement yet specific findings show a stronger relationship. Share, Jorm, Maclean and Matthews (1984) showed that the ability to isolate phonemes correlated (r=.66) with reading achievement scores in kindergarten and (r=.62) with scores in Year

1. Yopp (1988) reported the following correlations between measures of children's ability to isolate sounds and learning to read:

> ...the Yopp modified sound isolation test had the greatest predictive validity (r=.72), followed closely by the Goldstein (1976) phoneme segmentation test (r=.71), the Yopp-Singer phoneme segmentation test (r=.67), and the Bruce (1964) phoneme deletion test (r=.67) (Yopp, 1988, p. 174).

Similarly, relationships between phonological awareness tasks showed initial phoneme recognition and partial segmentation were strongly correlated to letter-sound correspondence knowledge and beginning decoding skills (Byrne & Fielding-Barnsley, 1993; Vandervelden & Siegel, 1995). The ability to blend and segment phonemes was more highly related to reading than blending and segmenting syllables (Wagner & Torgesen, 1987). A meta-analysis of the efficacy of teaching different phonological awareness tasks reported that blending and segmenting exerted a significantly larger effect on reading development than the combination of other sound awareness tasks (The National Reading Panel, 2000).

Thomson (1999) described the confusion teachers reported about including phonological awareness in their programs. He argued that imprecise definitions of phonological awareness might mitigate reliable identification of those children likely to develop literacy difficulties. Thomson maintained teacher confusion was due, in part, to the proliferation of terms used under the umbrella of phonological awareness to refer to a number of individual skills, some of which were more involved than others in the process of learning to read and spell. Spector (1995) focused on this issue in an earlier study and noted that many different terms have arisen from the literature to describe phonological awareness including different combinations of the words *phonological*, *phonemic, phonetic*, and *auditory* plus *awareness, analysis, reading* and *processing.*

2.5.4 Phonological blending

Sound synthesis, or the blending of sounds together to approximate the pronunciation of a word is a skill related mostly to reading ability (Lundberg et al., 1988; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993). Davidson and Jenkins (1994) argued that in conjunction with the isolation of phonemes in words, blending is the phonological awareness skill most related to reading development. Blending sounds is considered to be one of the simpler phonological awareness tasks for children (Yopp, 1988) yet, as Adams pointed out, appreciating that "strange little sounds can be 'smooshed' together into a word", requires a considerable level of phonological awareness (1990, p.75). The challenge with blending phonemes is in remembering and joining together arbitrary sequences of sound. The retention of blending stimuli is contingent on familiarity with sounds in isolation, and the more experience the child has with hearing and manipulating phonemes the easier they will be able to recall and blend sounds. Perfetti, Beck, Bell and Hughes (1987) demonstrated this in a longitudinal study of first graders' acquisition of reading and phonological awareness skills and showed blending draws on an essential but primitive knowledge of segmentation on which success at reading depends. In fact, integrated instruction in isolating and blending sounds has been reported to provide the greatest benefit to reading acquisition (The National Reading Panel, 2000; Snider, 1995).

Carnine, Silbert and Kameenui (1990, 1997) highlighted the importance of teaching phoneme blending, or 'telescoping sounds to form a word' before children learn to decode words. The writers argued that unless children can listen to and blend individual phonemes together orally, they will be unlikely to produce an approximation of the pronunciation of a written word. This is because the application of letter-sound correspondences to text generally results in a staccato recital of sounds, sometimes with intrusive sounds (*buh-uh-tuh* = *but*), that does not approximate the pronunciation of a word. The writers outlined a system for teaching decoding that begins with phonological awareness activities and includes explicit instruction in letter sounds. Children are told to hold continuous sounds and to say stop sounds quickly. According to the writers, knowing sound-symbol associations is insufficient to read a word. Children must understand that words comprise joined together sounds. Carnine et al justified their position by citing the following research:

> Muller (1973), Ramsey (1972), and Richardson and Collier (1971) reported that blending is a necessary component skill for successfully applying a sounding out strategy to unfamiliar words. Ramsey (1972) found that 40 percent of the errors made by nonreading second graders were due to blending difficulties. Coleman (1970) noted that blending is a strategy that students can apply to many different words, but direct instruction with many sounds is necessary before students will acquire the generalised skill. Skailand (1971) and Silberman (1964) reported that, if subjects were taught sound-symbol relationships but not blending, they would not be able to use sounding out as a decoding strategy. Haddock (1976) and Chapman and Kamm (1974) found that only when blending is taught will students successfully use a sounding out strategy for attacking words (Carnine, Silbert, & Kameenui, 1990, pp. 183-184).

Carnine et al (1997) advocate teaching children to hold sounds and join them to the next sound when they decode words. In order to produce an approximation of the target word at the end of holding and running sounds together, children must have learned the strategy of blending. To achieve this, the teacher demonstrates holding sounds and children listen to the sounds and practice saying the target word quickly.

Other research has shown the importance of teaching blending. Crawford (1994) found beginning readers who were taught letter-sound correspondences and how to blend explicitly outperformed controls who were taught only letter sounds. The intervention group showed superior decoding of non-words and passage comprehension. This finding is important because it demonstrates the importance of teaching blending explicitly to decode and comprehend text. In another study, Formentin, Summers and Crawford (1994) showed the efficacy of the intervention

Let's Decode (Formentin, 1992a) to teach reading skills in a similar context to this study.

2.5.5 Rhyming

The relationship between young children's sensitivity to rhyme and beginning literacy development is not straightforward. A popular saying amongst young children in Western Australia heard frequently at the schools included in this study, in response to a task, was "easy peasy Japaneasy". The words in the adage rhyme and it appears to be for this reason that many of the children derived a sense of enjoyment from repeating the phrase. The awareness that words can be divided into onset *p* and rime *easy* (Bryant, MacLean, Bradley, & Crosland, 1990; Goswami & Bryant, 1992), is considered by some to be an implicit and early indication of children's sensitivity to the sound properties of words (Cunningham, 1990). Children's ability to detect larger units of sounds such as syllables and onset-rimes emerges as early as three years of age, appears to be present well before children learn to read, and has been found to be highly predictive of future reading and spelling ability (Maclean, Bryant, & Bradley, 1987). Furthermore, rhyme awareness has been shown to be correlated with early reading and spelling ability (Lundberg et al., 1988). On the other hand, researchers have questioned whether rhyme constitutes phonological awareness at all because children who can recognise rhymes may not be aware of individual phonemes (Ellis & Cataldo, 1992). As the research will show, rhyme awareness does appear to be associated with children's development of explicit phonological awareness and reading and spelling ability.

Some of the earliest work in this field was conducted by Bradley and Bryant (Bradley & Bryant, 1978, 1983; Bryant & Bradley, 1985) who investigated the relationship between alertness to rhyme and later reading and spelling development. Bryant, MacLean, Bradley and Crosland (1990) clarified the relationship between rime, phonological awareness and spelling in a longitudinal study. They found that rime awareness did not have direct and independent influence over subsequent spelling development: rather rime awareness indirectly influenced spelling as a result of its contribution to the development of children's ability to isolate and identify phonemes in words. Catalado and Ellis (1988) investigated the same issue in another longitudinal study and found a strong relationship between implicit phonological awareness, that is, children's ability to recognise and manipulate rhyme and their development of explicit phonological awareness. They showed that children's implicit phonological awareness became less important as their explicit awareness of individual sounds developed and was employed to spell real and non-words. When Muter and Snowling (1997) investigated whether segmentation at the point of onset-rime or phoneme is more important they suggested that explicit phonological awareness is more strongly related to spelling ability than implicit awareness of rimes, but that both support spelling development.

When Treiman (1985a, 1986, 1992, 1994), examined the onset/rime approach to reading and spelling instruction she concluded that units larger than the phoneme and smaller than the syllable support literacy development. Treiman argued that children naturally link speech and print at the level of onset/rime, the vowel plus final consonant or 'rime' units have relatively stable spellings, and it is easier to divide single syllable words before than after the vowel. Treiman (1992) illustrated her theory by describing children's reading behaviours. When faced with reading the word *blast* Treiman observed children were more likely to remember the onset *bl* as a whole unit, than divided into other dichotomous parts such as *bla/st*. Similarly, the rime, *ast* was more readily identified as a sound unit than the single phonemes *a* + *s* + *t*. Treiman noted that while children often prefer intrasyllabic correspondences to correspondences at the phoneme level, successful manipulation of onset-rimes did not preclude phonological processing at the level of the phoneme, rather, as an intermediate step it facilitated children's eventual appreciation and understanding of individual speech sounds. The difficulty of segmenting syllables into phonemes was also highlighted by van Bon and de Haag (1997), who reported that poor spellers sometimes omit the first consonants of syllable-final clusters, such as *bad* for *band*, when attempting to spell words. Similar observations made about children's invented spelling (Read, 1971, 1986; Temple et al., 1982) are consistent with findings that suggest first graders who lag behind their peers in spelling are poor at analysing constituent sounds, in particular, the rime of spoken words (Treiman, 1995).

Goswami (1988, 1993, 1994a, 1994b; Goswami & Mead, 1992) a former student of Bryant, explored many aspects of onset and rime, in particular, whether teaching rhyme could be used as a linking principle to read and spell words. Goswami's (1988) interest in rhyming stemmed from the understanding that while English orthography is irregular, words that are semantically unrelated share consistent spelling patterns if they are grouped together in rhymes. For example, the words *heal* and *health* are related by meaning, but *heal* can be grouped with *steal, real* and *deal* by pronunciation. Goswami regarded these sets of rhyming words as categories and proposed that by identifying phonological similarities in words children would utilise the statistical properties of English orthography and read and spell some words by 'interactive analogy'. Goswami (1988) reported that while children were able to induce unknown words that followed the rime pattern exactly, (ie. *leak, teak*) the children were unable to make any use of spelling patterns to read words with the same vowel sound, but different ending (ie. *lea<u>n</u>* or *tea<u>m</u>)*. Munro (1998) arrived at similar conclusions when he developed and trialled a program based on the assumption that children find it easier to learn to read words by using rhyming phonograms than spelling-sound correspondences and phonic generalisations. Munro showed that using onset-rime was preferable because onset-rime units such as *ain* or *ail* facilitated learning prior to more abstract phonic units such as *ai.* However, Munro conceded, as Goswami and Bryant (1992) had earlier, that for young children teaching analogies appears to be a useful approach only if categories belong to a particular family. While rimes are up to 95 percent orthographically regular and occur frequently in children's beginning reading materials (Adams, 1990; Moats, 1995) exceptions make generalisation difficult.

Despite the secondary influence, sensitivity to rhyme appears to contribute to literacy development research literature on rhyming is plentiful. Similarly, there is an abundance of general literature advising teachers to include rhyming activities as literacy pre-requisites (Snow et al., 1998). Teachers are encouraged to teach rhyming because isolating the rhyme in words is considered easier than segmenting phonemes (Yopp, 1988) yet still draws children's attention to speech sounds (Bradley & Bryant, 1978; Spector, 1995; Vandervelden & Siegel, 1995) and children can be exposed to rhyme incidentally in the context of connected text, such as poems and songs (Western Australian Ministry of Education, 1992a). Notwithstanding the enjoyment children experience playing with language, teaching the intermediary step of rhyming has also gained support in the research literature.

Research on rhyming reviewed to this point is relevant to this study because it supports the inter-relationship between early reading and spelling development and shows that a knowledge of phonograms, underpinned by implicit and explicit phonological awareness, assists students to recognise and spell words. Research has also emphasised the importance of teaching the phonological and orthographical representations of rhyme in tandem. While this teaching approach appears to be optimal, another aspect of rhyming, that has received much less attention, is teaching children to identify and produce rhymes without orthographic information in order to develop their reading skills.

Carnine, Silbert and Kameenui (1997) noted teaching rhyming purely as an auditory activity prepares children to see the relationship between letter clusters that represent the same end-sounds and prepares children for sounding out words that begin with 'stop' sounds. The writers position rhyming after auditory blending and the segmentation of words into individual sounds in their instructional sequence and intend that children will apply rhyming knowledge when they read words. Children listen to an auditory cue and are presented with a letter sound, onto which a rhyme is blended orally with the instruction, "rhymes with *at* starts with *b*". Because the letter *b* is a stop sound and cannot be held without the introduction of a vowel sound, children learn to blend the consonant quickly into the remaining vowel and pronounce the target word *bat*.

The intervention featured in this study is based on an approach outlined first as a purely auditory skill by Carnine, Silbert and Kameenui in their 1979 edition of

Direct Instruction Reading. In subsequent editions the authors included visual cues to teaching rhyming (Carnine et al., 1990, 1997). Formentin (1992a) modified aspects of the Carnine et al's program so that it could be included easily within teachers' existing language programs by removing all visual cues and changing the order of the rhyming format so it was positioned before segmentation. This was done on the basis that rhyming is a phonological awareness activity that children learn easily and can apply to decoding words. Put simply, if the child is asked to say what word "rhymes with *at* and starts with *b*" they will learn to join *b+at* without attempting to hold the initial consonant, or add an intrusive vowel sound. This is based on the rationale that practice at rhyming with common phonograms helps the child to recognise familiar rhymes and assists with the decoding of the following words that begin with stop sounds such as: *cat, hat, pat.*

In summary, the available evidence seems to indicate a relationship between auditory rhyming and beginning literacy that is strengthened when instruction includes corresponding orthographic patterns and increases children's knowledge of English orthography. Children appear to find onset-rimes more manageable than individual phonemes, and it is suggested that awareness of larger units of sound facilitates awareness of individual sounds in words. Further, although there seems no doubt that those children who are unable to segment words into syllables, onset/rimes or phonemes experience difficulty learning to read and spell, it appears the ability to isolate phonemes is the most critical skill for early literacy development and rhyming is facilitatory step. Yet, it is the observation of this researcher that the sheer volume of research in rhyming has been interpreted by many teachers in Western Australian to mean this component of phonological awareness is the most important, and at times the only skill necessary to emphasise. Similar views were put forward by (O'Connor, Notari-Syverson & Vadasy, 1996) who noted that many junior primary school aged children received minimal phonological instruction beyond rhyming.

2.5.6 Phonological segmentation

The isolation of individual sounds in words has led most researchers to position phonological awareness, in particular, complete segmentation of words into phonemes at the most difficult end of the continuum of phonological awareness tasks. Liberman, Liberman, Mattingly and Shankweiler (1980) offered the useful analogy of speech as less like a row of buckets, and more like a continuous stream of water. What literate adults perceive to be discrete sounds actually flow together, overlap, and influence each other substantially. It is not possible to segment a speech signal so that each segment corresponds to only one phoneme (Liberman et al., 1967). This is what makes segmentation difficult: it is not entirely clear in what sense speech consists of discrete units, or why it can be perceived in this way. In order to produce physical approximations of the abstract phonemes it is necessary to add sounds. The word *cat* becomes distorted as *cuhahtuh* when it is segmented into the imprecise physical analogues of the word's constituent phonemes (Liberman & Shankweiler, 1985).

In relation to spelling, Liberman and Liberman (1990) argued phonemic awareness does not entail knowing how to spell an unknown word, only that it *can* be spelled. Once children appreciate that print is parasitic on speech, they must separate the semantic from the metalinguistic properties of language and divide the stream of speech into phonemes. Without awareness of the individual sounds in words matching letters to phonemes is a nonsensical process and the spellings of words can only be learned by rote. The writers argued the same is true for reading, in order to appreciate that the sounds of speech are encoded manifestations of print, children must understand that speech is comprised of phonemes which, if rearranged, make different words. For example, once again consider the sentence: *the dog barked.* Once the word *dog* is isolated, the next stage of phonological awareness considered necessary in order to read or spell this word is to reflect on the structure of the word as the composition of three phonemes, *d+o+g*. When some children are asked to "say the sounds that are in *dog*" in a test of phonological segmentation their response is 'woof' (e.g., Yopp, 1995). This indicates the child is unable to dissociate a word from its referent to manipulate the individual phonemes. When children are aware of phonemes and can partially or completely segment words, they appreciate the words *dog* and *jog* differ by one phoneme, share the same endings, but mean something entirely different.

Research into the relationship between auditory segmentation of phonemic units and reading acquisition has shown that a predictive relationship exists between the ability to isolate individual sounds in words and early reading ability (Juel, Griffith, & Gough, 1986; Lundberg et al., 1988; Nation & Hulme, 1997; Stanovich, 1986; Torgesen, Wagner, & Rashotte, 1994; Tunmer et al., 1988). The segmentation of words into phonemes is considered the linchpin that enables the beginning reader to move from spoken language to written representation of language (Adams, 1990; Bradley & Bryant, 1983; Dallas, 1992; Jorm & Share, 1983; Liberman & Shankweiler, 1985; Rohl & Tunmer, 1988). Children with poor phonological segmentation skills when introduced to reading instruction, tend to be less skilled word readers at some later time (Downing & Valtin, 1984; Yaden & Templeton, 1986). In contrast, beginning readers who are consciously aware of and can access the relationship between letter sounds and oral language are better equipped to understand the phoneme-grapheme system of written language and how to decode words (Wagner & Torgesen, 1987). For this reason researchers have recommended testing of sound segmentation to identify children who may be 'at risk' for success in reading, as well as direct teaching of segmenting as a preventative measure (Fox & Routh, 1984; Juel et al., 1986; Liberman, 1973; Rosner, 1974).

Perin (1983) noted that studies of phonological segmentation had overlooked spelling in favour of reading and argued explicit awareness of phonemes was more closely related to spelling. Perin designed two tasks to assess children's ability to isolate sounds in words, a spoonerism task requiring transposing of phonemes and segmentation of real and nonsense words. She reported that poor spellers, irrespective of their reading skill, had difficulty compared to good spellers in operating on the phonemic level of speech. Perin found that children's ability to perform a segmentation task was not significantly different from their ability to spell and concluded that the close connection between these skills showed necessity of explicit awareness of phonemes in spelling words. Subsequent studies have shown that phonological segmentation is an important contributor to spelling (Ball & Blachman, 1991; Goswami & Bryant, 1990; Griffith, 1991; Lindamood, 1994; Muter & Snowling, 1997; Rohl & Tunmer, 1988).

Wade-Woolley and Siegel (1997) took this argument further when they examined whether spelling problems reflect core deficits in phonological processing. They examined the spelling performance of beginning spellers who were classified as good and poor readers according to their ability to decode words in isolation. The poor readers tended to be poor at spelling and performed worse than the good readers on the phonological task of phoneme deletion. These findings support the phonological deficit hypothesis that difficulties in phonological analysis appear to be one cause of spelling problems (Frith, 1997) and highlight the strong relationship between awareness of individual phonemes in words and reading and spelling development.

Munro (1998) described two processes by which children learn to spell unfamiliar words: by internalising the orthographic patterns of written words by imitation and by synthesising their knowledge of how the word is said in an analogy process. Munro wanted to examine the link between an awareness of sound segments in words and learning to spell, both through imitation and analogy. He found that learning to spell unfamiliar words is influenced by a knowledge of letter-sound correspondences, the amount and complexity of orthographic information children can process and their knowledge of word structures. Munro concluded that to spell words by making comparisons between them, children needed to recognise, segment, delete and substitute sounds. Children who had the poorest levels of phonemic awareness, that is the ability to segment words into sounds, made the smallest gains in a spelling training study.

Another line of relevant research has explored the effect of teaching children how to segment words into phonemes and measuring the effect by examining invented spellings. Tangel and Blachman (1992) initially investigated the effect of phonemic awareness instruction on the spelling development of kindergarten children. Children received instruction in segmenting words into phonemes that included instruction in letter names and sounds for a period of 11 weeks. The children were required to spell a series of words, not included in the training program, and selected on the basis of the phonemic composition of the word that ranged from relatively easy *lap* to more difficult *elephant*. Tangel and Blachman reported that children who received the intervention produced developmentally superior invented spellings than their peers who did not receive treatment. Further, the treatment children significantly outperformed the control children on the isolation and identification of phonemes in words and alphabet knowledge, as well as reading phonetically regular words and non-words. In a follow-up study one year later Tangel and Blachman (1995) tested the treatment children who, after participating in their previous study, received a first grade reading program that continued to emphasise phonological awareness and the alphabetic code. These children outperformed the control children on measures of invented and standard spelling.

These studies support the view that a reciprocal relationship exists between children's reading and spelling development and level of explicit phonological awareness, and that alphabet knowledge is critical to development in each (e.g., Adams et al., 1998; Bentin & Leshem, 1993; Ehri, 1997; Perin, 1983). The isolation of sounds in words precedes the alphabetic phase of spelling, facilitates the invented spellings of young children, and equips individuals at all stages of spelling proficiency with a strategy to attempt to spell any word, particularly when taught in conjunction with letter-sound correspondences (Barry, 1994). Similarly, while a level of appreciation of the sound structure in words is essential to learn to read it is not sufficient (Smith et al., 1998). A combination of awareness of sounds in words and letter-sound correspondence training is necessary to understand the alphabetic principle and decode words (Adams, 1990; Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1993; Cunningham, 1990; Rack, Snowling, & Olson, 1992; Spector, 1995; Stanovich, 1986).

Bradley and Bryant (1983) highlighted the importance of teaching spelling patterns together with sound patterns when they reported that teaching phonological skills must be explicitly linked to letter-sound knowledge to result in improved literacy skills. Blachman, Ball, Black and Tangel (1994) highlighted the importance of teaching children to break down words into individual sounds with concrete cues. Their study of kindergarten children, close in age to the children in this study, involved children receiving training in phonological segmentation who outperformed controls who received instruction in letter names and sounds only on measures of sound isolation (d=1.17) with training effects transferring to reading (d=.65) and spelling (d=.94). This result was included in the National Reading Panel's meta-analysis of the properties of phonological awareness training that make instruction most effective: teaching children how to manipulate phonemes with letters, produced superior results than teaching phonological awareness in speech only (The National Reading Panel, 2000). The The National Reading Panel proposed that letters improved children's understanding of phonological awareness because letters provide "concrete lasting symbols for sounds that are short lived and hard to grasp" (p.2-21). Furthermore, teaching children to manipulate sounds with letters created an effect size almost double that without letters for reading and spelling. Other writers have noted that teaching these skills in tandem early supports the coding of orthographic representations necessary at later stages of spelling development (Ehri, 1989; Ellis, 1994).

2.5.7 Alphabet knowledge

Learning the alphabet is a complex task that requires not only recognition and discrimination of over 40 arbitrary shapes, depending on whether the letter typeface features the same upper and lower case version of letters, but also learning the corresponding letter names and sounds. Gough, Juel and Griffith (1992) argued that to be successful readers and spellers of alphabetic languages, children must learn how to apply the 'cipher' and to do this they must learn the alphabet. In a related study, the rapidity at which children could name alphabet letters and sounds was also identified as a factor that significantly affects the ease of reading acquisition (Fawcett & Nicolson, 1994; Vellutino & Scanlon, 1987). While the importance of alphabetic knowledge is not in question, some writers have debated whether the acquisition of letter name knowledge precedes letter sounds in children's reading and spelling development, and whether letter names and sounds ought to be taught explicitly at all.

2.5.8 Letter name versus letter-sound knowledge

Letter name knowledge has always been a part of most, other than the strictly whole word (Smith, 1971) methods of early literacy instruction. The ancient Greeks viewed learning the alphabet as the first stage in learning to read and write, and the pre-revolutionary *New England Primer* bluntly claimed that "he who did not know his ABC would forever a blockhead be" (Diack, 1965). Despite the apparent importance of recognising and learning the alphabet, confusion has arisen in relation to the role letter name knowledge plays in early reading and spelling instruction. Central to this confusion is the consistent finding that letter name knowledge is the single best predictor of reading achievement (Adams, 1990; Bond & Dykstra, 1967; Share et al., 1984) and by implication must relate to the knowledge and skills required to learn to read and spell. Yet, as Huey pointed out in 1908 "just how naming the letter was supposed to assist in pronouncing the word is difficult to see" (Huey, 1908, p.266, cited in Willows & Scott, 1994). Samuels (1971) and Share, Jorm, Maclean and Matthews (1984) noted this anomaly when they reported that letter name knowledge correlated highly with reading ability, but there was no evidence that letter-name knowledge facilitated reading acquisition. On no other basis than simple logic, to decode and encode words using their letter names is an ineffective strategy because letter names do not approximate the pronunciation of words.

Adams (1990) forwarded an explanation for the moderately strong predictive validity of letter name knowledge to reading achievement when she suggested letter name knowledge was probably an indicator of children's broad preschool reading experiences, which encompass more than recognising alphabet names. Thus although poor letter name knowledge is a symptom of a low level of print awareness and readiness for reading and spelling, it is not the single cause of literacy failure. Other variables, such as parents reading aloud to children or playing language games, could account for children's alphabet knowledge but also influence reading achievement.

Adams explained how researchers had made the mistake of assuming that a moderately high correlation between letter name knowledge and reading achievement implied that the predictor, letter name knowledge, should be taught to pre-readers to prevent reading failure. That is, the assumption was made that letter-name knowledge are casually related. In their investigation of the correlates of reading, Hammill and McNutt (1981) explained that reading is a system of conceptualisation that involves "abstract, graphic symbols; therefore logic indicates that they should correlate highly" (p.35). However, according to Hammill and McNutt, that this correlational relationship should lead to the simplistic view that knowing the alphabet is sufficient to read words is 'spurious': the ability to identify letters by name does not cause children to read words.

Samuels (1971) suggested while letter name training did not have a beneficial effect on reading, letter sound training was far more promising. Groff (1984) reviewed the literature debating the importance of teaching letter names, and reported researchers were divided. While proponents of meaning emphasis methods of teaching reading claimed teaching letter sounds was unnecessary, and at times interfered with the process of learning to read (Smith, 1973a), the same researchers considered letter names were not that important either. Meaning emphasis proponents endorsed teaching letter names so children could refer to the alphabet, spell words out loud and discuss language generally, but mainly because letter names are constant, whereas letter sounds are inconsistent depending on the position letters occur in words.

The use of letter names is evident in stage models of spelling particularly in the early stages of development. Read (1971) showed very young or beginning spellers may depend on an alphabetic or letter name strategy where the particular letter of the alphabet is used to directly represent the sound, but pre-school aged children were usually more familiar with letter names. Others investigators have suggested that children pass through a stage in learning to spell during which they use letter names whenever possible (Gentry, 1982; Henderson, 1985). During this stage children spell all sequences of phonemes that make up the name of a letter with that letter. By contrast, Treiman (1992, 1994) argued that letter name spelling is more common for some letters than for others. Treiman (1994) showed that the use of the letter name strategy depends on the phonological properties of the letter's name. For example, when spelling *car* the child may write *cr*. As children acquire a more sophisticated understanding of phoneme-to-grapheme correspondences, Treiman maintained their spellings reveal less reliance on the letter name strategy.

While letter names yield some success in early spelling attempts, most letter names bear little resemblance to the sounds said when a word is pronounced (Carnine et al., 1997). For only a minority of letters: *b, d, f, l, n, r, v, z* it is possible to identify the phoneme it represents from the initial sound in the letter name (Gough et al., 1992). This presents two issues for the beginning reader and speller. First, children who have learned alphabet names to the exclusion of letter sounds they will not advance in their spelling ability beyond this set of letters. Second, when children have to read or spell a novel word, and they need to map from the phonological form of the word to the orthographic form, letter sound translations are more useful than letter names. Although some children come to school having learned letter names and apply this knowledge to beginning spelling, teaching those who do not know letter names would not result in 'alphabetic' or letter-sound spelling (ie. *joklut* for *chocolate*). Thus, letter sound knowledge, as compared to letter names, is more relevant and useful to encode and decode words (Adams, 1990; Torgesen, 1998; Tunmer, Chapman, Ryan, & Prochnow, 1998).

It has been have argued if phonological awareness helps children to understand the relationship between spoken and written language, letter-sound knowledge is the key to applying this understanding to read and spell words. Poorly developed knowledge of letter-sound correspondences has been found to be the most common cause of reading difficulty (Perfetti, 1985; Rack et al., 1992; Tunmer et al., 1998; Vellutino & Scanlon, 1987). Mastery of letter-sound correspondences is essential for the accurate and efficient recognition of many words because skill in the application of letter-sound knowledge leads children to develop rapid and accurate decoding of phonically regular words (Jorm & Share, 1983). This 'automatic' recall and application of letter-sound knowledge to decoding these words enables children to concentrate on text comprehension (Samuels, 1976). When children cannot automatically decode words, they have limited attention to devote to meaning.

In order to expand on the relationship between letter-sound knowledge and spelling it is first necessary to distinguish between phonically 'regular' and 'irregular' words. All words fit into one or the other category. Regular words are defined in the first instance as "any word in which each letter represents its respective, most common sound" (Carnine et al., 1997, p.57). Thus to a beginning reader, with limited knowledge of letter-sound combinations many words will be classified as 'irregular'. However as an individual's knowledge of letter-sounds, letter combinations and orthographic rules increases, a greater number of words may be systematically analysed, converted to sound and pronounced. Irregular words, at the early stage of literacy acquisition, are defined as "any word in which one or more letters does not represent its most common sound" (Carnine et al., 1997, p.57). Therefore while the words *was, said* and *come* are always categorised as 'irregular', the words *look* and *like* become 'regular' when the individual learns the most common sound of the letter combination *oo* and the CVCe rule. This ability to encode and decode words is affected by an individual's existing knowledge of letter-sound correspondences, letter combinations and orthographic rules, that, in the early stages of literacy development, is subject to change.

The importance of the cipher to the reading process has, at times, overshadowed its role in spelling (Gough et al., 1992), yet many writers take the view that the process of early spelling is dependent, to a greater extent than reading, on application of letter-sound knowledge. Gough et al (1992) drew a parallel between the logographic and alphabetic phases (Frith, 1980) of the reading and spelling process and noted that, prior to learning letter-sound correspondences children can only read or spell whole words from memory. According to Gough et al letter-sound knowledge gives the child the ability to generate spellings and to create words not seen before. They also suggested that alphabetic spelling facilitates the coding of orthographic sequences in memory and assists children to recreate the spellings of known words.

In order to decode and encode words in an alphabetic language, knowledge of letter sounds is more useful initially than letter names, but both are important. The challenge for the novice is learning the arbitrary relationship between letter shape, name and sound. While historical reasons account for letters having particular names and sounds, this information is not helpful to a young child or illiterate adult trying to learn letter-sound correspondences.

2.5.9 Summary: Reading and spelling pre-requisites

The greatest challenge faced by the child learning to read and spell in English is understanding and utilising the alphabetic code, in particular, the conscious awareness that letters encode spoken language at the level of the phoneme. Viewed in this way, the skills required to begin reading and spelling words must include explicit awareness of individual sounds in words and alphabet knowledge and research has supported the fundamental importance of these pre-requisites. A second group of skills that influence children's acquisition of phonological awareness and alphabet knowledge but appear to be of lesser importance to beginning reading and spelling has also emerged from the literature. These include print awareness, concept of word and rhyming.

A recent meta-analysis of 52 experimental studies to investigate the effect of phonological awareness training programs (The National Reading Panel, 2000) endorsed the importance of teaching phonological awareness, but clarified the specific components that most effect reading and spelling. The National Reading Panel indicated that all phonological awareness skills had some benefit to beginning literacy development, but programs that coupled sound blending and segmenting words into phonemes resulted in superior reading outcomes than those programs that taught either skill in isolation. The addition of letters to teach segmentation of sounds in words produced better reading and superior spelling outcomes than attention to speech sounds alone and the Panel concluded that "shapes, names and sounds of letters need to be over-learned to read and spell words" (The National Reading Panel, 2000, p.2-41). These results confirm what research has shown for over two decades: that, at the very least, the attainment of literacy depends on the acquisition of pre-requisite skills. In relation to the investigation of the relationship between beginning reading and spelling reported here, teaching children phonological segmentation, phonological blending and letter-sound correspondences is considered critical.

Frith (1980) first put forward the view that the process of reading and spelling words involved common pre-requisites when she described the relationship between reading and spelling and suggested that early encoding lead to decoding. Since then, the relationship between teaching reading and spelling development has been investigated in more detail and the extent to which learning one activity supports the development of the other has influenced the ongoing debate about which skill children should learn first. In the next section this relationship will be reviewed.

2.6 The inter-relationship between the development of reading and spelling

There is clearly a connection between reading and spelling. The two have different, but complementary functions based on the same alphabetic writing system and children learn both skills at approximately the same time. Spelling was used for hundreds of years to teach early reading (Miles & Miles, 1994), however, that the relationship is as simple as Paul Bissex, aged five, reported to his mother "Once you know how to spell something, you know how to read it" (Bissex, 1980, p.122), is unlikely.

Investigators of the link between learning to read and learning to spell have reported moderate to strong positive correlations. Hammill and McNutt (1981) Morris and Perney (1984), Shanahan (1984) and Tunmer, Chapman, Ryan and Prochnow (1998) reported correlations between reading and spelling samples of Year 1 children ranging from r=.66 to r=.86. A number of explanations for this relationship are possible: learning to read improves beginning spelling development, learning to spell improves word reading, or reading and spelling contribute reciprocally to the development of the other. As knowledge of the cipher is at the heart of both skills reciprocal causation was proposed and demonstrated by Shanahan and Lomax (1986). Catalado and Ellis (1990) showed that the early flow of information between reading and spelling appears to be 'unidirectional': knowledge obtained from spelling contributes to reading.

In contrast, it has been argued that reading and spelling are not simply reversals of the same process because words that can be read using only a few letters cannot be accurately spelled using the same information (Bryant & Bradley, 1980). When Burns and Richgels (1989) reported preschoolers who produce phonetic spellings cannot always read words presented in isolation, they concurred "word reading appears to be a very separate ability from word writing or spelling" (p.13). Smith (1971) argued that knowledge of spelling does not make a 'good reader' or have a role in the development of reading, since reading is not accomplished by the decoding of words. On the other hand, Frith (1983) argued it was possible for individuals classified as 'good readers' to be 'poor spellers'. Such debate has both questioned the relationship between reading and spelling and suggested the correspondence between these skills varies at different stages of literacy development. In addition, these issues have prompted further investigation about whether early readers and spellers utilise the same information at the same time, and the extent to which instruction in one skill transfers to development in the other. This is a central question under examination in this study.

2.6.1 The impact of learning to spell on reading development

Spelling might be expected to contribute to reading skill because, in learning to encode words, children are taught some of the elements of decoding: the most obvious of which are segmentation of words into individual sounds and phoneme-grapheme correspondences. Frith (1980) proposed that writing improves command of the alphabetic principle and steers children to utilise this knowledge to decode words, and based her argument on the principle that children's knowledge of letter-sound correspondences, and by implication their level of implicit phonemic analysis, facilitated alphabetic reading. Frith (1980) reasoned that letter-sound knowledge can be transferred from spelling to reading but she cautioned this was not a simple process. When children read letter stimuli they evoke sounds as responses, whereas, in spelling, sound stimuli evokes letters. The assumption is that children draw from the same data-base of phoneme-grapheme correspondences to complete each task yet the process from sound to letter in which a pairing was learned is not the same. Spelling is a production task and reading a recognition task. Yet, despite the complexity of the task, and the difference in the way children learn this information, Frith maintained the exchange of letter-sound correspondences between learning to spell and read was possible. Research on paired-association learning has supported this assumption and suggests relations are useable for both reading and for spelling regardless of how they were learned (Deese & Hulse, 1967).

Debate about the transfer of specific skills from spelling to reading has continued to feature in the research literature. Juel (1986) suggested that as children refine their ability to detect and isolate sounds in spoken words through spelling practice, so they build up a store of knowledge about the relationships between sounds, letters, and pronunciations that can be applied to the task of decoding. Ellis (1991) reported research supporting the hypothesis that spelling facilitates the transition from the pre-alphabetic stage to the alphabetic stage in reading. Beginning spelling provides children with the opportunity to construct meaningful links between phonological awareness and letter-sound knowledge. Torgesen and Davis (1996) concurred when they argued that in order to invent spellings, children must be able to isolate and translate some phonemes into letters. In their view success at invented spelling may be the most sensitive indicator that children have started to understand the relationship between sounds and symbols which is essential for decoding. Such research has led to specific investigations into the issue of the inter-relatedness of spelling and reading, in particular, whether the way in which spelling is taught impacts on reading development.

2.6.2 Spelling achievement predicts reading ability

Interest in spelling as a predictor or reading achievement has focused on the role of allowing children to invent spellings. Morris and Perney (1984) investigated the link between children's performance on a developmental spelling test and their reading achievement at the end of one year's schooling. The writers found developmental spelling performance was a fairly good predictor (r=.68) of reading ability and considered the factors that might account for this phenomenon. They concluded that children "cannot invent the spelling of a word unless they are able to perceive the sequential phonemic segments within word" (Morris & Perney, 1984, p. 453). The type of spelling instruction and the reading strategies children were encouraged to take up in Morris and Perney's study are significant. First, children were encouraged to invent spelling as teachers modelled 'sound-it-out spelling' by orally segmenting words into their sounds and asking children "what letter comes next?" (p. 445). Second, as letter-name knowledge was tested at different stages during the study it is inferred letter-name knowledge was given greater emphasis than letter-sound correspondences because the measures of reading achievement focussed on whole word recognition, not the ability to decode unknown words. This suggests that modelling segmentation had a bearing on children's spelling performance, particularly as the spelling measure used was not a standardised spelling test, but a test selected to reveal children's ability to represent different phonemes. Further, partially correct spellings, such as including letter names to represent phonemes were given scores, not just words correct. It would appear that using letter name knowledge, as opposed to letter-sound correspondences was both encouraged and rewarded as a strategy to read and spell words. The report of their study did not indicate that children were taught letter-sounds to spell and read words.

In a related study Mann, Tobin and Wilson (1987) also considered whether the preconventional spelling skills of kindergarten children would predict future reading achievement, but unlike previous researchers, Mann et al acknowledged that the children's invented spelling ability was a measure of phonological awareness and highlighted the link between the alphabetic principle and decoding. They devised a scoring system that quantified kindergarten spelling responses based on Read's (1980) analysis of invented spelling and administered the spelling test mid-way through kindergarten. This result was correlated with two measures of children's reading achievement, word recognition and the ability to decode words, gathered at the end of first grade. The children's invented spelling score, taken by the authors to represent their level of phonological awareness correlated with word identification (r=.48) and word attack (r=.59). While the reported correlations are moderate, they can be taken as a reflection of children's awareness of phonological structure and the effect of this on reading achievement, in particular, children's ability to decode nonsense words. As the study did not specify whether children were taught letter-sound correspondences explicitly or describe the method of reading instruction employed during the first year of schooling it is not possible to speculate further about the effect of simply encouraging invented spelling. However, that invented spelling measures are a sensitive indicator of individual differences in phonological awareness marked a shift in the emphasis of research on the inter-relatedness of reading and spelling.

Research on the predictive validity of invented spelling as a predictor of subsequent reading achievement has continued to feature in the literature. In a recent study McBride-Chang (1998) reported invented spelling was highly associated with phonological awareness tasks and substantially predictive of standardised spelling and word and non-word decoding tests over time. McBride-Chang concurred with Mann, Tobin and Wilson (1987) that invented spelling is a proxy for phonological awareness. It is also important to note that McBride-Chang's study included Tangel and Blachman's (1995) invented spelling measure, the same measure used in this study. McBride-Chang analysed the invented spelling samples of kindergarten children on four separate occasions and examined the extent to which this test was a stable measure. McBride-Chang noted that Tangel and Blachman's measure of invented spelling may be an even more sensitive measure than other phonological awareness tasks.

2.6.3 Invented spelling, phonological segmentation and reading

The view that children who are able to invent the spelling of words are especially prepared for the use of phonetic knowledge that beginning word reading requires has gained momentum in the light of a number of research studies. Cataldo and Ellis (1990) examined the growth of reading, spelling and phonological awareness in a longitudinal study that extended over three years. The writers described the ways in which encouraging children to invent spelling acts as a mediator for the influence of explicit phonological awareness on reading and reported that transition from the logographic, or whole word stage of reading, to the alphabetic stage is facilitated by spelling. The writers argued that when children invent spellings they demonstrate an explicit understanding of phonological awareness that builds familiarity with the alphabetic nature of writing and in turn develops a bank of information on letter-sound correspondences and explicit phonemic content of words. Thus, Cataldo et al concluded, it is the act of inventing spellings that "forges a meaningful link between phonological awareness and letter-sound knowledge" (Catalado & Ellis, 1990, p.39).

Huxford, Terrell and Bradley (1992) reported a similar longitudinal study of the reading and spelling development of children aged between 3½ and 5½ years. Children who were able to hear the first sound in words met criteria for entry to the study and every eight weeks testing of phonological awareness, spelling and reading occurred. The use of dictated non-words ensured the children used an alphabetic strategy to spell, however, the authors accepted that the children would either identify the non-words presented for reading by decoding, or read words such as *pez* by analogy to known words. No training was provided, and Huxford et al noted although some children made steady progress in their phonological ability, in particular, the ability to isolate phonemes in words, children's "lack of knowledge of letters impeded their spelling and reading" (p.162). In general, children's ability to read non-words developed between 8 to 51 weeks after they successfully encoded non-words of commensurate ability. Of interest to the research reported here, the authors further noted that children with alphabetic knowledge could not necessarily combine sounds in order to decode non-words, or in an adjunct to the original study, decode phonically regular real words.

Researchers Ehri and Wilce investigated the relationship between spelling and reading in a number of training studies that focused specifically on the isolation of sounds in words. In one study involving preschool age children Ehri and Wilce (1987c) trained children in an experimental group to segment words into phonemes and represent those words with letter tiles. Children assigned to the control group practised matching letters to isolated sounds, but did not learn to spell the words. When both groups of children were asked to read novel words made up from letters used in the spelling activities, the experimental group outperformed the controls. Ehri and Wilce suggested the experimental group's superior reading performance was due, in part, to their ability to segment phonemes, something the researchers tested in both groups of children. They speculated that segmentation of sounds contributed to reading, particularly when phonemic awareness is taught in parallel with alphabet knowledge.

Despite superior performance of the children taught to segment words into phonemes, Ehri and Wilce (1987c) concluded that spelling may contribute to reading acquisition, but it does not teach decoding. The writers explained that spelling ability fosters word reading by enabling a letter-sound-associated storage of words in memory. This rudimentary process of associating letter sounds or letter names to reading words can be effective, for example, children may deduce how to read the word *jail* because the names of the first and final letters say their own names. However, Ehri and Wilce acknowledged this type of whole word recognition is fairly limiting.

Evidence from Bradley and Bryant (1983) and Ehri and Wilce (1987c) that instruction in segmenting and representing sounds with letters provided an advantage in reading, motivated Uhry and Shepherd (1993) to investigate further the relationship between encoding and decoding words. Uhry and Shepherd queried why the preschool subjects in Ehri and Wilce's study used partial cue, rather than 'cipher reading', that is systematic decoding and blending of sounds into words. Citing the children's overall lack of exposure to print, age and the shortness of the training period as potential cause of inability to blend, Uhry and Shepherd put forward the hypothesis that the provision of a year long training period of segmentation and spelling that was supplemental to classroom instruction would produce superior Year 1 readers of non-words and real words even though blending was not taught directly. In fact, after the segmenting and spelling training period, the experimental group did demonstrate superior cipher reading strategies, and Uhry and Shepherd argued this could be explained by the nature of the training tasks. Children were required to repeat a word, say sounds while representing them with blocks, then say the word again. According to the writers the act of taking words apart then putting them back together helped develop blending, but they conceded that the classroom environment was an influence. All children in the study were provided with systematic instruction in alphabet knowledge and were encouraged to invent spelling, as well as to use strategies to identify words aligned to the Whole Language approach. That the control group could not blend however raised the possibility that segmentation and spelling training may have enabled the experimental group to decode non-words (Uhry & Shepherd, 1993). Nevertheless, merely encouraging children to invent spellings was no substitute for the segmentation/spelling training program the writers devised, and did not facilitate systematic decoding.

2.6.4 Invented spelling does not teach systematic decoding

Fostering 'partial-cue' (Ehri & Wilce, 1987c) or whole word reading strategies goes against an overwhelming body of research evidence that has demonstrated that decoding must be acquired for success in reading alphabetic writing systems (e.g., Adams, 1990; Chall, 1967; Gough & Hillinger, 1980; Hoover & Tunmer, 1993; Juel et al., 1986; Stanovich, 1986; Torgeson, 1998). The ability to use the alphabetic principle enables its users to generate at least a 'rough approximation' of a phonically regular word's pronunciation from its spelling (Liberman & Shankweiler, 1979). In contrast, recognising whole words is not a generative strategy and relies on the memory of the child that is highly challenging tasks given the visual similarity of words, for example, *went* and *want*. In her comprehensive review of beginning literacy research, Adams (1990) concluded, "programs including systematic decoding instruction on letter-sound correspondences led to higher achievement in both word recognition and spelling, at least in the early grades and especially for slower or socially disadvantaged students" (p. 31).

Research has highlighted the importance of teaching children explicitly how to blend sounds together to form words (Carnine et al., 1997; Fox & Routh, 1975; Perfetti, 1985). In another investigation of the relationship between phonetic spelling and reading ability Ehri and Wilce (1987a) taught kindergarten aged children to segment and spell words and non-words, then tested their ability to read the same words. They reported that while learning to spell did contribute to word reading skill, children still found the list of learned spelling words difficult to read. The writers accounted for this difficulty as inability to blend sounds. They described a number of errors related to ineffective blending: children produced the correct sounds but could not blend the word, children would omit sounds and sometimes paused between sounds for too long and forgot the sounds they had produced so far.

Ehri and Wilce (1987a) reported that the results of their study showed that learning to spell makes a contribution to reading acquisition among children who are just learning to read in as much as it raises children's phonological awareness and conception of phonemes. As blending skills were not taught in the spelling training, partial cue reading or memory, was the way most children recognised the words. While not teaching children to decode words, the writers maintained that training children to isolate sounds in words enhanced phonetic cue reading by helping readers to store words in memory using letter-sound associations.

Arguing that the children did not use visual cues to read words, Ehri and Wilce described children's partial attempts to sound and blend some of the words as evidence that they were looking for phonic, rather than visual cues.

Clarke (1988) analysed the writing output and reading achievement of two groups of beginning spellers and found the invented spelling group had significantly greater skill in tasks requiring word analysis such as the decoding of nonsense words than the group that received traditional spelling instruction. This was in contrast to measures of flash word recognition and reading comprehension where minimal differences were reported. Clarke interpreted this finding to mean the invented spelling group benefited from the practice of matching sound segments of words to letters as they wrote from using their own sound sequence analysis. Of interest to this study and unlike Ehri and Wilce's research design (1987a), both groups in Clarke's study received explicit instruction in letter-sound correspondences and 'sound sequencing in words'. The latter was taken to mean teaching children to blend sounds. However, Clarke (1988) noted both groups used basal readers which promoted a "reliance on processing words by their visual cues rather than by phonic analysis" (p. 307). Given that children were taught letter-sound correspondences and how to sound words, but used reading materials that did not contain words the children could decode, Clarke reasoned that the process of inventing spellings appeared to have influenced children's ability to decode as indicated by their non-word reading performance. This finding is important to the present study because it suggests that when teachers include instruction in sound-symbol relationships and blending but do not give materials to children to practice decoding, their ability to decode words can be enhanced through encouraging children to invent spellings.

2.6.5 The impact of learning to read on spelling development

For many years spelling has been assumed to be a skill children 'caught' by reading. At one level, there is a simple logic to this argument: seeing words provides children with the impetus and basic knowledge to attempt to write. Print awareness is a significant contributor to children's knowledge of letter names before they enter school (Adams, 1990) and most likely the reason the children in Read's (1971) study of invented spelling were able to produce letter formations without formal instruction. As these same spellings adhered to orthographic conventions it was apparent that children were paying some attention to the spellings of words (Treiman, 1998).

Research has shown that there is some evidence to support the view that learning to read words improves children's ability to spell those words. Stanovich and Cunningham (1992) argued that during the process of reading the repeated action of processing words or word-group units impacts positively on spelling ability. The writers confirmed early research that adults and third and fourth grade children who have higher print exposure are better spellers (Cunningham & Stanovich, 1990). Even after partialing out IQ, memory ability and phonological processing abilities, print exposure, or the amount of reading the child did, accounted for significant variance in orthographic knowledge. In relation to this study, Cunningham and Stanovich also showed that the same is true for first grade students. Thus, exposure to letter sequences in words in reading allows even young children to develop orthographic representations that can be used in spelling. Muter and Snowling (1997) also noted that in addition to the important role phonological awareness plays in learning to spell, exposure to print also contributes to spelling development.

2.6.6 Decoding and spelling development

As well as the pre-literacy experiences children bring to the task of reading, sub-skills models of reading development which emphasise phonological awareness training and systematic decoding instruction may also support beginning spelling development. Ehri has consistently shown that reading influences spelling in both prereaders and children able to decode words. In a study of prereaders Ehri (1980) asserted that children's orthographic information is induced as a consequence of experiences with print. In another study Ehri (1992) showed that prereaders at the whole word or logographic stage of reading development learned arbitrary, visually distinctive spellings more easily than systematic phonetic spellings. In contrast, alphabetic readers who applied sound-symbol knowledge to decode words were able to spell words using this same knowledge. Ehri's research appears to show that exposure to print facilitates the spelling of words, but that the application of alphabetic knowledge applied to decoding words can transfer to encoding words. In studies of alphabetic readers, Ehri and other researchers have shown that the acquisition of decoding skills in systematic phonics programs improves children's spelling ability (Chall, 1967; Ehri & Wilce, 1985).

Griffith (1991) analysed the strategy of decoding and argued that the application of letter-sound correspondences to the task of sounding out words was preceded by phonological awareness. Griffith maintained that while children may appear to access letter-sound relationships learned through systematic phonics instruction to invent spellings, the ability to segment words at the level of the phoneme was more important. Griffith explained that alphabetic readers notice how some letters correspond to the sounds heard in a word and they store these representations in memory. Without phonological awareness, children would not be able to analyse words in this way.

2.6.7 Phonological segmentation and spelling

The research has reported a number of ways in which phonological awareness acquired through learning to read affects spelling development. On one level, when children appreciate the relationship between spoken and written language they begin to learn letter-sound representations that can later be used to generate spellings (Juel et al., 1986). Once children begin reading words, awareness of the sound properties of words is thought to aid in the storage of spelling for equivocal phonemes in these words (Griffith, 1991).

Evidence of the importance of segmenting words into phonemes on reading and later spelling development is also embedded in Frith's (1980) theory of good readers/poor spellers. Frith proposed a theory of reading by full or partial cues that emphasised the importance of phonological awareness in the development of orthographic spelling strategies for older children. Frith described children who did not attend to the sequence of letters representing the phonological properties of the word and relied instead on context and some letters to recognise words as partial cue readers. Frith hypothesised that these students would become poor spellers because they could not recall orthographic letter strings. Frith maintained that good readers use full cues to read, that is they decode words, store knowledge or letter strings and subsequently be able to recall orthographic representations for words.

2.6.8 Summary: The inter-relationship between learning to read and learning to spell

Viewed simply, reading and spelling skills are related in as much as they contribute to the development of each other. However, the question of whether teaching reading improves spelling more than spelling instruction contributes to reading ability is complex. In the studies which examined the link between reading and spelling development, reading was limited to word recognition, not comprehension. None the less, while invented spelling appears to promote beginning reading, acquisition of the skills to invent spelling is dependent on the same component skills as decoding: the segmentation of words into phonemes and letter-sound knowledge. Despite the reciprocity reported by some researchers, the necessity to teach children who learn to spell words how to blend sounds when they read suggests that teaching children to spell first will support word recognition, but may not result in the ability to decode words. This view is supported by a recent study that showed three measures of phonological awareness: invented spelling, sound categorisation and auditory blending were the most predictive of standardised reading measures obtained at the end of first grade (Gilbertson & Bramlett, 1998). In contrast, there is evidence to suggest that the inclusion of phonological awareness training, when coupled with learning letter-sound knowledge and systematic decoding instruction will provide the necessary sub-skills to promote invented spelling as well as foster essential decoding skills.

Of the phonological awareness skills children are thought to require to learn to read and spell the ability to identify in sequence each phoneme or sound is regarded as the single most important. Researchers have investigated the relationship between beginning spelling and reading and emphasised the importance of isolating sounds as a skill that facilitates the transfer of letter-sound knowledge from one skill to the other (Ehri, 1987; Ehri & Wilce, 1987b; Uhry & Shepherd, 1993). Nation and Hulme (1997) also isolated the segmentation of words into sounds as the link between spelling and reading development. They concluded segmentation of words into phonemes, not onset-rime segmentation, predicts early reading and spelling. This finding is consistent with previous research (Davidson & Jenkins, 1994; Hoien, Lundberg, Stanovich, & Bjaalid, 1995) and consolidates the importance of the child being able to identify sounds in order to access the alphabetic principle to encode and decode words.

While the process of children inventing spellings seems to sharpen their appreciation of the phonological structure of words, in particular the isolation of sounds as separate units, to expect all children to induce the alphabetic principle and letter-sound correspondences is falsely optimistic (Groff, 1986). First, it is optimistic because not all children gain insight into the alphabetic principle without instruction, and second because knowledge of letter-sound correspondences is fundamental to reading and spelling and also difficult for children to induce alone. Instead, instruction in the phonological awareness, phoneme-grapheme relationships sounds, and the alphabetic code heightens awareness of the internal structure of words. Tangel and Blachman (1992, 1995) have researched the effect of teaching children to segment words into their component phonemes on the invented spelling of first grade children and shown this awareness translates into significantly greater sophistication in terms of both standard spelling and invented spelling.

Debate about the optimal order in which children should begin reading and spelling to maximise the benefits of one skill supporting acquisition of the other appears to be most valid when students are expected to acquire literacy without adult intervention. When children receive explicit instruction in skills known to contribute to learning to read and spell such as phonological segmentation and alphabet knowledge and blending, dependency on discovering these concepts in the course of reading and spelling is significantly reduced. This is not to say that the development of one skill does not advance the other, or to dispute the interrelatedness of the two tasks, rather by teaching the pre-requisite skills explicitly it would appear that all children will be better able to succeed at both tasks.

As the development of beginning spelling skills is a central issue under investigation in this study an examination of theoretical models of spelling development follows. In particular, these models highlight the relationship between reading and spelling development.

2.7 Theories of spelling development

When educators make decisions about literacy instruction they are guided by theories that explain the mental processes involved in spelling. It is generally accepted that the acquisition of spelling skills is an extremely complex process (Adams, 1990) so to produce theoretical models is to risk oversimplification, or worse, inaccurately represent what takes place when we spell words. Researchers from diverse fields have put forward different theories to explain the process of spelling. The implications of such theories to the research reported here are critical, as the following example will show. Dual-route spelling theory is an extremely influential theory based, amongst other things, on observations that most adults spell words through a 'direct' route from a visual image of the whole word to letters on a page. It is argued that this process occurs with little effort and the need for phonological recoding, or matching isolated sound to letters and representing the word in print, is negated. Given that this process appears to work successfully for literate adults, it is reasonable to question whether emergent writers should be taught to remember whole words or whether they require instruction in the alphabetic principle at an early stage.

As the research has consistently shown the alphabetic principle is critical to beginning spelling because it exercises considerable influence over the spelling development of children. However, according to dual-route theories it is this 'indirect' process of matching speech sounds to letters that literate adults use if confronted with a novel word. While a clear distinction is made in this study between adult and beginning spelling because they are not considered to be the same process, the role of mastery of the alphabetic principle and the mental processes and pre-requisites involved in alphabetic spelling, are a central component of this research. Thus, the purpose of this chapter is to examine the role of alphabetic spelling in a number of theories, in particular, in a model that examines the relationship between reading and spelling development.

2.8 Frith's Model of Reading and Spelling (Frith, 1985)

The work of Uta Frith, and her development of an integrated model of reading and spelling has had a major impact on this research on spelling. The publication in 1980 of *Cognitive Processes in Spelling* edited by Frith marked a significant point in spelling research, because for the first time spelling difficulties and processes became the key area of investigation (Ellis, 1994). Frith's original model of reading and spelling development was first published in this text alongside other theories (e.g., Ehri, 1980; Marsh, Friedman, Welch, & Desberg, 1980) that were influenced by a growing understanding of the relationship between reading and spelling processes.

Frith's (1980) original model of reading and spelling development isolated three qualitatively different stages through which beginning readers and spellers are assumed to pass as they accumulate reading and spelling skills. Frith described these stages in terms of the strategies children utilise to read and spell words: logographic, alphabetic and orthographic. At the logographic stage, Frith explained that children read words by recognising the whole words by shape, salient features or contextual cues (ie. the colour of the fast food sign), and spell words from memory using the same visual cues. During the alphabetic stage, letter order and phonological considerations are considered critical as children begin to systematically decode and encode words grapheme by grapheme. Finally, at the orthographic stage, Frith argued that children's experience with the orthography of their written language enables them to read and spell words without phonological conversion. That is, children store, recognise and access lexical representations of 'graphemic clusters' such as *tion* and *igh* automatically. According to Frith the orthographical phase is free of sound because children recognise and produce abstract letter arrays that correspond to morphemes.

At about the same time, Ehri (1979, 1984, 1986) reported that improvements in phonological awareness are a consequence of learning how to isolate and spell sound segments. Ehri argued that sight word reading was dependent on children's memory of how words were spelt because spelling 'bonded' words to their semantic, syntactic and phonological identities (Ehri & Wilce, 1980). Ehri's (1986) interest in spelling as a foundation of reading development lead her to propose an integrated model of spelling and reading development. In a review of her academic work, Ehri (1997) noted that she had been influenced, and in turn, contributed to the research of the time on the connection between reading and spelling development. It appears the influence of Ehri's research, and similar investigations conducted by Frith (1980, 1983; Frith & Frith, 1983) lead Frith to revise her original model to reflect the reported interdependence between spelling and reading.

Stage	Reading	Spelling
1a	***Logographic 1***	(Symbolic)
1b	Logographic 2	Logographic 2
2a	Logographic 2	***Alphabetic 1***
2b	Alphabetic 2	Alphabetic 2
3a	***Orthographic 1***	Alphabetic 3
3b	Orthographic 2	Orthographic 2

Figure 1 Three-Stage, Six-Step Model of Reading and Spelling Acquisition (Frith, 1985); strategies acting as 'pacemakers' for each step are italicised and arrows indicate the movement in emphasis between spelling and reading development. "1" signifies a very basic level of the skill, "2" a more advanced level, and so on.

In 1985 Frith revised her simple three-stage model to six steps based on her observations of the interaction between children's reading and spelling development, particularly the apparent dependence of reading on spelling. Frith argued that in normal development spelling and reading follow the same stages, but develop at different rates. Retaining the three original phases, Frith proposed that children would remain longer at the logographic stage for reading, than for spelling. She also described the interactions between reading and spelling stages arguing that the need to write influences the strategies children apply to reading words. Central to Frith's (1985) model, like that of Ehri (1986) is the view that children first gain an explicit insight into the alphabetic code through practice at spelling, and it is this knowledge that triggers a shift from logographic to alphabetic reading. Frith explained how using a phonological approach to spelling prompts letter to sound alphabetic reading:

> ...the piecemeal left to right decoding of a word might first make sense to a child as a deliberate reflection of the first-to-last writing process.

> This then would become the guiding principle of analysis that was missing before. When a child has learned to spell a word then he or she may realise that what is important is temporal order rather then salient graphic features. The first letter is both prominent in the spelling sequence and graphically salient. This may be an example of a merging of components of two strategies (1985, p. 314).

At the orthographic stage for spelling, the reverse is true and reading becomes the 'pacemaker' for the development of orthographic spelling. In order to spell orthographically children must access an established storehouse of information about English letter strings and word meanings. Frith maintained this information is gleaned through considerable practice analysing letter sequences while reading words. Thus experience with reading allows children to abstract knowledge of orthographic sequences which can be applied to spelling. Frith described the dependent relationship between reading and spelling development as 'an alternating shift of balance' with 'reading the pacemaker for the logographic strategy, writing for the alphabetic strategy, and reading again for the orthographic one' (Frith, 1985, p. 313).

The interdependence described by Frith highlights the importance of pre-requisite skills necessary at critical stages of development, and the consequences when these skills do not develop. Frith's framework is based on the assumption that children will attain these skills as a result of interaction with the process of reading and spelling. At the logographic phase children rely on visual memory and repeated access to print. In order to enter the alphabetic stage the skills and understandings children require include the concept of 'word', phonological awareness, sound segmentation, auditory sequencing, phonological memory and phonological assembly. Transition to the final orthographic stage is brought about through experiences with reading and writing (Frith, 1985).

Frith's (1985) revised model is underpinned by another assumption: that reading and spelling are different processes and this distinction is most evident in the early stages of literacy acquisition. Frith argued that in the first instance, the alphabet is more useful to spelling, than reading words. This is because reading is essentially a recognition process that can occur with partial visual cues, but spelling is a phonological retrieval process. Thus, while children may be able to recognise the word *teddy* at the logographic phase of reading because it has *dd*, it is unlikely that the child will be able to utilise the same cue to spell the word in its entirety (ie. when writing teddy, the child is more likely to draw a picture of a bear or write TDE than to write *dd*).

Theoretical models of literacy acquisition must account for reading and spelling disability. Failure to develop reading and spelling skills is explained by Frith as an indication that a child's development has arrested at a particular stage. Frith (1983) and Frith and Frith (1983) identified three groups of readers; good readers-good spellers, poor readers-poor spellers, and good readers-poor spellers. They maintained that poor readers-poor spellers have not mastered the alphabetic code, make predominantly 'nonphonetic' spelling errors and could be considered dyslexic. Spelling development for this group is arrested at the logographic phase. Good readers-poor spellers, in contrast, have trouble remembering spellings that do not conform to phonological rules and tend to compensate by spelling words phonically. This group was described as being unexpectedly poor spellers, because they had no particular difficulty with reading. However, when presented with passages containing misspelled words that could be sounded and real words with omitted letters, these children had great difficulty with the 'sounds right' words, and yet coped with the 'looks right' words quite easily. Frith concluded that these children were using a visual 'by the eye' strategy to read, but a phonological 'by the ear' strategy to spell. Thus, the children had arrested in the alphabetic phase for spelling because when faced with equally plausible phonetic alternatives when encoding words could not reliably decide which grapheme to use (Frith, 1980). Frith maintained that despite using phonological rules so assiduously, the children's poor spelling was caused by the inability to remember what written words look like, which was in turn the result of paying only cursory attention to the letter-by-letter structure of words.

Criticism of Frith's (1985) model of reading and spelling development has mostly focused on the inflexibility of fixed stages to capture the intricacies of the learner's task, (see Goswami & Bryant, 1990; Snowling, 1994; Snowling, 1985, for a detailed review). Others have noted that there is limited evidence of the existence of a logographic stage of spelling (Ellis, 1994; Goswami & Bryant, 1990). Despite these concerns the response of Seymour, Bunce and Evans (1992) is indicative of the level of acceptance, in principle, Frith's model has maintained. The writers argued that logographic and alphabetic processes are more likely to develop in parallel rather than sequentially as Frith depicted, but retained her model, with only minor modifications, for the purposes of their research.

At the same time, Frith's (1985) theory of the dependence of beginning reading on spelling has been widely supported (Goulandris, 1992; Huxford et al., 1992). Bryant and Bradley (1980) reported findings that explained the phenomenon Frith observed of children reading words they could not spell, yet spelling words they could not read because readers could utilise logographic cues to read words which they could not spell, but apply alphabetic knowledge to spell words which they had not seen before. Longitudinal studies conducted by Catalado and Ellis (1988, 1990) also supported this argument. The writers showed children demonstrated an ability to spell certain words earlier than they could read them and argued children at the early stage of spelling development use a phonological strategy more effectively for spelling than for reading. Goswami and Bryant (1990) confirmed that Frith's (1980) finding paralleled their observations of young children who become poor spellers, but good readers, as "those children who never abandon an approach to reading and spelling which most children drop by the age of eight years or so (p.93)." Based on her observations of children Frith (1985) identified classic developmental dyslexia as the failure to proceed to the alphabetic stage for reading.

Ehri (1979, 1984) took a different investigative path when she questioned the attainment and transfer of the alphabetic strategy from spelling to reading in Frith's model, but arrived at similar conclusions. Ehri noted that improvements in phonological awareness, on which the acquisition of the alphabetic reading stage is based, are themselves a consequence of learning how sound segments in words are spelt. Ehri suggested that spelling words alphabetically enabled children to make sense of the phonetic properties of written language. In another study that emerged in response to Frith's contention that the alphabetic strategy may appear earlier in spelling than in reading, Seymour (1986) investigated whether young children would find it easier to spell non-words than to read them. Seymour reported that once taught simple letter-sound association, the preschoolers, aged four years, made plausible attempts at writing dictated CVC words, but were not as successful reading the same words. Finally, in his review of longitudinal studies of spelling development, Ellis (1994) revisited and gave considerable support to Frith's (1985) claims of developmental arrest, particularly, that the acquisition of phonological awareness through spelling facilitates development of an alphabetic reading strategy. Ellis' substantial review concluded that as a general description of literacy development "Frith's model holds many truths" (p.171).

The importance of Frith's (1985) model to this study is that it provides a framework within which the interaction of learning to read and learning to spell advance the young child towards increased proficiency in each skill. In particular, Frith's model provides a clear justification of the importance of the alphabetic or invented spelling stage of spelling, to both initial and proficient reading and spelling development. However, while Frith's model assumes that children will employ an alphabetic strategy to spell before they read, this study is an investigation of children's reading and spelling performance when sub-skills shared by both alphabetic reading and spelling are taught explicitly, and children are shown how to systematically decode words. Thus, rather than relying on practice at the alphabetic phase of spelling to facilitate children's movement into the same phase for reading, this study is based on the premise that children's spelling and reading development will be hastened by explicit instruction in these shared spelling and reading pre-requisites. Therefore without negating the mutually supportive relationship Frith reported between reading and spelling development, it may be possible to show improved literacy performance if children are not expected to deduce the alphabetic principle themselves by inventing spellings. For example, it is reasonable to expect that some children enter Year 1 already alphabetic readers, while others remain in the logographic phase throughout their first year at school. If attainment of the alphabetic phase for reading is contingent on children's intrinsic desire to write and begin inventing spellings, and this does not occur, their development in both skills may lag behind their peers.

Hence in this study Year 1 children in the intervention group received explicit instruction in phonological awareness, letter-sound correspondences and systematic decoding while their counterparts in the control group did not. Whether these children entered Year 1 as 'logographic' or 'alphabetic' stage readers, was unimportant as no assumptions about prior learning were made, however, it was explicitly stated that all children in the intervention group would be taught, and learn, the pre-requisite skills and knowledge to decode words, or read alphabetically, in their first year of school. At the same time, the Year 1 children from both the intervention and control groups were encouraged to invent spellings. The fundamental question investigated here was whether the intervention group which received direct instruction on how to decode words would produce superior invented spellings than the control group who were left to their own devices to infer the necessary skills and knowledge from classroom instruction and their experiences with print.

2.8.1 Frith's (1985) Model of Reading and Spelling Acquisition in relation to current theories of spelling acquisition

Theoretical models of spelling acquisition are influenced by the way researchers conceptualise spelling. In most cases researchers bring a different theoretical perspective to our collective understanding of the mental processes involved in spelling words, but tend to remain faithful to one discipline. Uta Frith is a researcher interested in the causes of reading and spelling disability who has demonstrated increased willingness to draw parallels between different disciplines, in particular, her behavioural observations of literacy failure with biological factors. For example, at the end of what many researchers (Ellis, 1994;

Goswami & Bryant, 1990; Montgomery, 1997; Snowling, 1994) regarded as a pivotal chapter on cognitive spelling processes, Frith (1980) commented that whilst it may seem "far fetched" to talk about a neurological basis for such a highly artificial skill as spelling, studies indicated that brain damage to particular areas had specific effects on spelling (p. 513). While hinting at the window of opportunity cognitive neuroscience could bring to the study of spelling and reading disorders, Frith's comments appeared as a footnote to the main points of the article and were relegated to the last page. Twenty years later, an introspective Frith explained that it was the legacy of behaviourism that had acted as a straight jacket against the supposedly "unscientific and indulgent speculation" she had only hinted at in her earlier writings (Frith, 1997, p.1).

Citing compelling causal evidence of the effect of children's neurons and genes on the reading and spelling process, Frith (1997, 1999b) argued strongly in a recent paper that it was no longer viable to perceive literacy acquisition from the narrow perspective of one discipline. Instead, Frith proposed a model to illustrate the potential impact of biological, environmental, cognitive and behavioural factors on literacy development. She argued that a chain of causal links from neural systems in the brain to cognitive abilities explained observable behaviours, or signs of literacy failure.

Two aspects of Frith's Causal Model of Dyslexia (Frith, 1997) are particularly significant to this present study. The first is Frith's consistent position on the importance of phonological development. Frith has always isolated phonological development as the core variable in literacy learning. The importance of this variable in her new model endorses the phonological stage of spelling development and supports the significance of alphabetic spelling and reading central to her earlier position on literacy. This finding has been endorsed by others who have shown that phonological deficit can lead to poor phoneme-grapheme conversion and result in difficulties encoding and decoding words (Goswami & Bryant, 1990; Snowling & Nation, 1997; Wagner & Torgesen, 1987). According to Frith, the proposal of a phonological deficit hypothesis as the cognitive basis of dyslexia has "such a strong theoretical and empirical basis that it has been widely accepted" (1997, p.5-6).

The second important aspect of Frith's new model is the integration of biological and cognitive factors. It appears Frith always suspected biological factors contributed to spelling development, even if she was initially reticent to expand on this thesis (Frith, 1985). However Frith's new model emphasised her earlier position that variation in spelling ability can be the result of arrested neurological development. That is, a brain based predisposition for dyslexia can lead to subtle malfunction of one single mental component, such as phonological processing, or possibly several.

Renewed focus on Frith's (1985) theory of literacy acquisition, particularly her explanation of how children acquire the early ability to spell, the skills they must learn to achieve this, and explanations of why some children fail to learn to spell can be found in the assumptions that underpin three models of the spelling process that are frequently cited in the research. The dual-route model, neurological model and computational model all highlight the importance of phonological processing. The dual-route model of spelling is based on information-processing models of adult spelling processes and has been reported in the literature for at least twenty years (Brown & Ellis, 1994). Equally well established are neurological models that describe spelling as the processing of sensory information, and draw parallels with studies of individuals with dysgraphia, the acquired loss of spelling ability, and developmental dysgraphia to infer damage or loss of connections between systems in the brain. Neurological models are less well known in an educational context, but formed the basis of early research on reading and spelling disorders, when dyslexia was thought of as a form of language disorder, or aphasia resulting from insult to particular regions of the brain (Richardson, 1989). Connectionist theory emphasizes the interdependence of one type of linguistic knowledge on another and the extent to which different aspects of word knowledge, such as phonological or visual-orthographic information is accessed simultaneously and in parallel when spelling a word. Connectionism provides a computational model for testing hypotheses about spelling development by assigning a value or 'weight' to connections between information such as graphemes and phonemes. As a link or connection is observed in an individual's pattern of spelling, weight is added. This is thought to indicate a stronger connection and faster rate of association. Moats (1995) noted dual-route and connectionist theories are the two models of cognitive processes involved in spelling competing for acceptance in the research literature.

Links will be established between these models and Frith's theoretical position on spelling development to demonstrate the centrality of an alphabetic strategy to beginning literacy development. As two of the models describe adult spelling processes and this study is an investigation of the relationship between early reading and spelling development, adult models are of limited interest other than to the extent that these models highlight the importance of phonological processing.

2.9 Dual-Route Theory of spelling production

The dual-route approach to spelling is regarded as the orthodox theoretical conception of the cognitive processes subserving spelling in English (Barry, 1994), and is the basis of a number of models of spelling performance (e.g., Ellis, 1993; Patterson, 1982). The dual process theory is based on the assumption that two major spelling routes are assumed to operate in parallel: the lexical (or word specific) route and the assembled route. The lexical route operates by the retrieval of spellings of known words stored in the 'orthographic output lexicon', a memory structure that acts as a repository for an individual's knowledge of known word spellings. The assembled route constructs spellings using a form of sub-word sound-to-spelling conversion process. Upon spelling a word using the assembled route, the phonological form of a word is thought to be held in an 'articulatory loop' of short term memory while phonological segmentation occurs. The assembled route would only be reliable for words with regular sound-to-spelling relationships, producing phonologically plausible, but incorrect spellings of irregular words such as does as *duz* (Barry, 1994).

The prevalence of the dual-route model appears to be sustained by the nature of written English. It is necessary to have a lexical system to deal with the irregularity of the English language, yet to spell new items an individual must be able to switch to an assembled system. The plausibility of this argument has reinforced the importance of lexical and assembled spelling routes, however the simplicity of the dual-route model has raised questions about how each route works, the degree of interaction between routes, and the independence of each route (Ellis, 1992).

In relation to this study, the dual-route model is of limited use because it is an explanatory framework for how adults spell, and offers no explanation of the process by which beginning spellers learn to spell, or develop the skills to utilise either lexical or non-lexical routes. Adams (1990) and others have maintained that adult reading and children reading are different processes, and the same argument is true of spelling. Despite the difference between dual process models of performance and Frith's (1985) developmental model, the view that two separate mechanisms exist for deriving spellings fits with the suggestion that these mechanisms may develop and arrest at different stages. Frith attributed developmental dyslexia to over-reliance on the lexical route, and the inability to develop an assembled approach to reading and spelling. Similarly, others have acknowledged that impaired spelling development can be characterised in terms of inability to utilise one or both spelling routes (Barry, 1994; Ellis, 1992; Stuart & Colheart, 1998). In order to spell fluently and utilise a range of skills, students must achieve mastery of subskills whether they be processing words alphabetically or through lexical routes that rely on stored orthographic information.

Another parallel between the two models is the response of the beginning alphabetic speller (Frith, 1985) or the dual-route model adult speller, when faced with the task of spelling a word never seen before. Both subjects will have to revert to an assembled route strategy irrespective of their skill level. This logic implies that both spelling models require similar cognitive processes and the application of sound-to-spelling conversions plays a pivotal role in each. Indeed, Brown (1994) noted that the dual-route approach has made important conceptual links with the developmental stage model because in order to utilise sound-to-spelling conversions, we must have been taught how to do this.

While the question of how children learn to represent the phonological structures of language is not addressed by the dual-route model, the importance of this skill is recognised. The dual-route model implicitly involves an important role for phonological representations because the development of sound-to-spelling translations will be constrained by the quality of the phonological representations available to map onto orthography (Ellis, 1992). Put simply, when spelling a nonword such as *gleep* the adult speller must isolate all phonemes in the same way, albeit more rapidly, as a child at the alphabetic stage (Frith, 1980). At this point what appears to be an 'educated guess' takes place and experience with English orthography determines the choices at the individual's disposal. Peters (1992) described English spelling as an example of a 'stochastic' process because the laws of probability underpin decisions adults make about orthographic representations, in this case the long vowel /e/. That adult spelling processes are affected by skills acquired in the earliest stages of spelling and reading is apparent in this example and supported by research that shows representations of the phonological structure of language precede orthographic representations (Brown & Ellis, 1994; Ehri & Robbins, 1992; Moats, 1995). Snowling (1994) showed that young children use phonological strategies to generate a framework upon which to organize orthographic information while Treiman (1994) described the hierarchy this way: until phonemes are mapped to letter units, "phonological rime units" will not be able to map to "orthographic rime" letter-cluster units. In relation to the study reported here it is critical that children can first hear, isolate and mentally represent phonemes before they learn to match these phonological representations with graphemes.

An assumption of dual-route spelling theory is that spelling competence is based on a number of internal processes. It is accepted that these processes are based on neural processes but are defined in terms of the functions they perform rather than strict localisations in the brain (Seymour, 1992). Exponents of the dual-route model have drawn empirical support from studies of impairments in neurological patients with forms of acquired central dysgraphia. These studies of once literate adults who have lost the capacity to spell through brain injury have highlighted the importance of phonological processing, or assembled spelling route processes (Ellis, 1993). While this research has established links between brain biology and mental spelling processes, evidence of acquired neurological damage has limited application to beginning spelling other than to highlight the importance of phonological processing.

2.10 Neurological Models of spelling

> If you have a broken arm, we can see it on an X-ray. These brain activation patterns now provide us with the hard evidence of a disruption in the brain regions responsible for reading (Shaywitz & Lyon, 1998).

The presumption that reading and spelling disability is caused by impaired neurological development is not new and developments in cognitive neuroscience have contributed to the growth in spelling research (Brown, 1990). What began as post-mortem studies of dyslexic brains during the pioneering work of neuroanatomists in the middle of the nineteenth century has been advanced by recent neuro-imaging studies of living individuals. This line of research has attempted to locate the underlying problem that causes variability in the brains of individuals who cannot read or spell and has resulted in suggestions for possible causes of dyslexia.

In 1985 Frith put forward a case for hemispheric lateralisation, or specialisation, as a way of viewing the pervasive dichotomy of phonological and visual strategies in reading and spelling. She speculated that reading by the eye was essentially the same as reading by partial, or right hemisphere processes, while reading by the ear was synonymous with left hemisphere processing. The same principle applied to spelling: mostly the right hemisphere mediated recalling whole words, whereas segmenting spoken words and matching phonemes to graphemes was essentially a left brain process. Frith's argument was based on the assumption first put forward by Broca in 1860 that in right handed people language problems tend to occur after damage to the left, rather than the right half of the brain, and it is the left half of the brain which is responsible for language abilities, including the process of reading and spelling (Posner & Raichle, 1994). Bakker (1979, 1990) also postulated the different roles of the right and left cerebral hemispheres in learning to read in a 'balance model'. Bakker maintained that the development of the reading process must be accompanied by a shift in hemispheric subservience from right to left. In common with Frith's description of the 'logographic' stage of reading, Bakker suggested that beginning reading is characterised by a spatial-perceptual analysis of letter shapes and letter strings that is mediated by the right cerebral hemisphere.

In an article published in 1997, Frith reiterated the importance of hemispheric specialisation she first described in 1985, added research from genetic linkage and cellular migration abnormality studies; but admitted that evidence to date was not enough to provide a full explanation of reading and spelling disorders. Speaking in general terms, Frith noted that a number of recurring themes had emerged in the neurological research, the most certain of which was that the vast majority of individuals with developmental spelling and reading difficulties have an underlying problem at a neurological level in the phonological coding of written language (Adams, 1990; Pennington, 1991; Vellutino, 1979). The brain basis of this phonological deficit is thought to lie in the perisylvian and extrasylvian regions of the left hemisphere of the brain, the area immediately surrounding the angular gyrus (Brown, 1990). Galaburda (1993) carried out post-mortem neuro-anatomical studies that revealed subtle abnormalities in the form of cell migrations in certain layers of this area of the cortex in dyslexic brains and this finding has been supported by others (Frith, 1999b). Frith (1999b) noted that as no-one had been able to detect actual lesions in the brain of individuals whose dyslexia is developmental, rather than acquired in origin, a possible hypothesis for brain abnormality is "disconnection between the various systems involved in speech processing" (p.203). As phonological processing ability is central to Frith's (1985) earlier model of reading and spelling acquisition, a brief description of the role of the angular gyrus and the effect of disconnections between this brain region and others in the language processing pathway follows.

The first strong evidence on neuroanatomical asymmetry, or specialisation of the left hemisphere for phonological processing, was put forward by Geschwind and Levitsky (1968) after conducting a post-mortem study of 100 adult brains. They concluded that greater left, than right planum asymmetry was related to both right handedness and language specialisation. This lead Geschwind (1979), to describe reading and spelling as secondary derivates of speech which share the same language processing pathway in the left hemisphere of the brain. Geschwind's model concurred with earlier research on brain region specialisation and resulted in a generalized map of the language processing pathway, that drew attention to the role of one particular brain region, the angular gyrus.

The left angular gyrus is thought to be critical to reading and spelling words and is located adjacent to the left inferior parietal lobe, which is at the intersection of the parietal, temporal and occipital lobes. Berninger (1996) likened the angular gyrus to a switchboard of cross-modal integration between incoming visual information in printed words and auditory linguistic information in spoken words. Put simply, when applying sound-to-spelling and spelling-to-sound translations, the angular gyrus is a mechanism for grapheme-phoneme correspondence. The same process is utilized when an individual who is blind reads Braille text, or a teacher draws a letter on a child's back and asks, "what letter is that?" The sensory information is processed by the parietal lobe of the brain and the angular gyrus orchestrates the matching of graphemes, coded as tactile information, to phonemes.

Geschwind's classical model of neural pathways in reading and spelling depicted the angular gyrus as the brain region engaged after the primary auditory area in the temporal area analyses and associates incoming stimuli. That is, when spelling an unfamiliar word the individual must reflect on the phonological composition of the word then match graphemes to phonemes. These representations or clusters of graphemes are then transmitted to Broca's expressive speech area and adjacent Exner's writing area for grapheme conversion and motoric expression in the form of writing. When spelling a known, or frequently occurring word, such as one's suburb, a different pathway that bypasses the need for to break words into component sounds and associate letters is followed because letter strings or whole words are accessed from memory storehouses in the right hemisphere, or in the case of one's signature, from motor memory. In the early stages of literacy development phoneme-grapheme conversions are an essential part of reading and writing, however, as an individual practices reading and writing, generalized pathways become personalized by experience.

The linear fashion in which neurological models propose that the brain reads and spells words lead researchers to explain reading and spelling difficulties as a series of disconnection syndromes. Geschwind began this process by taking a very basic view of primary areas in the brain and trying to understand how complex functions were actually built up by connecting them, such as the visual area with an auditory area (Denckla, 1987). For example, Geschwind's model of the reading and spelling pathway in the brain described a process that connected initial visual analysis of words and letters with the next stage of the reading process, the assigning of sounds to these recognised visual forms. Researchers have suggested that such a disconnection between the visual processing area of the brain and the angular gyrus prevents the association of letter sounds to letter formations, and is the location for pure word blindness (Denckla, 1987; Miles & Miles, 1990). Joseph (1993) described a number of lesions involving damage to the angular gyrus, or when damage occurs between the fibre pathways that connect one area of the brain to another. He proposed that when attempting to spell an unknown word an individual may successfully isolate the constituent sounds, but be unable to proceed any further with the spelling process because auditory representations have not reached, or been processed by the angular gyrus. The importance of matching sounds to symbols in the beginning literacy process is an accepted component of neural models.

Frith described entry to the alphabetic stage for reading and spelling as part of a developmental process. Neurological research maintains that the transition from predominantly right hemisphere holistic processing to left hemisphere phonemic processing is dependent upon brain maturational factors, specifically the development of the angular gyrus (Denckla, 1983; Epstein, 1978; Geschwind, 1974; Lecours, 1975; Restak, 1979; Trevarthen, 1983). The left angular gyrus is regarded as the most important area of the brain for literacy development, yet is one of the last areas to mature, taking between five to eight years (Lecours, 1975) and sometimes as long as ten years (Joseph, 1993). Molfese (1983) noted if the language pathway is not well developed, students will remain in the early stages of right hemisphere whole word recognition, fail to analyse and manipulate the parts of words essential for efficient reading and spelling, and underachieve in literacy. This description fits Frith's (1985) description of developmental dyslexia as over-reliance on lexical processing and supports her position that spelling and reading are mutually supportive processes that share the same three developmental phases.

In a clinic situation, Western Australian researchers Preen and Barker (1987) applied Geschwind's (1979) neural model of literacy development to students' spelling errors in dictation and spontaneous writing and noted that poor spellers have significant problems with three left hemisphere functions: an inability to hear correct vowel sounds or to reproduce them in writing; an inability to sequence the phonemic elements in words; an inability to recognise, identify, memorise and utilise the linguistic conventions of word construction. These symptoms of spelling failure indicate neurological immaturity, specifically of the left angular gyrus, but also match with Frith's (1985) position that inability to process phonological information arrests children's development in the logographic phase of reading and spelling.

It is not surprising that neurological models of literacy development have attracted a degree of skepticism, particularly from educators, as early research was based on the results of anatomical not educational studies. Neurological models of the process of reading and spelling are becoming better understood because technical advances have demystifed brain research and presented tangible evidence of mental activity during the act of reading and spelling words (Greenfield, 1997).

Despite these advances, neurological models have been criticised as too rigid in the way they depict language processing in the brain. Posner and Raichle (1994) highlighted this point when they noted that while neurological models are important in guiding thinking about language mechanisms in the brain, and are consistent with the observed deficits in patients with brain injury, the performance of normal subjects in experiments indicates considerably more flexibility in language-processing strategies than the fixed models proposed. Greenfield (2000) put it succinctly when she explained that an individual's brain is personalized by experience, the "connections mirror exactly what you're doing and the more you do something in certain parts of the brain the more it will be exaggerated" (p.10). While the neural architecture available for spelling words may be common to us all, the way in which individuals exercise different pathways and apply phonological or orthographic knowledge is unique. One approach that has evolved from neuroscience is the construction of 'connectionist' computational models that simulate the spelling process, but accommodate the type of individual differences inherent in human performance.

2.11 Computational Models of spelling

> It is easy to be misled by an elegant verbal description of a psychological model into the belief that the model is explanatory in that it has specified the relevant causal mechanisms, can exhibit the relevant behaviour and also give rise to novel predictions (Brown & Loosemore, 1994, p.320)

In a foreword to a new collection of papers on spelling development, Frith (1994) described 'connectionist' theory, on which computational models of spelling development are based, as an exciting advance in the understanding of the spelling process. Others have described computational models of spelling development as a radical alternative to dual-route and stage models of the spelling process (Brown & Ellis, 1994). Exponents of computational models are less diplomatic and openly criticise simplistic diagramatic models of the spelling process that incorrectly postulate internal mechanisms to explain complex behaviour (Brown & Loosemore, 1994). As Frith's (1985) model of reading and spelling development is a verbally represented stage model her positive comments about computational models are of particular interest.

Analogies are often drawn between the human brain and a computer to explain the learning process and in recent times researchers have attempted to 'build' computational models of the reading and spelling process that are based on the known structure of the brain (Brown & Loosemore, 1994). Computational models of spelling are based on the assumption that simple associative learning takes place in the brain at the level of the neuron whereby the denser the neural web, or connections between neurons, the greater potential for learning. By designing a computer program to simulate a neural web, the computer program can 'learn' to spell words. This allows researchers to test theories of spelling processing and make predictions about the neural networks the human brain constructs in order to spell words in conditions of normal and abnormal spelling development. A number of researchers have utilised neural networks, or computational models to illustrate different aspects of the spelling and reading process (Brown & Loosemore, 1994; Olson & Caramazza, 1994; Seidenberg & McClelland, 1989). Only Brown and Loosemore's computational model (1994) will be discussed in detail because it most closely reflects the spelling process underpinning the present study, that is: the ability to associate representations of word pronunciations with representations of corresponding orthographic forms.

The construction of a simulated neural network begins by assigning value to binary-valued artificial neurons in the form of input data. Psychologically meaningful units are represented as combinations of the numbers 0 and 1. Thus, in the model presented by Brown and Loosemore (1994) the word *soap* might be represented by the pattern 101100011, while the word *pill* is represented as 001011100. Because computational spelling is assumed to be the process of linking inputs to outputs, some units in the network represent the pronunciation of words, while others represent the orthographic forms of the words. These two populations of units of data, or neurons, are interconnected via an immediate level of units known as 'hidden units'. These hidden units prevent direct contact between inputs and outputs and represent the connections between neurons that facilitate the spelling of different words. Exactly how data is exchanged and coded at this 'hidden' level is regarded as the key to learning how children learn to spell.

Computational models make assumptions about how the brain utilises input data to generate outputs in the form of words. This is achieved by simulating a system for representing words at the level of the synapse, or neural connection. Most computational models code words as a series of phoneme or letter triples. The symbol _ is used to denote the space before, or after a word. Thus, in Brown and Loosemore's computational model, the word *soap* may be composed of four triples: *_so, soa, oap and ap_*. By giving a connectionist network one artificial neuron for each possible triple of letters that occurs in the represented vocabulary, it would be possible to represent *soap* by giving the value 1 to all the neurons that stood for one of the four triples listed above, with every other neuron being given the value of 0. This would then allow every word to be represented as a unique pattern of 0s and 1s over the set of artificial neurons. After constructing a computer program to represent an artificial neural network, the computational model can be used to investigate the difficulty of learning to spell words that differ in their sound-to-spelling characteristics.

Brown and Loosemore (1994) tested their computational model by teaching the model to spell 225 words. The target words were classified into groups as 'regular', 'irregular' and 'other' to simulate the word types children encounter. Regular words such as *hill* were spelled in an entirely consistent way and had spelling 'friends', within the neural network. Spelling friends were defined as words that share the same ending or rime as the target word. Thus, *hill, kill* and *fill* share the same word ending in rime segment and orthographic representation. Other words, such as *soap* were classified as irregular because they had only spelling 'enemies' within the network, such as *hope, cope* and *rope.* Spelling enemies share the same rime pronunciation, but differ in spelling. A third category of words, such as *bulb* were included that had no friends or enemies within the neural network.

According to Brown and Loosemore (1994) the learning process works by imposing the pronunciation representation of each of the 225 words on the network one at a time, and examining the pattern of spelling unit activation which is produced in response to each word. Put simply, the pronunciation of the target word enters the neural network and the computer calculates the level of activity that occurs at each intermediary connection until the word is spelt correctly. By comparing the pattern of activity that is actually produced at the level of the hidden unit, or neural connection, when the word is presented with the pattern of activation that would represent the correct spelling of the target word, the error score can be determined. Learning in the network is reflected by lower error scores, which indicate that the model is producing correct spellings quicker.

When Brown and Loosemore (1994) trialed their computer model, the performance on all three word types improved over time, or learning 'epochs'. The model spelled regular words with no 'enemies' more accurately. Irregular words were spelt least accurately, and words with neither friends nor enemies were spelt somewhere in between. The researchers argued that another way of looking at the results was to say that a given level of accuracy is achieved on regular words at an earlier stage of learning than for words with sound-to-spelling enemies.

In order to test the predictions of their model with respect to the level of difficulty of the various word types, Brown and Loosemore (1994) gave groups of children the same words to learn to spell. The findings of the computational simulation of learning to spell were confirmed when the children exhibited the same type of difficulty on the same word type as the model. The writers concluded that the difficulty experienced by the model so closely mirrored the pattern of difficulty encountered by the children that the process of learning to spell could be viewed as one of "mastering a set of statistical associations between representations of the phonological forms of words and representations of their orthographies" (1994, p. 320).

These results clearly cast doubt on the basic premise of the dual-route model of spelling whereby regular words are spelt via assembled and irregular words via lexical spelling routes. The computational model of spelling development designed by Brown and Loosemore (1994) spells irregular and regular words using the same mechanism that is dependent on the strength of connections between represented units of words.

The second question raised after trialing Brown and Loosemore's (1994) computational model was the validity of stage models of literacy development. Frith's (1985) model of literacy acquisition describes children passing through three stages of development: logographic, alphabetic and orthographic. However, it appears one process simulated by a computational model can produce spelling outputs that suggest the child is operating at different developmental stages.

After reviewing Brown and Loosemore's computational model, Frith (1994) noted that it seemed possible that one and the same processing mechanism operates throughout spelling development and "stage like transitions of behaviour may only be the surface phenomenon which may result from the interaction of an unchanging process with changing representations" (p. xii). Following this argument, when children attempt to spell a word such as *hill* they may have a variety of representations at their disposal: hill, h-i-ll, and h-ill etc. The first may be the orthographic representation of the word, the second the segmentation of individual phonemes and the later onset-rime. According to Frith, if children have different representations available at any one time, then it is not possible to predict which spelling rules will be developed first.

For some time, Snowling (1994, 1985) has argued that the strategies children bring to the task of spelling are largely determined by their knowledge. Thus, some beginning spellers may be able to by-pass sound-to-symbol associations and spell known words orthographically if they have learnt them. This concurs with a theme in recent research which rejects the notion of progression through a clear sequence of separate stages towards a more interactive approach where several different knowledge sources interact in parallel to constrain the operation of spelling output mechanisms (Brown & Ellis, 1994).

Further questions about existing theories of spelling development were raised by Brown and Loosemore (1994) this time in regard to the nature of developmental dyslexia. Referring to Frith's (1985) definition of developmental dyslexia as the failure to make the transition to alphabetic reading/and or spelling strategies, the researchers questioned a central tenet of her theory: that dyslexics should be unable to read or spell non-words. Brown and Loosemore (1994) wanted to examine the possibility that developmentally dyslexic spelling could be explained in terms of lack of access to computational resources and adjusted their model accordingly. They reduced the number of hidden units, or connections in the neural network available during learning, and set three learning periods to represent 'non-dyslexic' (35 hidden units and 130 epochs), 'mildly-dyslexic' (20 hidden units and 390 epochs) to 'severely dyslexic' (15 hidden units and 1580 epochs) models. The results showed a detrimental effect on the spelling of non-words relative to words while "leaving the sound-to-spelling regularity effect intact" (p.328). Brown and Loosemore took this as evidence that dyslexics utilise the same processing strategies as normal children but are delayed in their acquisition of these strategies because they lack the same pool, or data base, of spelling representations as normal children.

Brown and Loosemore's findings concur with the work of other researchers. Some cognitive psychologists have supported the premise that dyslexics pass through the same developmental phases for spelling and reading, but at a much slower rate (Rack et al., 1992; Stanovich, 1991b). This view was also put forward by Brown and Ellis (1994) who noted that even dyslexics can be taught to spell and read non-words, it just takes them longer and they are less accurate than their unaffected peers.

As Frith herself noted, computational models offer a different way of examining the spelling process that static models do not. Thus, it is not surprising that assumptions underpinning both Frith's (1985) model of literacy acquisition and dual-route theories of the spelling process have been questioned. With regard to the present study, the issues raised by Brown and Loosemore's (1994) computational model are extremely important. First, their model demonstrated the role phonological awareness and phoneme/grapheme relationships in learning to spell. Second, they provided a picture of the way phoneme/grapheme relationships are entered as 'inputs' and represented at the level of neural connections in beginning spellers.

Put simply, unless children are taught the pre-requisite skills or 'input data' to spell, they will not be able to achieve the task. Hence, how children acquire the input data to spell, and the quality of this data is a critical factor. Brown and Loosemore's (1994) research highlighted the absolute necessity of learning 'epochs', or opportunities to practise spelling words. In this study, children were taught explicitly how to segment words and apply phoneme/grapheme relationships to the process of beginning spelling. If children were unsuccessful at these tasks they received instruction that was 'sliced-back' to smaller steps until mastery was achieved.

2.12 Summary: Theories of spelling development

Each of the preceding theories has depicted the spelling process from a different perspective and put forward an explanation of the mental processes that support spelling competence. The 'morphophonemic' nature of English orthography (Pinker, 1994) has compelled each theorist to account for the process of spelling words with regular and irregular spellings with descriptions of lexical and non-lexical functions. These descriptions have included biological accounts of brain function and computational models designed to replicate the process of humans spelling words.

Frith's Causal Model of Dyslexia (Frith, 1997) accommodates both cognitive and biological explanations of literacy development on the basis that these discrete explanations are essentially different sides of the same coin. Frith showed that biological and cognitive systems operate in parallel because cognitive abilities underly observable behaviour, and these are based on neural systems in the brain. At the same time Frith acknowledged that while imprecise descriptions of cognitive processes clumsily depict complex neural architecture, phonological processing has emerged as a factor common to all accounts of reading and spelling performance. Put simply, without phonological processing it is impossible to utilise the alphabetic system on which English is based to spell words never seen before. Sterling and Seed (1992) described this 'highly demanding' process of spelling an unknown word from the perspective of a young child:

> To spell the sounds in a word the speller has first to identify them. He or she has to hold the word in short-term memory simultaneously while segmenting it into its components parts, hold these in short term memory without losing any or confusing their order, retrieve the spelling of each sound and then write the word down letter by letter (p.273).

While Sterling and Steed (1992) have used simple terms to describe a very complex mental process, their account of alphabetic spelling has much in common with the preceding theories of spelling. In particular, the writers highlighted the importance of segmenting words into phonemes as the first step in alphabetic spelling and the application of sound-symbol relationships.

This review of models of spelling development has served to highlight the fundamental importance of children successfully reflecting on the abstract properties of spoken language, isolating letter sounds and applying alphabetic knowledge to encode speech in printed form. This thesis is based on the assumption that the acquisition of the knowledge and skills to read and spell is not innate and must be taught explicitly. In particular, children require explicit instruction on how to segment spoken language into sounds, letter-sound correspondences and the strategy of decoding words. This position appears to have been accepted, albeit gradually, by the spelling theorists included in this review. However, as the following section will show, the way in which early reading and spelling skills are taught in the first years of formal schooling does not always reflect what Adams (1990) described as an 'immutable fact'. Two approaches to beginning literacy instruction will be examined in the next chapter, namely 'instruction centred' and 'child-centred' approaches.

CHAPTER 3
THEORETICAL FRAMEWORK

3.1 Theories and models of literacy instruction

In schools around the world one is likely to find evidence of two broad premises underlying the design of literacy programs: those that are theoretically 'child-centred' and those that are based on a theory of instruction and are 'instruction-centred'. Currently in Western Australia schools teachers are guided by system-wide support documents that espouse an approach founded on child-centred principles. Teachers are not prevented, however, from using an approach that is instruction-centred, or combining approaches, but the predominant theoretical basis of teaching literacy remains child-centred. The differences between these two theoretical positions, and the programs they have generated are significant and have direct implications for this study.

The classrooms in which data was collected for the research reported here included instructional approaches more theoretically child-centred than instruction-centred. The daily literacy lessons and activities were typical of current practices in most junior primary classrooms in Western Australia. For example, children wrote each day, reading, writing and spelling activities were meaningful and embedded in a literature context and children were encouraged to invent spellings. What differed between the experimental and control classrooms in this study, was that the experimental teachers were asked to add an explicit form of skills/strategy instruction to their existing literacy programs. The intervention, *Let's Decode* (Formentin, 1992a) included phonological awareness and systematic and explicit decoding instruction.

Child-centred approaches are driven by assumptions about how children become literate. By observing children and adults engaged in reading and spelling, child-centred theorists propose developmental stages and outline strategies that support the progression. Child-centred approaches to literacy instruction are grounded on the premise that learning to read, write and the development of oral language are entirely comparable instances of language development. Yatvin (1991) a proponent of Whole Language, a child-centred approach to literacy explained:

> The premise of Whole Language is that children are born with the capability to learn all facets of their native language intuitively, and have already done a good job with oral language and the beginnings of literacy before coming to school. Children will continue to learn successfully in a healthy school environment where there are interesting materials and activities, teachers who appreciate and cultivate children's skills, opportunities for active learning, and classmates who work co-operatively with them (p.2).

Underpinning all child-centred approaches is the 'constructivist' perspective on learning. Constructivism represents the view that students actively acquire knowledge and make meaning for themselves out of interacting with their social and physical environment, rather than as a result of direct teaching (Merrill, 1992). Related to this is the philosophical perspective known as 'naturalism', whereby it is assumed children have the innate ability to learn such things as reading and spelling naturally without formal instruction. Thus in child-centred approaches, students are given many opportunities to work independently and collaboratively to discover knowledge for themselves. The prior knowledge and skills children bring to the task of learning to read and spell are valued and dictate the level of support required by the child. Child-centred approaches to literacy instruction include so-called 'Language Experience', 'Whole Language', and 'Meaning Based'.

By contrast, instruction-centred approaches make few assumptions about the child, rather, the emphasis is on analysing and designing the sequence of skills necessary to master a task. Task-analysis is a component of 'Instructivism', a teaching approach guided by experimental research on instruction and learning. Instruction-centred approaches are founded on detailed analysis of knowledge types and the information and strategies required to achieve a specified learning outcome. Responsibility for promoting learning rests with the teacher. Lessons are explicitly crafted and sequenced, and delivered carefully, to avoid ambiguity or misinterpretation.

Literacy approaches founded on instruction-centred principles are based on the understanding that the development of oral language is biologically based, but learning to read and write does not unfold in the same 'natural' manner because the skills required to perform these tasks are not biologically determined. Instead, teachers adopting a skills/strategy approach teach what prior analysis of the task stipulates. The goal of instruction-centred approaches to beginning literacy is that with explicit instruction and practice in the application of component sub-skills, such as phonological awareness, letter-sound correspondences and the strategy of blending, children will acquire the knowledge and strategies to learn to decode words (Groff, 1987). Instruction-centred approaches encompass models generally referred to as 'strategy' or 'skills' emphasis.

3.2 Theory of instruction-centred approaches and the intervention *Let's Decode*

Englemann and Carnine (1982) described the theoretical basis of instruction-centred approaches in their book the *Theory of Instruction:*

> If we are humanists we begin with the obvious fact that the children we work with are perfectly capable of learning anything that we can teach...We try to control for variables that are potentially within our control so they facilitate learning. We train the teacher, design the program, leave nothing to chance.....We know that the intellectual crippling of children is caused by faulty instruction – not by faulty children (p. 376).

In their book the writers described an analysis of cognitive skills and recommended strategies for the effective communication of these skills. Englemann and Carnine explained how three converging factors impinge on the task of learning: an analysis of behaviour; an analysis of knowledge systems; and, an analysis of communications. The relationship of each factor to cognitive learning is illustrated in Figure 2.

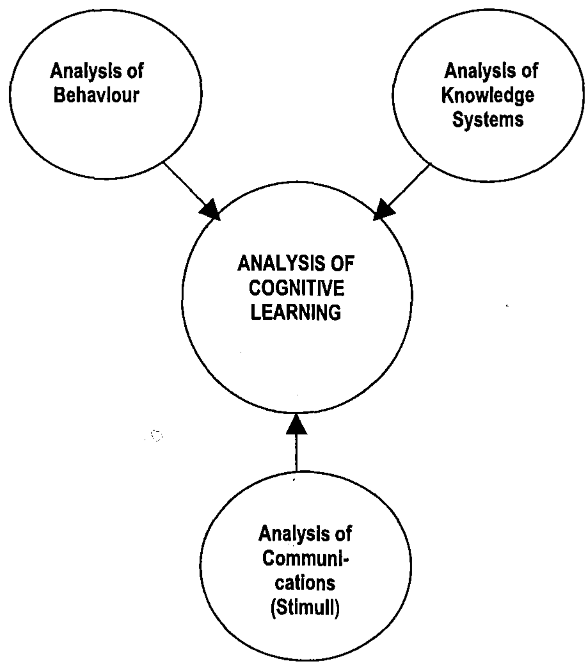


Figure 2 Analysis of Cognitive Learning (Englemann & Carnine, 1982)

Analysis of Cognitive Learning

In relation to the instructional model used in this study understanding Englemann and Carnine's theoretical foundations of cognitive learning are critically important. First, *Let's Decode* (Formentin, 1992a) is founded on Englemann and Carnine's logical analysis of stimuli for designing instructional sequences. Essentially this strategy governs decisions about the pre-requisite skills, knowledge and strategies necessary to decode words. The design of instruction, which is by far the most critical feature, takes place before information is presented to students so an explanation of the analysis of knowledge system that underpins *Let's Decode* is described.

Second, the delivery of the instruction and the aspects of instructional design that maximise the learner's capacity to respond to *Let's Decode* are based on Englemann and Carnine's analysis of communications and analysis of the behaviour of the learner. While effective instruction requires the combination of all three aspects of cognitive learning, less attention is given here to the analysis of communication and behaviour because the focus of this study is more closely aligned with the relationship between beginning reading and spelling development and the issue of reciprocal skills, such as letter-sound correspondences and the segmentation of words into phonemes. Still, there are marked theoretical differences underlying the delivery of instruction in instruction-centred and child-centred approaches and these will be highlighted later in this chapter.

Analysis of Knowledge Systems

Englemann and Carnine's analysis of knowledge systems involves analysing and organising the content of instruction to ensure the learner receives clear, accurate and unambiguous information. The focus of this study is beginning literacy, however Englemann and Carnine's theory of instructional design has been applied from junior primary school to secondary high school to advanced reading skill knowledge such as: higher order thinking (logic and reasoning), anaphora knowledge and syntax knowledge, as well as the content areas of science and social studies (Adams & Englemann, 1996; Kameenui & Simmons, 1990). In relation to beginning literacy, this means teaching concepts, principles, rules, strategies and operations in a carefully crafted sequence enabling students to build elemental knowledge, such as decoding new words, into complex wholes: reading fluently and comprehending stories and non-fiction texts. *Let's Decode* (Formentin, 1992a), is an example of the way Englemann and Carnine's strategy for designing effective teaching sequences has been used to orchestrate the simple and complex knowledge types necessary for students to learn to decode words, one component of reading instruction. Figure 3 indicates the coverage of skills, knowledge and strategies included in *Let's Decode* to teach decoding.

Beginning Reading
Teaching Vocabulary and Language Skills
    Auditory Skills
    Letter-Sound Correspondence
    Sounding Out Regular Words
    Passage Reading: Sounding Out
    Irregular Words
    Sight Word Reading
    Passage Reading
Primary Reading: Decoding
    Phonic Analysis
    Structural Analysis
    Contextual Analysis

Figure 3 Content of *Let's Decode* Pertaining to Decoding Instruction

Let's Decode is based on Carnine, Silbert and Kameenui's (1997) model of decoding instruction. Their model is underpinned by the view that learning to read is a two step process: "The acquisition of a set of subskills is the first step, the assimiliation of those subskills into the holistic act of reading and bringing meaning to the text is the second step" (p. 22). The subskills taught to learners in the early stages of reading acquisition include different knowledge forms and are presented in a particular order. For example, before beginning readers are taught letter-sound correspondences in order to decode words, they are taught phonological awareness skills. This enables learners to understand the relationship between spoken and written language prior to applying this alphabetic principle to reading and spelling words.

The *Let's Decode* approach to beginning reading instruction depends on prior learning and follows a clearly defined sequence. Before students begin reading words they learn the phonological awareness skills of telescoping, rhyming and segmenting words. For example, the auditory awareness skill of telescoping or blending sounds together is taught by demonstration. The teacher says words 'slowly' and students say the same words 'fast'. Thus, in the word *mum* the sounds are held as *mmmmuuuummmm* and students are required to listen to this 'slow' rendition of sounds and provide the actual word. This format is relatively easy, even for pre-school aged children, and is taught as an oral language skill with no visual cues such as alphabet letters or reading materials. To an observer, unaware of the analysis of knowledge underpinning the *Let's Decode* program, auditory telescoping may appear to be an activity unrelated to reading. In fact, the skill presented in this format is an essential pre-requisite for decoding words.

Considered as a knowledge set, the letter sounds and names of the alphabet is a complex and potentially confusing fact system: many letters are similar in shape, have similar sounds, and there is an arbitrary relationship between the names and sounds of letters. To address this, teachers following *Let's Decode* teach letter-sound correspondences in an order that separates auditorily or visually similar letters. However, the sequence presented to students belies the complexity of the issues considered in the instructional design.

a m s t i f d r o g l h u c b n k v e w j p y
T L M F D I N A R H G B x q z J E Q

Figure 4 Sequence of Alphabet Knowledge in the *Let's Decode* Program

Figure 4 illustrates the sequence in *Let's Decode* for teaching letter sounds. All letter sounds are taught before the five vowel names, lower-case versions of letters are taught before upper-case versions, and only upper-case versions that differ from lower-case versions are taught at all. This is in accordance with Englemann and Carnine's (1982) analysis of knowledge systems as applied to the alphabet and a model of learning to read that acknowledges the need for decoding strategies. By introducing letter-sound correspondences in order of usefulness, students can begin to apply letter-sound correspondences to the process of decoding words earlier than if they learnt them in alphabetical sequence. For example, once learners have been taught the first four letters in the sequence they can apply the strategy of decoding to the following words: *am, at, sam, mat* and *sat.* At the same time, the sequence of sounds complies with the separation of visually and auditorily similar letters. Letter names are used in some *Let's Decode* formats to teach spelling, rather than reading, and for this reason are taught selectively and after letter sounds. Further, as the first words students read in books are predominantly printed in lower case these symbols are taught first. That only selected upper-case letters are taught in *Let's Decode* is purely an economic decision based on the logic that because lower and upper case letters are the same shape but different sizes, there is no need to teach extraneous information.

Once learners can recall a number of letter-sound correspondences to the point of 'automaticity' (Samuels, 1976), this knowledge is applied to more difficult tasks such as sounding out whole words. In order to decode words, learners are taught a blending strategy, and this is an example of a different knowledge type. Englemann and Carnine described word decoding, that is matching sound-symbol associations to printed text, as a 'cognitive problem solving routine'. The writers defined a cognitive problem solving routine as "any task that may be treated as a series of steps that lead to a solution" (Englemann & Carine, 1982, p.23) and described the process of decoding a word:

> ... for the learner who is assumed to be naive, simple word decoding logically implies attention to the different letters in the word, and to their order. If the learner does not attend to the m in mat, the learner logically may confuse mat with hat, cat, or at...This analysis suggests we should design a routine that deals with all the various discriminations or concepts (p. 23).

The cognitive routine Englemann and Carnine (1982) recommended is the format for decoding words included in *Let's Decode.* Teachers say: "when I touch a letter I'll say it's sound. I'll keep saying the sound until I touch the next sound. I won't stop between sounds" (Formentin, 1992a, p.18). This strategy requires blending. Prior to decoding words and following the sequence of skills in *Let's Decode* students are taught to telescope sounds, that is, to listen to the stretched out sounds in a word and "say the word fast". No visual information is presented to learners at this stage because listening to sounds is the focus of telescoping. Thus, when attempting to decode the word *man* students would say the sound of the first letter, then hold and run each sound into the next without stopping. Learners join these sounds together *mmmmmmaaaaaannnnnn* and say the target word, because they have learned the pre-requisite skill of blending. While auditory telescoping may have appeared to be an isolated skill taught before learning to read, it is apparent how necessary this prior knowledge is when the strategy of blending is introduced: Having practiced listening to the segmented sounds in words pronounced slowly, students have already learned to blend these sounds together as a word.

Once children are able to apply the strategy of blending they can, with practice and carefully selected examples, generalise this cognitive routine to decode regular words of any length and composition of sounds. Englemann and Carnine (1982) noted cognitive routines, such as the strategy of decoding words that make explicit the stages of the operation, reduce the possibility of misgeneralisations, such as learners omitting steps and producing an incorrect response.

An example of another knowledge system included in *Let's Decode* is the teaching of generalised rules. While letter-sound correspondences must be memorised, learners are taught to discriminate between CVC words (such as *at, rip*) and VCe words (such as *ate, ripe*) and apply a generalised rule:

Teacher		Student
Children see the following words: same, rope, mine, cake, note		
1.	(point to *same*) An /e/ at the end tells us to say the name of this letter. (Point to vowel)	
2.	Is there an /e/ at the end of this word?	Yes
So, we say the name of this letter.	What's the name of this letter?	A
4.	So, what's the word?	same

Figure 5 Introductory Format for *VCe Words* (Formentin, 1992a, p.98)

This rule presents a series of steps that solve a problem, which in this case is how to decode a word with a VCe pattern (commonly known as 'fairy /e/ words' or 'magic /e/ words'). When students have demonstrated their ability to apply this basic rule, they are presented with instances and non-instances of the rule such as *sam/same, note/note* and *rip/ripe* to read. To read each word correctly, students must discriminate between instances and non-instances of VCe and apply the rule. This procedure has been designed so that, once internalised, students may independently read unfamiliar words following the VCe spelling pattern. Without application of this rule, students would have to guess words or remember them as whole, because the strategy of decoding, that is applying the sound-symbol correspondence of each letter would not produce the correct response.

Carnine et al (1997) also noted that positioning of the VCe rule in the sequence of instruction, after the introduction of letter sounds and letter name knowledge, is critical. Once students apply their knowledge of letter sounds to the strategy of decoding simple words, they will soon encounter many common words containing the VCe spelling pattern. Those that are regular, that is, those that can be decoded using the most common sound of each letter, will be read using the rule. Those that are irregular, for example, *come, have, some* are taught explicitly using a different strategy. To apply the VCe rule, or read an irregular VCe word using the Modified Format for Irregular Words (Formentin, 1992a, p.91) knowledge of the five vowel names is a pre-requisite skill. Failure to teach letter names prior to the introduction of the VCe rule format would in Carnine et al's words be to "attempt to teach more than one new skill and cause two problems (1997, p.12). First, introducing two new skills at once doubles the learning load, and second, when students fail it is unclear which skill caused the failure: lack of knowledge about the letter names of the vowels or application of the rule. This complex sequencing and selection of knowledge and strategies is indicative of the level of analysis of knowledge systems undertaken by the designers of instruction-centred approaches, such as *Let's Decode.* Put simply, this approach to instructional design leaves 'nothing to chance' (Englemann & Carine, 1982).

Analysis of Communication

Englemann and Carnine's analysis of communication focuses on the preparation and delivery of 'faultless instruction' (Englemann & Carine, 1982, p.3). Instruction that is 'faultless' is designed to convey only one interpretation, and this is contingent on two factors: the content and the delivery of the instruction. While the design of instruction is of paramount importance because students must be able to induce the proper generalisations and discriminations, the way in which instruction is communicated to students is equally important. Englemann and Carnine (1982) maintained when instructions are delivered clearly and unambiguously, communication can be removed as a variable impacting on students failing to learn.

It is for this reason that the formats, or mini lesson plans, in *Let's Decode* are scripted and carefully constructed so that they are easy for the students to understand, and they contain only one new skill. *Let's Decode* is a simplified version of Carnine, Silbert and Kammenui (1990) because teachers found the detail of Carnine et al too much to follow when actually teaching. Language used in formats that may not be understood is taught explicitly. For example, the Concept of 'Word' format teaches the meaning of *word* so that students are able to understand and respond to later formats containing this vocabulary item. The structure of the format is fixed and follows a clear sequence. Whatever is to be learned is modelled by the teacher and cued as "my turn". Students respond in unison with the teacher leading "everybody do it with me" and individual testing takes place when the teacher cues students "your turn" and then gives individual turns. This procedure is the same for all formats and is designed to emphasise guided practice as well as promote trust between teacher and learners. The instructional sequence of *model, lead, test* ensures learners will not have to provide an individual response without the concept first being modelled by the teacher and practiced as a group. Carnine et al noted "detailed formats free teachers from design questions and enable them to focus their full attention on students' performance" (Carnine et al., 1997, p.11).

The reduction of 'teacher talk' time with young students is an important factor in Englemann and Carnine's theory of instruction (1982). Teachers implementing *Let's Decode* are instructed to follow the exact wording of formats and use the relevant signals to cue learner's responses. Used in formats, signals provide clear non-verbal cues that something is about to happen, a point is being emphasised, or that there is an opportunity to respond.

The provision of immediate feedback to students is another critical component of communication because it either confirms the student is correctly demonstrating knowledge, a strategy or a rule, or corrects the specific error the student is making. The correction of errors must be precise, and in order to minimise confusion teachers implementing *Let's Decode* are told explicitly how to respond to children's incorrect answers. The following guidelines are an example of the correction feedback teachers provide:

> *Correcting errors* (Word reading)
>
> The basic rule is to correct every error as soon as it occurs, and include problem words in the next day's word list.
>
> - Sound confusion errors are corrected using a limited model. What sound? Sound the word. What word?
> - Random guessing is indicated when the child makes a mistake reading 10 percent or more of the words in a passage. In this case check that the child can keep up with the pace you are setting, and encourage the child to attend to each letter (Formentin, 1992a, p.35).

Figure 6 *Let's Decode* Correction Feedback

Analysis of Behaviour

A distinctive feature of *Let's Decode* which was based on Englemann and Carnine's analysis of behaviour, is the way instruction is presented. According to Engelmann and Carnine, "the learner learns from the environment." They make the assumption that the environment is the primary variable in accounting for learning, and can be manipulated to maximise learning experiences (Englemann & Carine, 1982, p. 1). Evidence of systems and strategies to minimise potentially negative environmental influences are included in the instructions to teachers implementing *Let's Decode.*

Teacher implementing *Let's Decode* present lessons that are fast paced to contribute to student attentiveness, reduce the chances of inappropriate behaviour and reduce oral responding errors. Learners are required to respond actively to instructions, either in unison or individually, because this increases the amount of practice each children receives. Practice is a critical variable in learning and teachers must match the amount of practice learners receive to their learning needs. Too little practice will not result in mastery, too much will lead to problematic behaviour caused by boredom. Unison oral responses also establish a non-threatening learning environment, when students do have to respond individually it is at the end of period of teaching and only if the teacher believes the student is able to provide the correct response. Responding in unison is not only efficient but allows teachers to listen for errors in responses, observe whether students are paying attention, and to "watch the shape of their mouths to see if they appear to be making the expected response" (Formentin, 1992a, p.6).

In order to manage the delivery of instruction the use of signals is a feature of *Let's Decode.* Teachers cue students with signals to allow students to have adequate thinking time before they respond, and to provide a clear signal to respond in unison. This management procedure ensures all learners attend to the learning task and follow instructions, which in turn, maximises the impact of the instruction in the learning environment. As Carnine et al noted "one of the potential disadvantages of unison oral responses is that brighter students will crowd out other students....allowing wait or think time followed by a signal can prevent this problem" (Carnine et al., 1997, p.15). Teachers are urged to work with small groups of children based on ability levels, so issues of pacing and correct use of hand signals are critical to maximise student participation.

Finally, *Let's Decode* acknowledges the role teachers play in monitoring students' levels of motivation and mastery of knowledge. In short, the teacher must present the instruction in such a way so that students remain motivated and on task. It is suggested teachers should reflect on their delivery, pacing, provision of corrective feedback and difficulty of content when student performance does not meet expectations (Formentin, 1992a). Teachers are also advised to test and record students' mastery of formats and specific knowledge such as letter-sound correspondences. From careful monitoring teachers should provide additional instruction for students to achieve mastery. In addition, it is suggested teachers monitor their own delivery of *Let's Decode* formats by noting what they teach and how much time is devoted to this activity each day. This ongoing review is designed to provide teachers with information on student's needs and whether they are being met.

3.3 Child-centred approaches

By contrast, child-centred approaches are based on the fundamental assumption that the design, sequence and content of instruction is determined by the developmental status of the child. In particular, this approach promotes the belief that children are the most critical variable in the learning process. Proponents of child-centred approaches regard children as highly capable learners whose inherent ability outweighs the need for explicit instruction. Put simply, supporters of child-centred approaches argue that when children are motivated and engaged in learning they discover knowledge for themselves. Experiential learning is a characteristic of child-centred approaches.

> By providing opportunities that encourage and stimulate natural language use through extensive speaking, reading, and writing as means of communication and expression whole language teachers believe children will 'discover' for themselves the structures governing English spelling (Walshe, 1981).

This view has been traced to the writings of eighteenth century French philosopher Jeans Jacques Rousseau who expounded a theory of education based on Naturalism, a philosophical movement rooted in the doctrine that all knowledge is derived from experience. Rousseau argued children had an innate developmental script and referred to this as 'naturally unfolding development'. He argued that society, in particular schools, should not interfere with the natural development of children: "give your pupil no lesson in words, he must learn from his experience" (Rousseau, cited in Weir, 1990, p.28). In child-centred approaches the teacher's role is to provide educational experiences that nurture children's natural ability, with minimal intervention.

In relation to learning to read and write, child-centred theorists subscribe to the theory that reading and writing are part of the same natural language process that enables children to learn how to talk. Weaver (1988), a child-centred proponent described this process in the frequently cited quotation: "Anything I can say, I can write; anything I write, I can read." The terms 'Language experience', and 'Whole Language' have been coined to describe child-centred literacy approaches. In Western Australia the predominant approach to teaching literacy is based on Whole Language principles. These terms emphasise the pivotal role child-centred approaches ascribe to children's spoken language competence in the facilitation of reading and spelling development. For example, the 'whole' in the Whole Language approach refers to maintaining the integrity of spoken or written language as a complete process for the manner in which it was intended: to convey meaning. To Whole Language proponents, getting or conveying meaning from the reading material is the ultimate task. Ken Goodman, (1995b) who is considered by some as the father of Whole Language, clarified this issue, almost twenty years after he published his original argument:

> All of my research, and a world wide body of research on print awareness and literacy development supports the view that oral and written language are learned in the same ways and for the same reasons – to communicate, to learn and to think (Goodman, 1995b, p.2).

The term 'Whole Language' was first used by Comenius in 1658 (Nicholson & Lam, 1998), but it was in the 1970s that Goodman first began using the term to describe the teaching practices and integrated language arts curriculum he observed during a visit to Canadian schools (Goodman, 1995a). Goodman noted the Canadian children were actively engaged in meaningful tasks that integrated and developed all components of language, and that their teachers valued their contributions. Asked to describe what he had observed, Goodman noted Whole Language theory cannot be reduced to a simplistic definition because it is a complex belief system based on two principles: humanistic and scientific.

Smith (1971), a co-founder of the Whole Language movement and a cognitive psychologist, claimed a scientific basis for Whole Language by drawing parallels between the linguist Noam Chomsky's theory of oral language acquisition and the process, assumed by advocates of Whole Language, to take place when learning to read. Chomsky argued that humans have an innate ability for speech because our brains are pre-wired with the rules of all spoken languages. He proposed being immersed in the mother tongue of their community would enable children to work out the rules of their language and begin to talk. No formal instruction, beyond guidance and encouragement was required. Smith maintained that learning to read is acquired in the same manner, and should be taught in an authentic and natural way. Similarly, Goodman described the development of literacy as a natural by-product of immersion in high quality literacy environments (Goodman, 1986, 1989, 1990) and maintained that acquiring literacy skills would be no harder than learning to speak if teachers presented reading and spelling as meaningful and purposeful tasks. Smith echoed this view when he argued that learning to read is not reliant on instruction as the essentials skill of reading cannot be taught. Instead he argued, like learning to talk, children will learn to read by being involved in its use (Smith, 1971).

The view that reading and spelling are biologically based processes underpins child-centred teaching approaches. Cazden (1972) argued to help young children break the code of written language, teachers must take their cue from how babies learn to talk: "language development takes place on a non-sequenced whole task basis" (p.36). The teaching of component reading sub-skills, such as letter name or letter-sound correspondence, is eschewed because, according to Whole Language theorists, it contradicts the way children are observed learning to talk and the 'wholeness' of language development. According to Goodman (1986) language is learned "naturally and intuitively because the rules of language can't be taught imitatively, rather children infer them from experience" (p.13). A commonly cited argument by child-centred literacy theorists is that when parents teach their children to talk they do not dissect oral language into component parts, rank phonemes from simplest to most complex and then teach them one at a time to children. They use this argument to criticise teachers who drill children on components of oral language before introducing them to reading whole words (Holdaway, 1979). Child-centred approaches are based on the assumption that literacy acquisition is analogous to language development in as much as it presupposes that children, who have become proficient at spoken language through practice, will become literate through reading experience.

Proponents of the Whole Language approach also believe children will learn to spell by spelling. They defend this position on the basis that there is a natural parallel "between the central principles of learning to write from ages 5-6 and the central needs of every infant learning to talk from age 1-2" (Walshe, 1981, p.123). Spelling is said to develop naturally if the appropriate modelling and practice occurs. Comparisons are drawn between the process of learning-to-talk with learning-to-write and it is argued that when early chatter or babbling - the oral version of scribbling, is 'conferenced' by parents and other listeners and is practised regularly, children learn to talk. That is, when a baby says 'botty' you respond by bringing him his bottle, not correcting his speech (Calkins, 1986). When applied to writing words, children's approximations of standard spellings are overlooked in favour of the intention to capture meaning in writing. "I respond to what my children's meaning is first and rejoice in each sign of progress" (Silberman, 1989, p.91). Based on these arguments explicit instruction in pre-requisite skills of spelling is considered unnecessary by Whole Language advocates (Goodman, 1989; Moffett & Wagner, 1992; Sloan & Latham, 1981; Smith, 1971). Indeed, Moats (1995) observed that within Whole Language based approaches to literacy development, component skills take the 'back seat' in curriculums that overemphasise composition to the detriment of handwriting, spelling, punctuation and grammar.

The claim for a scientific basis of Whole Language also stemmed from miscue analyses that Smith (1971) and Goodman (1986) conducted on adults and children reading aloud from a variety of texts. They concluded readers rely more on context to guess words, rather than attend to the actual spelling of the word. Their position was that reading was far too cumbersome to be approached letter by letter, and they claimed fluency improved when readers engaged with the text and used their contextual understanding to identify words. The writers viewed spelling in a similar way, although spelling instruction has received far less attention than reading. In Whole Language classrooms, spelling skills are thought to develop naturally as a result of immersing children in a print rich environment and encouraging writing. Whole Language theorists believe proficient spelling development is contingent on children reading.

Teachers adopting the Whole Language approach regard their students as equal collaborators in the learning process and facilitate learning opportunities so that children may take risks without fear of being corrected. The implicit assumption is that children are capable learners who bring different, but considerable, knowledge to the task of learning to read and write. Advocates of Whole Language claim a Humanistic basis for this approach and argue that it sits easily with the values of progressive education. For example, 'kid watching' is a term that frequently appears in the Whole Language literature (Graves, 1983). It describes the process of observing children's errors "so that we may allow them to teach us how they learn" (Calkins, 1986, p.32). Watching children learn is at the heart of child-centred approaches and communication is regarded as the key to the mutual exchange of information that enables teachers to facilitate and scaffold learning while extending and mentoring children. An example of a Whole Language approach to early literacy used widely in Western Australia is known as *First Steps*.

3.3.1 *First Steps*

For the last ten years Western Australia educators have been under increasing pressure to show improved outcomes in literacy achievement. In 1992 these concerns lead to the development of *First Steps,* a series of curriculum support documents outlining strategies and approaches for teaching reading, spelling, writing and oral language (Western Australian Ministry of Education, 1992a). Although *First Steps* was initially written to assist teachers of students at risk of developing literacy problems or already experiencing difficulties, the developmental continua, modules and *First Steps* documents are the current curriculum documents guiding classroom practice for students of all ability levels in government and most non-government primary schools.

> Purposeful talk underpins every aspect of learning. Oral language provides a bridge into written language where structures are adapted to serve a range of different purposes (Western Australian Ministry of Education, 1992a, p.v)

The *First Steps* materials are underpinned by 'holistic beliefs about language and literacy learning" (p.iii) and the references provided for the Reading and Spelling Continua reflect the influence of the Whole Language approach (Cambourne, 1988; Holdaway, 1979; Sloan & Latham, 1981; Weaver, 1988). Beliefs about the meaningful and interconnected nature of language and its components are evident in the instructional strategies and approaches recommended by the writers of *First Steps.*

All the teachers involved in this study had attended *First Steps* in-service courses either during their university training or prior to the study at school. These teachers described their approach to literacy instruction as predominantly Whole Language. With respect to beginning reading and spelling instruction this researcher observed students engaging in daily activities and strategies outlined in the *First Steps* materials.

An examination of the *First Steps* approach to beginning reading and spelling follows to set the context within which the main question is addressed by this study: whether phonological awareness and systematic decoding instruction will affect Year 1 children's invented and conventional spelling. In particular, the attention given to phonological awareness, alphabet knowledge and systematic decoding in the *First Steps* support materials is discussed in order to examine the degree of exposure to those variables in the control classes.

3.3.2 The *First Steps* approach to learning to read

> First, reading isn't simply a matter of turning writing or print into sounds or speech. Second, the role played by the eyes, ie. the visual system, is not as important as frequently believed. Third, there are severe limitations to the way in which the brain operates that can make reading almost impossible if the reader tries to read every letter and word he finds on the printed page (Latham & Sloan, 1979, p.1).

The *First Steps Reading Developmental Continuum* and support materials are underpinned by Whole Language principles but were also guided by the views of two Western Australian Whole Language theorists, Latham and Sloan (1979). Latham and Sloan's views on teaching reading are of interest because as well as informing *First Steps,* the teachers in this study undertook their pre-service training at a time when the book, *A Modern View of Reading*, (Latham & Sloan, 1979) was a recommended text at three of the four local universities. It is likely that Latham and Sloan's position on reading has influenced many teacher's decisions about how to teach reading in Western Australia in recent years.

Latham and Sloan defined reading "as the process of decoding to meaning and not to sound" (1979, p.5) and urged teachers "right from the beginning (to) let the learner into the secret that reading is for the purpose of identifying meaning" (Latham & Sloan, 1979, p.6). The writers cautioned teachers not to become unduly concerned about children's inaccurate oral manifestations because dysfluent oral reading was a sign children were making reading harder than it should be by over relying on visual information. In Latham and Sloan's view, the eyes provide limited information to the reader so "insisting on accuracy" was one of a number of ways teachers could "take the joy out of reading" (1979, p.71).

Latham and Sloan's comments are an endorsement of Frank Smith's original position that reading should not be regarded primarily as a visual process. He argued that "information that passes from the brain to the eye is more important in reading than the information that passes from eye to the brain" (Smith, 1973b, p.9). Smith also claimed that the process of seeing words and letters overloaded an individual's visual system because information is delivered in 'packages' or chunks as the eyes sweep across the page, leaving visual processors unable to keep up with the deluge of information. According to Smith, the limitations of visual processing were the cause of children "plodding laboriously over words in an attempt to read a passage" because the eyes only see a small part of the text (1973b, p.103). Instead, he advised children should be encouraged to behave like skilled readers who skim or visually sample a text without needing to process every word. In Smith's view, the actual marks on a printed page are of less importance than the knowledge of language a reader has before he even opens a book. This explanation of how young children read was likened to a 'psycho-linguistic guessing game' by Ken Goodman (1976). Goodman also believed reading was an active process of constructing meaning that occurred in the child's head and depended more on the experience of the child and their oral language competence than their ability to identify words.

This argument encapsulates the position taken up by the authors of *First Steps* as evident in the following beliefs about reading instruction that underpin the approach:

Beliefs about learning to read

- Children learn how to read by being active in the process of controlling language
- Reading should have significance for all children, they should understand the purposes for reading
- Reading requires a knowledge of the linguistic system
- Reading requires children to become responsible for applying skills and strategies
- Children learn through immersion when they are exposed to demonstrations of how language is used in many varied situations
- Skills and strategies are learnt in the context of whole language activities (Western Australian Ministry of Education, 1992a, p.vii).

Figure 7 Beliefs about Learning to Read Outlined in *First Steps*

The *First Steps* Reading Developmental Continuum describes the behaviours children exhibit at different stages of development and outlines ideas and strategies to assist children to progress to the next phase. The reading phases begin with the 'Role Play' and 'Experimental' phases and end with 'Independent' reading. In all phases the approach teachers are advised to follow is consistent with *First Steps* beliefs about learning to read. For example, teachers are advised to present information in the context of language activities that are meaningful to the child, to design learning opportunities that allow children to discover concepts for themselves and to model particular skills. At all times children are encouraged to take responsibility for their own reading development. This position is consistent with the views of Smith, who argued young children "cannot be taught to read", instead a teacher's responsibility is to make it possible for children to read by providing interesting material that makes sense to the individual, and an understanding and more experienced reader as a guide (1985, p.5).

The *First Steps* materials are underscored by the belief that meaning is the most important factor in learning to read and this influences the content and structure of the approach. For example, in the 'Early Role Play' and 'Experimental Reading' phases teachers are advised to choose reading books that relate to the experiences of the class and encourage children "to predict what a story may be about", "retell stories from illustrations and from memory" and to "delete words from sentences and predict what word is missing" (Western Australian Ministry of Education, 1992a, p.6). These strategies are designed to stimulate children's oral language experience in order to provide the necessary context to identify words and comprehend the text. This adherence to meaning also governs the way teachers are advised to treat 'sight words'. In *First Steps* sight words are defined as "frequently occurring words that are personally meaningful to children" (Western Australian Ministry of Education, 1992a, p.4). Teachers are encouraged to build children's sight word vocabulary by exposing them to high frequency words in big (enlarged print) books and building personal sight word banks. This strategy assumes children will learn complete words as units of knowledge and is aligned to the Whole Language principle of retaining the holistic properties of language. Other *First Steps* word identification strategies recommended for children learning to read that are dependent on contextual cues include: identifying whole words by their shape, identifying words using the first letter, or inserting a semantically appropriate substitution so as not to risk interrupting the flow of reading and 'jeopardise' comprehension (Western Australian Ministry of Education, 1992a).

Despite their belief that readers can "recognise words and comprehend text without decoding to sound at all" (Smith, 1985, p.57) most Whole Language theorists concede that there is a place for the application of phonic knowledge in the reading process, but do so on the understanding that graphophonic cues must be used sparingly, and not before all other meaning based strategies have been employed. In Frank Smith's view, phonics is the "great fallacy" of reading instruction: largely unused by adult readers, but of assistance to beginners provided they have a rough idea of what the target word sounds like (Smith, 1973b, p.70). The position put forward by Whole Language theorists Latham and

Sloan is that phonic knowledge is required for successful reading but "teaching phonics is not teaching reading" (Latham & Sloan, 1979, p.7). They argued that when children apply letter-sound knowledge consciously to decoding print, the ability to comprehend is adversely affected because reading has been made unnecessarily complicated. According to Latham and Sloan the view that lack of phonic knowledge causes reading difficulties is incorrect and teaching phonics may in fact be "dangerous" to young children who will turn to piecemeal decoding at the expense of attending to meaning. Not only do Latham and Sloan maintain the application of letter-sound knowledge is dispensable, in their view the teaching of letter-sound knowledge is an act of "absurdity" because English is so irregular and sounding out words letter by letter is intolerably slow for beginning readers (Latham & Sloan, 1979, p.18). The inclusion of letter-sound correspondences in *First Steps* in an incidental, rather than explicit manner, is a reflection of the aversion Whole Language theorists feel towards the explicit teaching of phonics knowledge.

The role of phonological awareness receives only incidental attention in the *First Steps* reading materials. Teachers are advised to "show children what a word is" and "read rhyming books daily" in the 'Role Play' phase of reading (Western Australian Ministry of Education, 1992a, pp.6-7). In the next developmental stage, the 'Experimental' phase, only three activities focus on isolating sounds: finding words in a story that start with a particular sound, making up a tongue twister; and, identifying the common sound in a list of words. As *First Steps* is based on the central principle that to begin to read a child has only to hear and speak language, it would appear the writers have assumed there is no need to emphasise phonological awareness or teach the skills of concept of word, rhyming and segmentation explicitly.

The relevance of alphabet knowledge in the process of identifying words is also ambiguous in *First Steps.* The approach emphasises letter names over sounds because they are 'constant' whereas letter sounds vary. Teachers are advised to model how to identify words using the first letter and guessing the word, or combining the first letter with context cues to predict the missing word. Some teaching strategies require children to say what sound a particular letter makes in a word, while in others words are to be grouped under their letter names. The importance given to letter name knowledge in such activities implies, particularly for young children, that letter names are of importance in learning to read.

While the sequence of phonic knowledge and decoding skills outlined in *First Steps* is consistent with the assumption that learning and applying alphabet knowledge to identify words is of less value than using semantic cues, it is also apparent that children are expected to acquire these skills through immersion, self-discovery and 'having-a-go'. In the 'Experimental' phase of reading development *First Steps* lists under the heading 'Knowledge and Understanding' that children will "show beginning knowledge of letter-relationships" (Western Australian Ministry of Education, 1992a, p.11). In the same phase, the second of reading development, teachers are advised to encourage and model 'sounding out' to identify words. Prior to this, the *First Steps* materials advise teachers to expose children to letter names in the context of literature or by pointing out letters in children's names and familiar words, but no specific reference to teaching letter sounds is made. Instead, it is assumed that modelling sounding words will be sufficient to teach both letter-sound associations and decoding. As these documents indicate, children learning to read by the *First Steps* approach are expected to learn alphabet knowledge, particularly letter-sound correspondences, through being immersed in spoken and written language.

First Steps is founded on the understanding that because children are "self motivated learners" they will take responsibility, from a very young age, for "selecting and applying the skills and strategies" necessary to read (Western Australian Ministry of Education, 1992a, p.vii). It is assumed that children will progress from one developmental phase to another with a minimum of adult intervention. The teacher's role in *First Steps* is essentially to show, model, question, provide opportunities and demonstrate skills and concepts. The *First Steps* teacher is best described as a 'facilitator'. Teachers are advised to observe children's reading strategies and conduct running records and miscue analysis to identify strengths and weaknesses, then select learning opportunities from the

First Steps materials that will consolidate and advance the child to the next phase. These learning opportunities almost always involve meaning making strategies. The way in which *First Steps* views reading errors as either semantically acceptable or unacceptable substitutions is aligned with the Whole Language perspective that reading is primarily a meaning making activity. When children cannot identify words, greater attention is given to activating prior knowledge than teaching the pre-requisite skills to decode words.

3.3.3 The *First Steps* approach to learning to spell

The *First Steps* approach is underpinned by Whole Language principles about how children learn to spell. It is argued that children's spoken language skills facilitate spelling development, and spelling development is enhanced through discussion and reading, and occurs as children strive to express themselves in writing. Whole Language proponents take the view that children utilise their knowledge about their culture's written language, in conjunction with their innate knowledge of the rules of spoken language, to begin writing. This belief is the basis of advice given to teachers in the *First Steps* support materials: "provided schools encourage the development of early writing, children will learn to spell as naturally and sequentially as they learn to speak" (Western Australian Ministry of Education, 1995, p.4).

The view put forward by Whole Language theorists that spelling competence unfolds in a series of developmental phases is reflected in the *First Steps* Spelling Developmental Continuum. The writers of *First Steps* have divided children's spelling development into a sequence of phases. 'Key indicators' are provided for each phase to enable teachers to identify children's stage of development and major teaching emphases are included to promote movement to the next stage. These stages are based on the work of Gentry (1981) who advocated extensive writing experience to facilitate children's spelling development. Thus, the developmental phases outlined in *First Steps* begin with scribbling, progress through phonetic and transitional spelling and end with conventional spelling. Despite the wholistic content of *First Steps,* the application of sound symbols relationships to spell words covers a substantial part of children's spelling development and is emphasised at the semi-phonetic, phonetic and transitional stages of the *First Steps* developmental continuum. The authors of *First Steps* assumed that although children progress at different times and rates and may remain or move through phases out of step with their chronological age, development will occur eventually, without explicit instruction.

The preservation of meaning is central to the Whole Language approach. First, writing, of which spelling is a 'tool', is viewed as a process of conveying meaning and young children are not forced to spell correctly (Bergeron, 1990). It is implied in the *First Steps* support documents that misspellings should be overlooked because they will correct themselves as the child matures and gains experience with language and the purpose of writing. Second, teachers are advised to encourage young children to be 'risk takers' and adopt a trial and error approach to spelling because it is assumed children have 'tacit', or subconscious knowledge about words which they draw upon when constructing words they want to write down (Gentry & Henderson, 1980) and when children do produce a text this engenders a strong sense of ownership. They argue that when the child's spoken language has been encoded faithfully in print in a manner that is meaningful to the child, this motivates and helps the child to read what has been written.

> Encourage children to invent their own spelling. Some children will need reassurance that it is all right to 'take risks'. Teachers will need to help these children understand that we want them to 'have-a-go' at writing the word they way they think it is spelt (Western Australian Ministry of Education, 1992a, p.16).

Invented spelling is the initial strategy teachers implementing *First Steps* encourage children to use to write words and "maintain the fluency of writing" (Western Australian Ministry of Education, 1995, p.8). Since the early 1970s proponents of the Whole Language approach have recommended inventing spelling to promote the independent writing skills of young children and literacy development in general (Moffett & Wagner, 1992). Invented spelling is considered a naturalistic way children can communicate meaning without being confounded by the inability to spell unknown words (Graves, 1983). This view was echoed by Turbill (1982) who argued, "so nothing should be done that deflects the child's attention from getting meaning (content) onto paper, for clarifying and correcting can come later, at the editing stage"(p.88).

Proponents of Whole Language believe children acquire a literacy skill in its entirety by active participation and teachers implementing *First Steps* are advised to encourage very young children to write frequently in a variety of realistic situations because "writing provides the context for spelling development" (Western Australian Ministry of Education, 1992a, p.4). Whole Language theorists believe if teachers encourage children and take a genuine interest in their writing, students will move along the developmental continuum from scribbles to conventional spelling without formal instruction. This is the fundamental position put forward in the *First Steps* support documents, however, teachers are advised to emphasise particular points at the preliminary phase of spelling: print concepts such as letters and words, opportunities to write in authentic contexts and an awareness of letter names (p. 4). *First Steps* documents advise teachers to emphasise these concepts in meaningful contexts, for example by demonstrating inventing spellings through modelled writing activities and exposing children to the letters of the alphabet "using alphabet rhymes and jingles, alphabet books, blocks and charts" (p.5). At no stage are teachers advised to teach alphabet knowledge, or other skills in isolation or explicitly. Instead, a problem solving approach is endorsed because it is argued, it is "far more powerful than teaching 'letter' stories and drilling 'sounds' because it teaches children strategies that they can use as independent learners. Children will "puzzle out symbol-sound relationships and generalise from what they learn" (Western Australian Ministry of Education, 1995, p.10).

The *Have-a-go-Pad* is a strategy described in the *First Steps* documents to support beginning spellers to work independently, to try out their ideas, build on previous attempts and to take risks safely to spell unknown words (Western Australian

Ministry of Education, 1992b). In constructing a *Have-a-go-Pad* this researcher has observed teachers rule up a pad or small booklet with three columns: one for the child's attempt at spelling a word and another for the teacher to write the correct spelling, and a third for the child to rewrite the word if incorrect.

In the earliest publication of the *First Steps* support materials teachers were advised to provide students with a process for attempting new words by modelling invented spelling and providing children with a *Have-a-go-pad.* In the most recent edition of the *First Steps* Spelling Resource materials (Western Australian Ministry of Education, 1995) a prompt card titled "Using a *Have-a-go-Card"* is included for teachers to give to students. The centrality of meaning that underpins Whole Language approaches is apparent in the procedure children follow when inventing the spelling of a word. The meaning of the whole word is emphasised before children are cued to listen to the sounds of the word.

Using a *Have-a-go-Card*

- Think about the meaning of the word. Does it give a clue to the spelling pattern?
- Say the word slowly. Listen to the sounds.
- Write the word syllable by syllable.
- Make sure each sound is represented by a letter or letters
- Look carefully to see if the pattern looks right, if not: try different patterns that might be right, see if you can think of another word that may be similar. Try again. (Western Australian Ministry of Education, 1995, p.109)

Figure 8 Instructions for Using a *Have-a-Go-Card*

Monitoring children's spelling development is an important part of the *First Steps* approach. Teachers are advised to foster children's early attempts to spell and view errors as 'developmental sign posts' that indicate children's developing understanding of the writing process. Invented spellings are considered in the same way, for example Smith (1971) categorised reading miscues as indicative of a particular stage of development (Zutell, 1980). When children are not progressing teachers are directed to teaching points assigned to each development phase. For example, the following teaching emphases are suggested for children to enter the semi-phonetic phase of spelling.

Teachers should:

- establish a print-rich environment where print is presented in natural and meaningful contexts
- provide opportunities for children to write informally in context
- develop and use alphabetical lists
- **help children to develop a stable concept of word** *(emphasis added)*
- help children to hear different sounds in words
- **help children develop the ability to segment spoken words into individual sounds** *(emphasis added)*
- help children to represent the sounds heard in words with letters written in the order heard
- teach children that letter names are constant but the sounds they represent will vary
- provide opportunities for children to explore and identify sound-symbol relationships in meaningful contexts
- encourage children to take risks
- continue to model writing in a variety of tasks
- select high interest and high frequency words from children's reading and class writing to add to class word lists (Western Australian Ministry of Education, 1992a, p.12).

Figure 9 Major Teaching Emphases Semi-Phonetic Phase of Spelling Development *First Steps*

Teaching at the point of need is a recurrent theme in the *First Steps* materials. The two teaching points marked in bold in Figure 9 are considered to be critical to children's development at the semi-phonetic phase. *First Steps* refers to alphabet knowledge and phonological segmentation. With respect to phonological segmentation, teachers are advised to develop children's ability to segment words into sounds by "providing opportunities to experiment with words", "asking students how to spell words when scribing class stories" and "asking children to clap the parts they hear in words" (Western Australian Ministry of Education, 1992b, p.13). In *First Steps*, clapping the parts of words, asking students to "put down a block for each sound heard" and using sound frames which involves drawing a box for every sound and having the child write the letter in each frame is the closest that *First Steps* comes to advocating teaching phonological segmentation (Western Australian Ministry of Education, 1992a, p.13). Children are asked to demonstrate their knowledge by observing a teacher completing each task then segmenting words into phonemes on their own.

Guidelines about the teaching of alphabet knowledge at the semi-phonetic phase are less specific. Teachers are advised to expose children to letter names, and provide opportunities for children to "explore" letter sound knowledge. The reading of tongue twisters, words that begin with the same letter and asking children to identify words in a story with the same sound are examples of instances when *First Steps* endorses the introduction of letter sound knowledge. At no stage are teachers advised to teach letter-sound knowledge explicitly. Instead, it is assumed that by immersing children in literature they will learn letter-sound correspondences.

Teachers implementing *Have-a-go-pads* are assured that encouraging invented spelling will eventually lead to conventional spelling. The *First Steps* support materials report: when young children are confident to experiment with words they will be "willing to take risks and accept responsibility" and become "aware of social obligations as a speller". Graves (1983) reasoned the daily influences of integrated listening-writing-reading serve to move the child rapidly towards standard spelling. *First Steps* puts forward the view that continual reinforcement of reading and writing through meaningful and regular encounters with print creates a classroom environment that promotes correctness. Implicit in this advice is the belief that children will be intrinsically motivated to take responsibility for their spelling development.

3.4 Comparison of *Let's Decode* and *First Steps*

Let's Decode and *First Steps* are two teaching approaches that share the common goal: that all children should become literate. However, each approach is based on very different, and at times antithetical assumptions about how this process occurs, especially at the beginning stage. *First Steps* is based on a view of literacy acquisition that assumes meaning is the key to learning to read and spell. When children focus on the meaning of what they are reading or writing their spoken language skills provide the key to reading and writing print. By contrast, the model of reading underpinning *Let's Decode* requires that children first acquire a set of sub-skills, then assimilate these sub-skills into the holistic act of reading.

A core issue that informs and divides the two different approaches is the relationship between learning to talk and learning to read. In *Let's Decode* the importance of oral language in learning to read in terms of the semantic and phonological properties of words is acknowledged but the approach is based on the view that unlike spoken language development, learning to read is not a biological process. By contrast, *First Steps* is based on the premise that reading, writing, speaking and listening parallel, compliment and support each other because they are part of the same language process (Western Australian Ministry of Education, 1992a). Underpinning this relationship is the belief that learning to read is a naturally occurring phenomenon that is parasitic on learning to talk, in as much as oral language competence provides children with the necessary experience to make sense of the printed form of language.

In *Let's Decode* phonological awareness is taught explicitly, out of context and prior to, and alongside, beginning reading instruction. Where little evidence of sequencing phonological awareness skills is evident in *First Steps,* there is a clear structure in *Let's Decode.* Teachers follow specific formats and present a sequence of phonological awareness skills that begins with concept of word, blending, rhyming and segmentation. The final skill, the segmentation of words into phonemes is considered the most difficult, yet critical, and teachers are advised to continue teaching segmentation with progressively more difficult word types throughout the first two years of reading instruction. All *Let's Decode* phonological awareness skills are taught as oral language activities because the focus of phonological awareness is the speech stream. To use visual cues, such as a big book, would render the instruction ambiguous because children may focus on the meaning of the words, rather than the composition of the phonemes.

As *First Steps* devotes little attention to phonological awareness skills, presumably on the basis that meaning making strategies are of greater importance than developing children's understanding of the alphabetic principle, it not surprising that the treatment of graphophonic information is also limited. Letter names are included before letter-sound correspondences and all alphabetic knowledge is treated in the context of meaningful language. In *Let's Decode* letter sounds are taught before letter names and in a pre-determined sequence based on the usefulness of sounds, and the need to separate visually and auditorily similar letters. This attention to sequence is evident in the link between phonological awareness and reading in *Let's Decode.* For example, auditory telescoping or blending, is the pre-requisite phonological awareness taught before children learn letter sound correspondences and the strategy of blending sounds together in print.

The level of responsibility children are expected to bring to the task of reading is another difference between the two approaches. The instructional methods described in *First Steps* support fostering children's inherent knowledge, risk taking, 'having a go' and making learning experiences enjoyable and meaningful. Teachers are encouraged to 'show', 'demonstrate' and 'facilitate' children's learning. In short, children must engage with the learning process if they are to progress in this child-directed approach.

By contrast, *Let's Decode* is a teacher-directed approach in which the teacher takes responsibility for the delivery of faultless instruction. Children are not expected to discover concepts on their own, in fact, whenever a new skill is introduced the pre-requisite skills, if any, will have been learned beforehand. Scripted formats are used to teach groups of children whose unison oral response is an indication of their active participation in the learning process, and their individual level of understanding is monitored by the testing stage of the format sequence. Compared to the 'fun' activities that characterise the child-centred teaching approach, *Let's Decode* may appear less interesting. However, teachers are advised that if they skilfully deliver formats at the appropriate pace and level of difficulty students will remain motivated and teachers will be able to focus more clearly on student's individual progress.

3.4.1 Combining *First Steps* and *Let's Decode*

While the theoretical assumptions on which child-centred and instruction-centred approaches are based are clearly incompatible, research has shown combining approaches is critical to the prevention of reading difficulties (Adams, 1991b; Chall, 1989; Snow et al., 1998). This represents a conundrum for theorists, because neither approach in isolation is considered ideal, but each contains important components in the development of children's literacy skills. For example, as insistent as Whole language proponents are that beginning reading and spelling does not need to be taught formally or separately from authentic reading and writing activities because exposure to natural text is sufficient for literacy development, other researchers do not share this view. Stahl and Miller (1989) suggested the Whole Language approach was too implicit for children who require more time to learn the alphabetic principle. Further, Liberman and Liberman (1990) described the Whole Language expectation that children begin to read and write spontaneously as a result of hearing and reading natural text as highly unrealistic. Instead, they argued children need more explicit and systematic instruction in pre-requisite skills known to be critical to beginning literacy: phonological awareness, letter-sound correspondences and the strategy of decoding. At the same time, Liberman and Liberman acknowledged meaning based approaches that make reading enjoyable and worthwhile learning were also important. This debate raises the question of whether it is possible and desirable for teachers to include both approaches in beginning literacy programs.

In her review of the research into the effectiveness of different approaches to teaching beginning reading, Adams (1990) concluded that a combination of systematic instruction in phonics along with language enrichment was essential. Hall and King argued teaching beginning readers explicit strategies for attempting to identify unknown words was a necessary supplement to Whole Language approaches (Hall & King, 1992). Henry (1997) concurred when she noted that explicit instruction in decoding and spelling was not a feature of the Whole Language approach but should be if those children who do not easily discover the alphabetic code are to learn to read and spell.

A number of studies have validated this claim and shown that children in kindergarten and Year 1 Whole Language literacy programs make greater progress in basic reading and spelling skills if they also receive instruction in phonological awareness and alphabet knowledge. Castle, Riach and Nicholson (1994) and Rubin and Eberhardt (1996) showed that integrating language analysis activities into Whole Language kindergarten curriculum showed improved reading and spelling skills and Urhy and Shepherd (1993) reported similar outcomes with Year 1 children. Cunningham and Cunningham (1992) and Joseph (1999) examined the value in adding invented spelling strategies to whole language approaches, such as the Reading Recovery Program (Clay, 1985), by using word boxes and magnetic letters to 'slice' words and make the process of segmenting words into sounds explicit to Year 1 children. Eldredge and Baird (1996) investigated the effect of supplementing a whole language program with phonological awareness and phonics instruction by comparing the writing samples of two groups of Year 1 children: those that received additional instruction and those from the traditional whole language classroom. Eldredge and Baird's training study is of particular interest because both groups of children were encouraged to write on a daily basis and received incidental assistance from their teachers to invent spellings. Only those children that received explicit instruction in sound segmentation and alphabet knowledge, wrote longer compositions, attempted more complex words and spelt fewer words incorrectly.

In addition to these studies the latest in a series of reports on the state of literacy instruction in America: *Preventing Reading Difficulties in Young Children* (1998) highlighted the importance of an integrated approach to reading and spelling instruction. Snow, Burns and Griffin (1998) advised explicit teaching of phonological awareness, letter-sound correspondences and how to decode words alongside interesting stories containing sophisticated language to develop children's vocabulary and language comprehension. With regard to spelling, the writers endorsed the practice of allowing children to 'invent' spelling but advised teaching the pre-requisite skills of phonological segmentation and alphabet knowledge in parallel with the development of conventional spelling through focused instruction.

The promotion of a balanced approach is not new. In 1967 Jeanne Chall wrote *Learning to read: The Great Debate* and although she concluded that reading programs that introduced phonics early were more successful that those that did not, Chall has always adopted a flexible stance on the integration of letter-sound knowledge with meaning based approaches (Chall, 1989). This is evident in Chall's (1983) theoretical model of reading development that includes both systematic decoding and meaning based strategies. Interestingly, and of particular significance to this study, Chall's model of reading development is referenced in both the *First Steps Developmental Continua* (Western Australian Ministry of Education, 1992a) and *Let's Decode inservice manual* (Formentin, 1992a).

Based on the view that elements of both child-centred and instruction-centred approaches are essential components of beginning reading instruction, Western Australian researchers have investigated whether it is possible to prevent reading disability by combining *First Steps* and *Let's Decode*. Formentin, Summers and Crawford (1994) reported that when Year 1 teachers added phonological awareness and systematic decoding instruction to their *First Steps* literacy programs those children who received *Let's Decode* achieved superior results in word recognition, decoding ability and passage comprehension, that those that did not receive the intervention. Formentin and Hammond (1997) reported similar results at another school where the first study was replicated. Again, teachers were asked to include approximately fifteen minutes of phonological awareness skills and systematic decoding instruction to their existing Whole Language program. These, and the results of other unpublished studies of the efficacy of *Let's Decode* in the prevention of reading disabilities in Year 1 children have found the intervention to be consistently effective in conditions were teachers added an explicit form of phonological awareness and decoding instruction to their *First Steps* literacy approach (Formentin, Hammond, & Elderfield, 2000).

3.5 Summary: Theories and models of literacy instruction

Currently in Western Australian schools, junior primary school aged children are encouraged to invent the spellings of words in order to promote both reading and spelling development. This child-centred position implies that learning to read and spell are natural occurring phenomenon like learning to speak and the explicit teaching of pre-requisite skills is unnecessary. Instead children are expected to spontaneously invent spellings and transfer their knowledge of the alphabetic code to learning to read. While child-centred theorists believe this will occur without intervention, a large body of research does not support this position.

The synergy between models of children's early literacy development and pre-requisite skills reported in the research as necessary to read and spell words supports the premise that reading and spelling depend on common pre-requisites, and some skills are more critical than others. Phonological awareness, in particular the isolation of individual sounds in words and phoneme blending, have consistently been linked to superior reading and spelling performance, while rhyming is of secondary importance. Alphabet knowledge, specifically the ability to automatically identify the most common sound of letters is also critical. Such is the importance of these skills that explicit instruction is considered preferable to incidental learning, because those 25 percent of children who do not deduce this information are at high risk of literacy failure (Liberman & Liberman, 1990).

CHAPTER 4
MATERIALS AND METHODS

The study involved four phases: an initial single case study in which reading and spelling data from a single case study, known for the purposes of this research as 'Rosie' were examined, a post-hoc investigation of the spelling performance of a cohort of Year 1 children who had received systematic decoding instruction, the main study in which the effects of systematic decoding instruction on the development of spelling were investigated, and a single-subject research design in which the effect of individualised phonological segmentation instruction was investigated.

4.1 Participants

4.1.1 Single Case Study: 'Rosie'

This is a single child in Year 1 at a Western Australian State primary school. She was 6 years and 7 months at the time the data was collected.

4.1.2 Post-hoc Study: Year 1 cohort who received systematic decoding

This cohort attended a Western Australian State primary school in 1998. It included 23 boys and 21 girls. The mean age of students was 6 years and 5 months at the time of testing at the end of Year 1. The school is one of 20 percent in Western Australia who receive Commonwealth literacy funding. This funding is allocated on a sliding scale based on the index of disadvantage referred to as the H index (Education Department of Western Australia, 1999a).

4.1.3 Intervention Study: Year 1 classes at three Catholic primary schools in Western Australia.

These schools were of similar socio-economic standing, each being entitled to Commonwealth literacy funding. The four classes were similar in size. A total of

112 students were involved in the study, 64 boys (34 control and 30 experimental) and 48 girls (25 control and 23 experimental). The two experimental classes were from different primary schools. The two control classes were from one school. The age of the students who participated in the study varied from 5 years 11 months to 6 years 10 months and the mean age of students was 6 years and 6 months at the end of Year 1.

The classrooms were selected on the basis of the teachers' encouragement of invented spelling during daily writing activities and commitment to children's use of *Have-a-go-pads*. All four teachers described themselves as supportive of 'child-centred' approaches including the so-called 'Whole Language' approach to literacy development. These teachers were observed reading 'big books' to their students frequently, maintained well-stocked classroom libraries and provided daily opportunities for child-centred writing activities. These writing activities included writing on topics directly related to some aspect of a big book and writing in daily diaries on set and open topics.

Three of the teachers, including the two control teachers, had taught junior primary school exclusively for over ten years. One intervention teacher was in her third year of teaching and had only taught Year 1. The intervention teachers showed a willingness to implement the intervention *Let's Decode* (Formentin, 1992a) in addition to their existing language programs. The two control teachers continued to teach their Year 1 literacy programs as they had in previous years. Both the intervention and control teachers agreed not to implement any other new literacy initiative during the period of this study. This was an important consideration because a number of new approaches were being trialed by schools initially invited to participate in this project, but who were ultimately excluded to reduce the likelihood of uncontrolled variables.

4.1.4 Single-Subject Design

Four individual students were selected on the basis of their pre-test phonological awareness scores (Test of Phonological Awareness Standard Score of <73) and poor spelling performance. The classroom teachers were initially asked to nominate a group of weak spellers based on children's classroom spelling performance. As the teachers selected all but one male student, it was decided to include only males in the single subject design. Factors such as the student's TOPA pre-test score, willingness to work with the researcher, and regularity of attendance were then applied to the list. Four boys, two from Intervention Group and two from the Control Group were eventually chosen.

4.2 Procedures

4.2.1 Case Study

Samples of work from an individual child, known for the purposes of this research as 'Rosie', were examined to evaluate the quality of her reading and spelling performance. Samples of written work were presented to the researcher who then followed up by collecting further data on the child's reading and spelling. Reading was assessed by using a Miscue Analysis, Yopp-Singer Test of Phonemic Segmentation and Woodcock Reading Mastery Test-Revised Word Attack subtest. Spelling was not assessed beyond the data provided in the *Have-a-go-pad* and asking the child to spell words that she used in her written work.

4.2.2 Post-hoc Analysis

This aspect of the research took advantage of the availability of data from a school in which a study had already been undertaken using *Let's Decode.* The spelling performance of three classes of Year 1 children, at a school whose teachers had received professional development and support to implement *Let's Decode,* was examined to look at the relative quality of invented spelling of these classes and use of conventional spelling. The Developmental Spelling Test (DST) (Tangel & Blachman, 1995) and the Wide Range Achievement Test-Revised (WRAT–R) (Jastak & Wilkinson, 1984) were administered to three classes of Year 1 children at the end of their first year at school. Standard scores from the Woodcock Reading Mastery Test-Revised Word Attack subtest (WRMT–R) (Woodcock,

1998) were provided by another researcher and were analysed for this study along with the WRAT-R spelling data.

Testing

The reading data (Woodcock, 1998) provided by another researcher was collected at the end of Year 1. Testing was carried out individually by a teacher trained for this purpose and conducted in a quiet space in the school. The spelling tests administered for the research reported here were conducted in the final week of Year 1. Two research assistants under the supervision of the researcher carried out the spelling testing. Research assistants were kept 'blind' to the specific research questions to avoid bias during data collection. Testing was carried out in an empty classroom that was familiar to the students. The room had separable desks and chairs and there were no alphabet or word charts on the walls. Instructions were delivered by the researcher while the research assistant ensured students kept up with the group and did not copy other student's work. Students were allocated to ability groups based on their classroom spelling performance to enable researchers to dictate sufficient words to ensure children reached 10 consecutive errors, but were not frustrated by having to attempt more words than was necessary to reach this ceiling. Thus, students identified by their teachers as 'strong spellers' were grouped together and attempted up to 30 words while weaker students attempted only 20.

Scoring of tests

The other researcher scored the WRMT-R sub test and data was received in tabulated form. A research assistant trained for the task undertook scoring of the spelling data and results were randomly checked to ensure reliability. Scoring the DST (Tangel & Blachman, 1995) is a complex process and frequent discussions ensued to review unusual spelling responses not described by the DST Rating Scale. An experienced junior primary school teacher was employed as a second research assistant to randomly check the rating of spelling responses.

4.2.3 Intervention Study

The main aspect of this study involved an experimental design in which the Intervention Group teachers attended professional development and were supported to implement phonological awareness strategies and systematic decoding instruction in their Year 1 classes. The Control Group did not attend the professional development, but received professional development on the implementation of *The Literacy Net* (1998), a new initiative. *The Literacy Net* (1998) is a literacy monitoring tool that includes references to phonological awareness and sound-symbol associations, but does not advocate explicit teaching of phonological awareness. *The Literacy Net* is designed to compliment teachers' existing Whole Language teaching programs, by highlighting areas of weakness in children's skills. The major difference between the Intervention Group and Control Group professional development programs was this: the intervention school received the background and skills to directly teach phonological awareness and systematic decoding instruction, whereas the control school were asked to monitor children's skills in these and other areas as stipulated by *The Literacy Net.* While it is implicit that teachers should teach to particular *Literacy Net* 'checkpoints' such as letter-sound relationships, no clear direction about how to teach this knowledge is provided. Instead, teachers are encouraged to refer to ideas and strategies outlined in *First Steps* (Western Australian Ministry of Education, 1992b).

Following the initial professional development and support period, both the Intervention Group and Control Group received an equivalent amount of in-class support to assist in the introduction of a beginning spelling tool known as the *Have-a-go-pad*. In addition, the Control Group teachers received some *Literacy Net* professional development and in-class support. These procedures are summarised in the following table:

Table 1 Support Provided to Intervention and Control groups

Intervention Group	Control Group
1. Teachers receive *Let's Decode* professional development over 12 weeks on a fortnightly basis to a total of 15 hours.	1. Teachers receive *Literacy Net* professional development over a four week period to a total of eight hours.
2. Teachers receive one hour per fortnight support over 12 weeks to implement *Let's Decode* to a total of 6 hours.	2. Teacher receive one hour per fortnight over six weeks to implement *The Literacy Net* to a total of three hours.
3. Teachers receive in-class support over two school terms to implement *Have a-go pads.*	3. Teachers receive in-class support over two school terms to implement *Have a-go pads.*

Testing

The researcher and three research assistants conducted the pre- and post-tests. Two research assistants were qualified teachers and one research assistant was completing her undergraduate training in this area. Research assistants were kept 'blind' to the specific research questions to avoid bias during data collection. The pre-tests comprised two group tests, the Test of Phonological Awareness (TOPA) (Torgesen & Bryant, 1994) and the DST. These tests were administered by the researcher and a research assistant to groups of 4 to 10 students depending on the available space in each school. Testing was carried out in an empty classroom that was familiar to the students. The room had separable desks and chairs and there were no alphabet or word charts on the walls. Instructions were delivered by the researcher while the research assistant ensured students kept up with the group and did not copy other student's work. Participants were shown how to cover their work and reminded to "do their own work" during testing.

Explanations for the TOPA were read carefully to students and they were reminded to "leave the box blank if they did not know" to discourage guessing.

When the DST was administered, children were given a prepared record sheet and asked to write their name on the line provided. The children were alerted to the alphabet printed across the top of the page and told to use this if they forgot how to form a letter. They were then told, "I want you to try to write some words for me. I will say a word and you write it as best as you can. If you cannot write the whole word, write as many sounds as you can hear, and any of the letters that you think might belong to that word". Presentation of the test items then followed. If children commented the words were 'too hard' or they required help, they were cued to "just do your best."

This exact procedure was repeated at the end of Year 1 with the addition of the spelling subtest from the Wide Range Achievement Test-Revised (Jastak & Wilkinson, 1984). The same procedure reported in the post-hoc analysis was replicated for the WRAT–R spelling subtest. Three subtests from the Woodcock Reading Mastery Test–Revised (Woodcock, 1998) were also administered: Word Recognition, Word Attack and Passage Comprehension. The research assistants, under the guidance of the researcher, carried these reading tests out on an individual basis. Testing took place in a quiet space close to the students' classroom that was relatively free of distractions. Each research assistant was given detailed written instructions and observed the researcher administering the test to a Year 1 student not involved in the study. The researcher observed each research assistant administering the WRMT-R to other students not involved in the study and provided corrective feedback in conjunction with relevant items of the 'Self-Evaluation Checklist' (Woodcock, 1998, p.60). After this training period formal assessment commenced. At all times the researcher was available to answer questions or address any problems raised by the research assistants during the assessment period.

Scoring of tests

To maintain consistency, the same research assistant scored the pre- and post-TOPA, DST and the post WRAT–R Spelling subtest (Jastak & Wilkinson, 1984). A random check was undertaken by the researcher to ensure accuracy. The same procedure for scoring the spelling tests undertaken for the post-hoc analysis was repeated for the spelling data collected from the four classes of Year 1 children. The three subtests of the WRMT-R were scored by the researcher and checked randomly by another researcher experienced in the scoring of this test.

4.2.4 Single-Subject Design

The single subject design involved four boys, two from the Intervention Group and two from the Control Group. The two Intervention Group children took part in a multiple-baseline across-subjects design with invented spelling as the dependent variable and instruction on the isolation of phonemes in words, and prompts to apply this strategy to spelling words as the independent variable. This design was replicated with the two Control Group children.

Gathering of writing samples

The researcher visited each of the four students three times a week for five weeks in the morning. Students were seen at approximately the same time and in the same quiet space. Instructions were scripted and the procedure remained exactly the same for each student for every session whether on baseline or intervention (Appendix K). After a period of discussion and instruction, during intervention sessions, students wrote for 15 minutes.

Analysis of writing

After each session students' writing was analysed and the percentage of correct letters was recorded and graphed.

4.3 Materials

4.3.1 Non-standardised test materials

Miscue Analysis

Miscue analysis is a set of specific procedures for marking a copy of a text read aloud by a student in order to examine errors (Lipson & Wixon, 1997). In this instance, the researcher asked the student, 'Rosie', to select a book from the readers available in the classroom and read it aloud. The researcher marked the words the student read correctly and incorrectly, and noted any relevant behaviour, such as the strategies the student employed to work out unfamiliar words in accordance with the miscue analysis procedure described by Goodman, Watson and Burke (1987). As miscue procedures are not standardised, rather short hand codes are used to indicate whether the student omits, substitutes or reads words inaccurately, it is contingent on the examiner to apply the code correctly and interpret the student's reading performance in accordance with the number of grapho-phonic, semantic and syntactic errors.

Yopp-Singer Test of Phonemic Segmentation (Yopp, 1995)

The Yopp-Singer Test of Phoneme Segmentation is a non-standardised test used to measure a child's ability to "separately articulate the sounds of a spoken word in order" (Yopp, 1995, p. 21). The twenty two item test includes a teaching period during which children are provided with support and guidance as the assessor models the appropriate response. When testing commences the assessor continues to give feedback to the child. This component of the test, which is not usual practice in tests of phonological awareness, is an attempt to ensure the child has the best chance at success, and does not perform badly simply because they misunderstand the task.

In a previous study Yopp (1988) undertook to compare tests of phonemic awareness and examine the reliability and validity of each. Yopp examined the

Yopp-Singer Test of Phoneme Segmentation (Yopp, 1995) and reported it had a reliability score (Cronbach's alpha) of .95. Yopp (1988) argued that the test could be used in the assessment of individuals as the reliability of the Yopp-Singer exceeded reliability co-efficients reported by other researchers .85 (Hills, 1981) and .90 (Jensen, 1980). Yopp (1988) also reported analyses that showed the Yopp-Singer Test is a valid measure of phonemic awareness. A factor analysis etermined construct validity.

Developmental Spelling Test

The Developmental Spelling Test (Tangel & Blachman, 1995) is a measure of invented spelling. The Year 1 version consists of ten words dictated in set order in isolation and embedded in sentences so that the test follows the same format as classroom spelling tests. The words (*lap, sick, elephant, pretty, train, hunt, kissed, street, order*, *snowing*) are each scored on a 7 point scale from 0 (random letter string) to 6 (correct spelling), out of a total score of 60 points (see Appendix F).

The revised ten word DST (Tangel & Blachman, 1995) was used here because the subjects had completed Kindergarten. Based on the development of the five and ten word version of the Test, and the writers' research to validate both measures, they noted the rating scale has been shown to be sensitive to changes in students' ability to segment words into phonemes and orthographic knowledge. Furthermore the words in the test and scoring system represent a fair measure of beginning spelling across the broad range of ability evident in children in their first year of schooling (Tangel & Blachman, 1992). Tangel and Blachman (1995) reported Pearson correlation r=.999 p<.001 for the reliability of scores between assessors for the ten item version of the DST employed here.

4.3.2 Standardised measures

Test of Phonological Awareness (TOPA)

Yopp (1988) highlighted the impact different definitions of phonological awareness has had on the content validity of tests to measure this concept. Over ten years later the number of tests measuring phonological awareness has increased and Yopp's original arguments continue to be relevant. First, tests of phonological awareness test claim to measure the same phenomenon, but in fact tap a variety of skills, some of which, such as producing a rhyming word are known to be more challenging, while others, such as recognising when two words rhyme are easy. Yopp advised caution when interpreting and comparing research findings, and in particular drew attention to the validity of particular phonological awareness tasks.

In this study the relationship between phonological awareness, that is the ability to break words into their component sounds, and beginning reading and spelling is under investigation. Thus in the light of Yopp's comments, the primary reason for selecting the TOPA (Torgesen & Bryant, 1994) from the large range of available tests, was because this test measures the ability to identify individual sounds within words presented as wholes. This is also the reason that in this study phonological awareness, measured by the TOPA, was the covariant. Phonological awareness correlates with reading and spelling and is considered a pre-requisite (e.g., Nation & Hulme, 1997; Tunmer & Nesdale, 1985), however children commence Year 1 with varying ability in this area. Introducing a covariant removes the effect of phonological awareness from the post-test results so that variation in the dependent variables, spelling and reading ability, can be interpreted via the independent variable, the intervention *Let's Decode* (Formentin, 1992a). Further, that the TOPA reports in standard scores, can be administered as a group test and features a 'child friendly' format with pictures, also influenced selection.

There are two versions of the TOPA and the Kindergarten version was used here. The TOPA – Kindergarten measures awareness of beginning sounds in words and features two different subtests. The Initial Sound-Same subtest requires children to mark which of three words begins with the same sound as the stimulus word. The Initial Sound-Different subtest requires children to mark which word in a group of four begins with a different first sound from the other three words. Each subtest contains 10 items that are added to reach the raw score that is converted to a standard score.

Torgesen and Bryant (1994), the authors of the test, maintain the TOPA meets the requirements of the American Psychological Association and reported the following measures of reliability. The TOPA yields standard scores that are sensitive to the time of the school year the test is administered for the kindergarten version. Coefficient alpha was .90 for the kindergarten version and total score reliability was reported by the authors as .91 (Cronbach's alpha) Yopp (1988). This evidence supports the internal consistency of the TOPA. Using time sampling over a 6 week time frame a corrected stability estimate of .94 was calculated. The average standard error of measurement for students in the age range five to six years was $SEM = 4.6$.

Torgesen and Bryant (1994) cited measures of criterion-related validity as further support for the TOPA. They correlated the TOPA - Kindergarten scores with scores from a measure of phoneme isolation at r=.66 and with a segmentation task at r=.47. The authors noted that while these other measures assessed analytic phonological awareness, they required a more explicit level of phonological awareness than did the TOPA. The TOPA – Early Elementary was also correlated with two subtests of the Woodcock Reading Mastery Test – Revised, Word Attack r=.66 and Word Identification r=.60. While not the TOPA version employed here, the reported correlations with the Woodcock subtests supports the authors' claims of the concurrent validity of the TOPA.

The final type of validity to be examined by Torgesen and Bryant (1994) was construct validity. The TOPA purports to measure children's sensitivity to the phonological structure of words and the authors reported three kinds of evidence for the construct validity of the TOPA. To summarise, the item types used on the TOPA - Kindergarten assess skills were shown to be central to the construct of phonological awareness. Of particular relevance to the design of this research, is a study cited by Torgesen and Bryant (1994) that examined the effect of a program of explicit phonological awareness on the performance of kindergarten children on the TOPA. The findings of the study reported the TOPA is sensitive to changes in student performance when training in the isolation of individual sounds in words is provided. Furthermore, Torgesen recently noted the TOPA was constructed to be most sensitive to children with weak development in phonological awareness, making it appropriate for identifying 'at risk' children (1998). In this study, student's pretest scores on the TOPA in conjunction with invented spelling performance were used to identify weak students.

The visual appeal and structure of the test was also a factor in its suitability for the Year 1 cohort. Each section of the test is preceded by a period of instruction in which children practise the item on which they are about to be tested. The Kindergarten version was used here and children were required to listen to a target word, isolate the first sound of the word and decide which of four words begin with the same or a different sound as the target word. Each word has a corresponding picture that acts as a cue and reduces the working memory demands of the test. Children draw a line through a box to make their selection.

Wide Range Achievement Test-Revised: Spelling subtest

The second measure of spelling ability to be used in this study is a measure of conventional spelling. As opposed to awarding partial marks for qualitative changes in spelling development, a measure with a dichotomous scoring system was selected to measure the accuracy of beginning spelling. Arguments against the examination of student writing samples for evidence of spelling ability influenced the selection of the invented spelling measure and also applied in this instance. In particular, that students may have copied text from peers or other sources was a significant factor. Thus, a dictated list of words was deemed the most reliable and expedient way of comparing the spelling performance of students.

Of the range of standardised spelling measures available the Wide Range Achievement Test – Revised (WRAT – R) was selected for three reasons. First, the items in the test include a range of words that all children in the cohort could be expected to spell correctly. At the same time the range of words also included items that those children who had received phonemic awareness training and systematic decoding instruction may be able to spell. For example, the first items in the test include short regular words such as *in*, *and*, *cat* and *must*. These words can be spelled by isolating each phoneme, matching it to a letter, and writing it down. The early items include the most common sound of all the vowels. Knowledge of letter combinations is tested by other items such as, *say, light* and *reach*, and application of the Cve rule is required to spell *make*. That there are no irregular words in the test or words requiring the application of rules for adding endings is important, because this information was not a feature of the intervention. The ability to break words into their component parts and the orthographic knowledge required to spell these words was taught systematically to the children in the Intervention Group, whereas this information was presented to the children in the Control Group in an incidental fashion.

The construction of the WRAT-R spelling subtest in three parts was another factor influencing selection. Students are required to copy 18 marks presented on the test form (18 points), print or write their name (2 points) and print or write 45 words to dictation (45 points). Words are dictated in isolation and embedded in sentences. Testing discontinues after 10 consecutive errors and spellings are scored either right or wrong. Thus, for the weaker students, copying shapes and writing their name were achievable, even if they were unable to attempt spelling any words.

Jastak and Wilkinson (1984) the authors of the WRAT-R reported median coefficients for Spelling range from r=.92 to r=.99, and cited moderate correlations between the California Achievement Test and WRAT-R Spelling.

The test-retest reliability of the WRAT–R Spelling relevant to the age of student included in this study was r=.97. Finally, that the WRAT–R reports in standard scores was essential for this study.

Woodcock Reading Mastery Test-Revised: Word Attack and Passage Comprehension subtests

The Woodcock Reading Mastery Test-Revised (Woodcock, 1998) is a battery of individually administered tests comprising of measures of reading readiness and various components of the reading process. Two subtests were used here in order to measure decoding ability and the comprehension of passages of text. On the Word Attack subtest students are presented with forty five nonsense words (letter combinations that are not actual words such as *dee, flig, vunhip*) or words that occur rarely in English (such as *pog, poe*) that when read aloud are used to measure phonic and structural analysis skills. The Word Attack test is individually administered, in an untimed condition and testing stops after six consecutive errors. The authors of the test maintain the pronunciation of nonsense words provides a valid indication of decoding ability because the words could not have been previously committed to memory (Woodcock, 1998). This view is supported by many reading researchers who, for some time, have regarded the use of nonsense words as both the most 'hygenic' (Ellis, 1994) and appropriate measure of phonological recoding ability (Hoover & Gough, 1990; Kamhi, Catts, Mauer, Apel, & Gentry, 1988; Pennington, 1991; Rack et al., 1992; Stahl & Murray, 1994; Stanovich & Siegel, 1994). The Passage Comprehension subtest is a modified cloze activity consisting of sixty-eight sentences or short paragraphs containing a missing word. Students are required to read each segment and supply the missing word. This procedure approximates naturalistic reading because passages are drawn from actual texts students may encounter. Further, students read the passage silently to themselves and may supply one of a number of acceptable responses to demonstrate comprehension.

The WRMT–R was renormed in 1998, but all test items and administration remained the same. The test manual reports adherence to standards stipulated by the American Psychological Association. The Internal consistency reliability coefficients were calculated for a Grade 1 sample and split-half reliability coefficients are reported as being r=.94 on the Word Attack subtest and r=.94 on the Passage Comprehension subtest.

As the model of reading on which this study is based is represented by the formula *reading = decoding x comprehension* (Carnine et al., 1997) the Word Attack and Passage Comprehension subtests are considered valid components of the reading process. In this study the Word Attack subtest measures the degree to which students apply letter-sound knowledge and the strategy of blending to reading unknown words. The Passage Comprehension subtest is a measure of whether the student understands what is read. Thus, from a philosophical perspective, it is because the WRMT–R measures these components of reading, and will discriminate between those students who did and did not receive the intervention, phonological awareness and systematic decoding instruction, that it was selected here.

4.3.3 Professional development materials

The intervention teachers were asked to purchase support materials to assist them to implement *Let's Decode.* These materials were: *Let's Decode Inservice Manual* (Formentin, 1992a), *Let's Decode Videotape* (Formentin, 1992b) and *Direct Instruction Reading* (Carnine et al., 1997).

4.3.4 Single Subject Design materials

To ensure consistency across subjects all instructions were scripted and to minimise practice effects all subjects wrote on the same topic (see Appendix K). To ensure consistency across all subjects children were provided with writing paper, a pencil and an alphabet chart. The practice items for word segmentation were the same for all students (see Appendix L).

Measure

An analysis of children's writing samples was undertaken and the total number of correct letters was recorded. A research assistant who was an experienced junior primary school teacher checked this analysis during and after the single-subject design.

Graphs

The total number of correct letters was graphed manually, on graph paper for each child every time a sample of writing was completed.

4.4 Data Analysis

4.4.1 Single Case Study

Research Question 1: Given evidence of a single Year 1 child's competent reading of text and samples of her written work, considered by the school to be significantly better than her peers, what evidence is there that this child could decode simple Year 1 words in isolation, segment those words into phonemes and spell the same words without assistance?

A qualitative descriptive analysis was undertaken to investigate: (i) whether Rosie's edited written work was actually advanced for her age, (ii) whether her ability to phonemically segment spoken words was commensurate with her ability to write stories, (iii) whether she could encode words she frequently used in her written work and, (iv) how well she could decode simple Year 1 words. Samples of her written work and scores, including miscue analysis are presented and evaluated in the results chapter.

4.4.2 Post-hoc Analysis

Research Question 2: Given that a cohort of Year 1 students received systematic decoding instruction in Year 1, will students classified as 'Good Decoders' (more than 1sd above the mean on Woodcock Reading Mastery Word Attack subtest) include any 'Poor Spellers' (more than 1sd below the mean on Wide Range Achievement Spelling Test) and if so, what evidence does their spelling performance show of the use of segmenting words into phonemes and letter-sound knowledge when spelling words?

Students were classified as 'Good Decoders' if they scored more than 1sd above the mean on the Woodcock Reading Mastery Word Attack subtest (1998). They were classified as 'Poor Spellers' if they scored more than 1sd below the mean on the Wide Range Achievement Test-Revised (Jasktak & Wilkinson, 1984). Students classified in these two categories were cross-referenced to identify any that were classified as both 'Good Decoders' and 'Poor Spellers'. It was planned to examine the Wide Range spelling data from such children to document the use of phonological segmentation skills and letter-sound knowledge, however, no children met the specified requirements.

4.4.3 Intervention Study

As the intervention study involved a number of different dependent variables statistical analysis of this aspect of the thesis utilised a MANCOVA with a single covariant (pretest scores on the TOPA). Consequently, use of the covariant permitted the partialing out of effects due to any differences in phonemic awareness evident at the start of the study. It also permitted the analysis of more than one dependent variable.

Analysis of the intervention study involved the pairwise comparisons listed in the following table:

Table 2 Data Analysis for Research Questions Three to Seven

Research Questions	**Data Analysis**
3. Will two classes of Year 1 students who receive systematic decoding instruction including phonological awareness (Intervention Group) achieve significantly better standard scores at the end of Year 1 on the Word Attack subtest Woodcock Reading Mastery Test than those of two other classes who did not receive such instruction (Control Group)?	3. MANCOVA: Analysis of difference at the end of Year 1 in levels of performance between IG and Control Group on word attack with TOPA as covariant. (Was the decoding instruction effective in teaching children to decode words?)
4. Will the Intervention Group achieve significantly better scores of invented spelling as measured by the Developmental Spelling Test than the Control Group?	4. MANCOVA: Analysis of difference at end of Year 1 in levels of performance between Intervention Group and Control Group on the Developmental Spelling Test with TOPA as covariant. (Was there a difference in spelling?)
5. Will the Intervention Group achieve significantly better scores of conventional spelling as measured by the Spelling subtest of the Wide Range Achievement than the Control Group at the end of Year 1?	5. MANCOVA: Analysis of difference at the end of Year 1 in levels of performance between Intervention Group and Control Group conventional spelling and invented spelling with TOPA as covariant. (Did systematic decoding impact on conventional and or invented spelling?)

6. Will the Intervention Group achieve significantly better standard scores on the Passage Comprehension subtest of the Woodcock Reading Mastery Test than the Control Group at the end of Year 1?	6. MANCOVA: Analysis of difference at the end of Year 1 in levels of performance between Intervention Group and Control Group on the Passage Comprehension subtest of the Woodcock Reading Mastery Test. (Did systematic decoding instruction impact on comprehension?)
7. Will four children (single-subjects) chosen on the basis of their pre-test TOPA scores and classroom Teacher's observations that they are poor spellers, two from the Intervention Group and two from the Control Group, show evidence of improved invented spelling following the introduction of explicit instruction in segmenting words into sounds combined with prompts to use these skills in spelling?	7. Qualitative analysis of invented spelling from a sample of children in the Intervention and Control Group at the end of Year 1. (Were there qualitative differences in spelling?)

4.4.4. Single-Subject Design

Research Question 8: Will four children (single-subjects) chosen on the basis of their pre-test TOPA scores and classroom Teacher's observations that they are poor spellers, two from the Intervention Group and two from the Control Group, show evidence of improved invented spelling following the introduction of explicit instruction in segmenting words into sounds combined with prompts to use these skills in spelling?

Daily data, indicating percentage of correct letters written, was graphed using standard arithmetic charting procedures. Data were analysed using descriptive summary statistics, visual analysis and the standards required for single-subject demonstration of experimental control across subjects and baseline-intervention conditions (Tawney & Gast, 1984).

CHAPTER 5
RESULTS

Research Question 1: Given evidence of a single Year 1 child's competent reading of text and samples of her written work, considered by the school to be significantly better than her peers, what evidence is there that this child could decode simple Year 1 words in isolation, segment those words into phonemes and spell the same words without assistance?

5.1 Case Study 'Rosie'

Data was gathered from a single student, given the pseudonym 'Rosie', over a two day period in the third term of her first year at primary school. Decisions about testing evolved from observations the present researcher made of Rosie's performance in a small group lesson on the first day, in particular her inability to blend, rhyme and segment words orally. At this stage an initial analysis of Rosie's diary writing and *Have-a-go-pad* was undertaken. The following day an assessment of Rosie's reading, spelling and phonological awareness was completed during a short session. This involved listening to Rosie read a book of her choice and completing a miscue analysis, then administering two non-standardised reading tests to examine Rosie's letter-sound knowledge and ability to read words in isolation. Rosie was then asked to write the alphabet and the first nine words from a standardised spelling test. Based on the present researcher's initial examination of Rosie's writing samples, a sentence comprising of correctly spelt words that appeared frequently in her diary writing was then dictated. Finally, a test of Rosie's ability to break spoken words into their component sounds was administered.

5.1.1 Evidence of reading competence

When asked to read her class reading book aloud Rosie read seventy one out of a possible seventy two words quickly and accurately. The text Rosie read was comparable in length and level of difficulty to other Year 1 reading books available for home reading in the classroom, and the subject noted that she had read most of these books. The language in the story was highly repetitive and the line *Wake up!* occurred twelve times. The names of characters were also repeated on each page. Although most words were no longer than four letters, started with different letters and were visually distinctive (e.g. *Kate, James, Nick*) only a small number were phonically regular in terms of the letter-sound knowledge of most Year 1 children after eight months of reading instruction. 'Regular' words are defined as those that can be decoded using the most common sound of letters e.g., *up* and *Dad.* Other words included in Rosie's reader e.g., *said* and *is,* are irregular. Each page featured illustrations of the text.

The only word Rosie was unable to read immediately was *said.* This word occurred on the first page of the book, but not again until the final page. It was when attempting to read this word the second time that Rosie stopped mid-sentence and looked at the word. She then turned back to the beginning of the book, looked at the picture, re-read the first page to herself, appeared to recall what the word was and returned to her place on the final page and read the word correctly.

5.1.2 Evidence of writing competence

Samples of Rosie's writing were analysed. The writing samples were diary entries completed during twenty minute independent writing sessions conducted three times each week (See Appendix A). Rosie wrote the diary entries during second semester of Year 1 before the researcher met her. Each of the writing samples averaged seven words with no spelling mistakes, e.g., *Today I'm going to swimming lessons* and *On the weekend I went to grandma's.*

5.1.3 Teacher report of Rosie's competence

Rosie's teacher described her as a 'talented' student who could produce written work superior to all other children in the class. The teacher noted, "every couple of years a student like this comes along...she is a delight to have in the class". This claim was validated when the samples were shown to a number of Year 1 teachers from other schools. When asked whether Rosie ever requested help, her teacher noted that she rarely asked for assistance, other than the spelling of an unknown word. In this instance, Rosie would spell the word as she thought it was spelt in her *Have-a-go-pad* and her teacher would provide the correct spelling if necessary. A number of words were repeated occasionally in Rosie's diary writing, and every entry was about a different topic. Rosie's teacher noted that Rosie always finished her work earlier than her peers and was an independent worker who required little supervision.

5.1.4 Evidence of ability to decode words

Rosie's decoding ability was assessed using two non-standardised tests. The Diagnostic Test of Word Attack Skills (Carnine et al., 1990; Formentin, 1992a) is a short decoding assessment that begins by testing basic skills. The first part of the test requires students say the sounds of letters. The letters are written in lower case and not listed in alphabetical order. Rosie provided the correct letter sound for twenty out of twenty six letters, however, of the sounds she correctly identified thirteen letters were identified first by name. The researcher prompted Rosie, "yes, that is the name of the letter, can you tell me the sound that it makes." The next part of the test requires students identify the sound of eight letters whose upper case version is different to the lower case (ie. *D, A, R, H, G, B, E, Q*). Again, Rosie provided letter names first, but successfully identified the sound of each upper case letter.

The next part of the test requires students to read regular words of increasing complexity in isolation. The first three words are VC (vowel consonant) words, the next six are CVC over half of which begin with a stop sound (ie. *cat, him*) and the final word type is CCVCC. As Rosie read each word she responded in one of two ways. She either appeared to recognise the word immediately (ie. *it, am, if, cat, him*), or attempted to sound the word out. It was when sounding out the words that Rosie made errors. She attempted to sound out words using a combination of the names and sounds of letters, and on the occasions when Rosie successfully identified the sounds of all the letters she was unable to say the correct word. For example, Rosie sounded *mad* correctly, then said *dad.* In this instance Rosie said each letter sound but paused between letters. Further examples of this behaviour were noted when Rosie correctly identified the sounds of the letters in the following words *sam, hot, tag* and *must* but was unable to join the sounds of the words together. The final word type Rosie attempted was CVCC and in total she attempted only half of the words in the test.

In the last section of the first part of the Diagnostic Test of Word Attack Skills (Formentin, 1992a) students read five common irregular words in isolation. Rosie responded in the same way observed in the previous section of the test. She either appeared to recognise the word immediately or attempted to sound out the word. Rosie correctly identified *the* and *was* quickly without sounding the word aloud. When sounding *has* and *put* Rosie identified the letters as a mixture of names and sounds and was unable to produce the target word. Rosie did not attempt *said* commenting "I don't know that one."

The next investigation of decoding required Rosie to read a selection of non-words similar to those in the Word Attack subtest of the Woodcock Reading Mastery Test-Revised (1998). Reading non-words measures the ability to apply letter-sound knowledge as a strategy to decode unknown words. These words were generated by the researcher during the assessment and written at the bottom of the previous test. Each word contained sounds Rosie had previously demonstrated she knew. The researcher prompted Rosie, "these are not real words, you have to sound them out". Despite knowing the letter sounds, Rosie was unable to read any of the non-words. These non-words included: *ap, und, han, flig, somp, slek.*

5.1.5 Evidence of ability to segment words into phonemes

Rosie was given the Yopp-Singer Test of Phoneme Segmentation (Yopp, 1995) and scored ten out of a possible twenty two items. The test is divided into two stages. Before formal assessment begins the examiner presents a series of trial items and demonstrates how to complete the task. This process is designed to demonstrate explicitly what is required and by the end of the test items children are expected to be able segment a word independently. The procedure for the formal test is the same. The examiner says a word, e.g., *dog* and asks the child, "tell me the sounds in *dog*". If an incorrect response is provided the examiner demonstrates the correct response, "listen *d / o /g*" and asks the child to repeat the correct response before proceeding to the next item.

Although Rosie was asked to "say each sound in the word" she attempted to spell words using letter names and was observed looking away. She gave the impression of visualising the spelling of words. For example, Rosie correctly spelt the words *red, she* and *that* using letter names, but was unable to segment these words into sounds. Rosie's other errors occurred when she segmented words using a combination of letter names and letter sounds, and omitted sounds altogether.

Rosie's *Have-a-go-pad* also provided evidence of her ability to isolate individual sounds in words (See Appendix B). In Rosie's classroom children use *Have-a-go-pads* to try to spell unknown words. It is accepted that children will not spell unfamiliar words correctly, and are encouraged to experiment and invent spellings in their *Have-a-go-pads*. Rosie's teacher was observed instructing the children to 'have a go' at working out the spelling of unknown words in the first column of their *Have-a-go-pad.* The students were then told to bring their *Have-a-go-pads* to the teacher who would write the correct spelling of the word in the column alongside. The teacher did not model how to isolate phonemes in words while issuing these instructions, but explained to the researcher that during whole class modelled writing activities how to segment words was demonstrated by thinking aloud and saying "I want to spell (target word) so I will have to work out the sounds in the word."

Rosie's attempt to 'have a go' at spelling a range of words revealed that in most instances she provided the correct first letter, but the sequence of letters that followed bore little resemblance to the target word. Short words such as *fly (fonuon)* and *has (heutee)* were represented by more letters than phonemes in the target word. At the same time, long words such as *butterfly (hapo)* and *swimming (stont)* were represented by too few letters. The pages of Rosie's *Have-a-go-pad* did not reveal any instances of phonetic spelling or one to one letter-sound correspondences. For example, Rosie's spelling of *love (lenum)* bears little resemblance to the target word other than the correct first letter and *tloe* bears no relationship whatsoever to the target word *will.*

5.1.6 Evidence of ability to spell words

After examining samples of Rosie's writing, including her *Have-a-go-pad* the researcher asked Rosie to spell words conventionally under test conditions (See Appendix C). The first nine words of the Schonell Spelling Test (Schonell, 1932) were dictated and comprised of a series of regular CVC (consonant-vowel-consonant) words. Rosie spelt *net, fun, top, hit* and *yes* correctly, but was unable to spell *can* 'caen', *rag* 'rog', *man* 'nes' and *land* 'len'. When asked to "say the sounds in *man"* Rosie said, "I don't know how to spell that word."

A selection of words that Rosie had spelt correctly in previous diary entries on more than one occasion were then dictated to Rosie. Rosie spelt *the* correctly, but *sleep* 'soni', *weekend* 'wneeto', *grandma* 'gomenst' and *swimming* 'sotmmeigin' incorrectly. When spelling *swimming* Rosie wrote the first eight letters then said, "it's a long word isn't it...I better put some more letters on."

At this point the researcher asked Rosie about her spelling. Responding to the question of how she spells words, Rosie explained she "just knows the words" or "finds the words". Asked where she 'finds' the words, Rosie explained she looked for words she wanted to write in her *Have-a-go-pad,* her daily writing pad or from the charts in the classroom. When she was unable to find a word Rosie noted "I ask the teacher or mummy and they write it down for me."

5.2 Post-hoc analysis

> **Research Question 2:** Given that a cohort of Year 1 students received systematic decoding instruction in Year 1, will students classified as 'Good Decoders' (more than 1sd above the mean on Woodcock Reading Mastery Word Attack subtest) include any 'Poor Spellers' (more than 1sd below the mean on Wide Range Achievement Spelling Test) and if so, what evidence does their spelling performance show of the use of segmenting words into phonemes and letter-sound knowledge when spelling words?

Data gathered to address this question was gathered from the Year 1 subjects in the last weeks of their first year at school. Reading data was provided by another researcher who required the results of the cohort's decoding ability for research purposes. The reading subtest was given individually approximately two weeks prior to the spelling test, that was given by research assistants overseen by the present researcher. Children were divided into small groups and the spelling test was administered over two consecutive mornings.

5.2.1 Students classified as 'good decoders'

Of a cohort 44 students six achieved a standard score more than 1sd above the mean and were classified as 'good decoders'. Of this group none were classified as 'poor spellers'. In fact, to the contrary, the 'good decoders' achieved all but one of the best spelling scores, and all scored at least 1sd above the mean (see Appendix D). Thus no students met the criteria of 'good decoders' and 'poor spellers'.

5.3 Multivariate Analysis of Covariance

SPSS (1994) was used to conduct a Multivariate Analysis of Covariance. Post-test data were analysed using a single co-variate (TOPA pre-score) and a 2 x 3 factorial design. The one independent variable had two groups, control and intervention. The three dependent variables measured the participant's standard scores on the tests of Word Attack, Passage Comprehension and conventional spelling (WRAT-R). The covariate measured the participant's standard score on the TOPA.

The following questions were addressed using this analysis:

> **Research Question 3:** Will two classes of Year 1 students who receive systematic decoding instruction including phonological awareness achieve significantly better standard scores at the end of Year 1 on the Word Attack subtest Woodcock Reading Mastery Test than those of two other classes who did not receive such instruction?
>
> **Research Question 5:** Will the Intervention Group achieve significantly better scores of conventional spelling as measured by the Spelling subtest of the Wide Range Achievement than the Control Group at the end of Year 1?
>
> **Research Question 6:** Will the Intervention Group achieve significantly better standard scores on the Passage Comprehension subtest of the Woodcock Reading Mastery Test than the Control Group at the end of Year 1?

5.3.1 Evaluation of assumptions

Univariate normality assumptions were not violated with the exception of the Word Attack subtest standard scores. The control group for this dependent variable had a bi-modal distribution due to nine subjects achieving the same score and falling outside of the distribution. These scores were not more than two standard deviations from the mean and were not considered outliers. The intervention group for this dependent variable had a moderately positive skew. This was not considered to be extreme and no outliers were present. Therefore, the scores were not adjusted. In addition, the strength of the multivariate tests will overcome these slight abnormalities (Weinfurt, 1995).

Multivariate assumption testing was then performed. Assumptions for homogeneity of variance and homogeneity of regression were not violated. No multivariate outliers were detected and no instances of multicollinearity or singularity between the dependent were found. As the assumption of linearity was met, the TOPA was deemed to be an appropriate covariate.

In this study the level of significance used to determine whether of not groups were different was $\alpha = 0.05$. Thus the probability of a Type 1 error, that is the likelihood that a significant difference is claimed where one exists, is 5 percent. However, where multiple comparisons are made as they were in this study, the probability of a Type 1 error increases.

As a matter of interest, an independent samples *t* Test analysis was also carried out to compare the TOPA pre and post test results for the Control Group and Intervention Group. At pre-test the difference between the two groups was not significant. At post test the difference was significant ($p < 0.05$). The Intervention Group gained over one standard deviation on the TOPA from pre to post test, while the Control Group gained a little over one-third of a standard deviation.

5.3.2 Major Analyses

Multivariate tests of variance indicated significant effects for group (control versus intervention), $F < .05$, Pillai's criterion =.577. Univariate F tests for each dependent variable were evaluated using a Bonferroni type adjustment, thus decreasing the chance of Type 1 error. Using the adjusted alpha of .017 significant univariant effects were found for Passage Comprehension (F=64.38, $p < .017$), Word Attack (F=133.63, $p < .017$), Conventional Spelling (F=98.99, $p < .017$). An examination of the means for all dependent variables show the intervention group scored higher than the control group on all measures as indicated in Table 3.

Table 3 Means and Standard Deviations for Word Attack, Passage Comprehension and Conventional Spelling

	Passage Comprehension		Word Attack		Conventional Spelling	
	CG	IG	CG	IG	CG	IG
M	81.97	102.13	90.58	115.30	110.86	127.53
SD	11.59	10.96	13.68	10.67	11.84	11.50

Results indicate the two classes of students who received systematic decoding instruction (Intervention Group) including phonological awareness achieved significantly better standard scores on the Word Attack Subtest Woodcock Reading Mastery Test-Revised than those of two other classes who did not receive such instruction (Question 3). The Intervention Group also achieved significantly better scores of conventional spelling as measured by the Spelling subtest of the Wide Range Achievement Test-Revised than the Control Group (Question 5). Furthermore, the Intervention Group achieved significantly better standard scores on the Passage Comprehension subtest of the Woodcock Reading Mastery Test-Revised than the Control Group at the end of Year 1 (Question 6).

5.4 Non-Parametric Tests

Research Question 4: Will the Intervention Group achieve significantly better scores of invented spelling as measured by the Developmental Spelling Test than the Control Group?

Ordinal scores were allocated for participant's performance on the invented spelling test. Non-parametric tests were used to analyse the differences in scores between the control and intervention groups. Pre and post scores of the Developmental Spelling Test (Tangel & Blachman, 1995) were compared using the Wilcoxon Signed Ranks Test. As expected the median rank for control group post scores was significantly higher than the median rank for the pre-scores, $z = -6.587$, $p<.05$. The median rank for the intervention groups was significantly higher than the median rank for the pre-scores $z = -6.336$ $p<.05$. Median and Range figures are shown in Table 4 and indicate both groups showed improvement.

In view of the nominal scale of data a Mann-Whitney non-parametric test was conducted on the post invented spelling scores for the control and intervention groups. With correction for ties and z-score conversion, the result was significant, $z = -8.157$, $p<.05$. Descriptive statistics are reported in Table 4.

Table 4 Means, Medians, Standard Deviations and Range Scores for Invented Spelling

Group	n	M		Mdn		SD		Range	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post
Control	40	12.90	33.97	14	38	8.49	12.56	30	58
Intervention	38	16.04	53.08	14	54	11.09	5.25	49	23

The standard deviation for control post and the intervention pre-scores are quite large and this is due to the spread of scores. Of particular interest is the post-test scores of the two groups. The control group reported scores in the range 0-58 whereas the intervention group scored in the range 37-60. A score of 37 out of a possible 60 indicates that all intervention students represented better than 50 percent of the total letters correctly, or made phonetically acceptable substitutions spelling the items. This result suggests the type of instruction the intervention group received may have developed their invented spelling ability.

> **Research Question 7:** Will there be evidence of greater use of phoneme identification and letter-sound knowledge in the invented spelling samples of children in the Intervention Group compared to the Control Group?

This research was designed to assess the effect of phonological awareness and systematic decoding instruction on measures of spelling and reading performance. A total of eight research questions were generated to examine discreet, but related aspects of this issue.

5.5 Qualitative Analysis of Invented Spelling Samples

The Developmental Spelling Test (Tangel & Blachman, 1995) was given to all participants at the beginning and end of Year 1 as a measure of invented spelling ability. Application of the DST rating scale involves assigning partial marks for each word attempted (see Appendix F). Scoring criteria are provided for each word and marks are allocated for representing the correct number of phonemes in words, substituting phonetically appropriate letters and using correct letters. Thus, a high score on the DST is an indication of a participant's greater use of phonological segmentation and letter-sound knowledge, and a low score a reflection of weakness in these areas.

The invented spelling samples of four students were selected to examine the relationship between the DST and phonological segmentation and letter-sound knowledge. To address this question in detail four students were matched before the intervention period and then their post-test results were examined. Two students matched on their initial DST scores deemed to be weak invented spellers and two strong invented spellers at the beginning of Year 1 were selected. One 'weak' and one 'strong' speller at the start of Year 1 was selected from the control and intervention groups respectively. The starting scores of the selected students are indicated below.

Table 5 Matching of Selected Students

DST Score Start of Year 1	Group	
	Control	Intervention
'Weak'	Tess DST 0	Luke DST 0
'Strong'	Kelly DST 30	Beth DST 30

5.5.1 Students considered 'Weak Invented Spellers'

The student selected from the control group given the pseudonym 'Tess' (CBF8) and the student from the intervention group 'Luke' (IAM4) both scored zero on the DST at the beginning of Year 1. The students were within two months of each other in age. The student from the control group attempted all ten words, and her responses are a combination of random letters, numbers and 'squiggles' across the page (see Appendix G). The student from the intervention group only attempted the first five words and his response included random letters, shapes resembling letters and a drawing (see Appendix H). Neither student showed evidence of segmenting words into phonemes or matching letter-sound knowledge to the target word. Some letters were correctly formed, but occurred randomly. The most highly occurring letters such as 'L', 'N' and 'T' were also in the students' names. An alphabet prompt was provided on the test paper for students to find and copy letters, however, the letters in the invented spelling samples did correspond to the target word and were most likely copied at random.

At the end of the year both these 'weak' students completed the DST. Tess (CBF8) attempted all 10 words and scored one out of a possible score of 60 (see Appendix G). Her responses were a combination of random letters, repeated letters that are included in her first name and shapes resembling letters. None of this student's responses to the first five test items represented words, that is, sequences of letters found in written English. For example, words one, four and five include letter strings neither related to the target word, or found in written

English (ie. 'ttt'). This student's single letter response 'e' to the second word *sick* is different to her typical response of letter strings, however, this response is not considered an example of phoneme segmentation according to the DST rating scale. Instead, the single letter response 's' or 'k' would be evidence of isolating a sound in a word. In the second half of the spelling test Tess produced invented spellings that represented words. For example, her response to the word *street* as 'frag' stands out as a closer representation of written English than any of Tess' other invented spelling attempts. However, despite this orthographic string of letters resembling English, the letters do not correspond with the target word. Tess' only attempt to be awarded any marks was 'nuttttu' for *hunt*. She scored one mark for this response because the letter 'n' represents some salient part of the word other than the initial phoneme but is followed by a random string (Tangel & Blachman, 1995). Given the frequency of Tess' repetition of the letters 'u', 't' and 'n', it would be impossible to conclude she had actually isolated any sounds in the word *hunt*. At the end of Year 1 Tess maintained her position as one of the weakest invented spellers in the control group. Tess' results and the results of the three other selected students are represented graphically below.

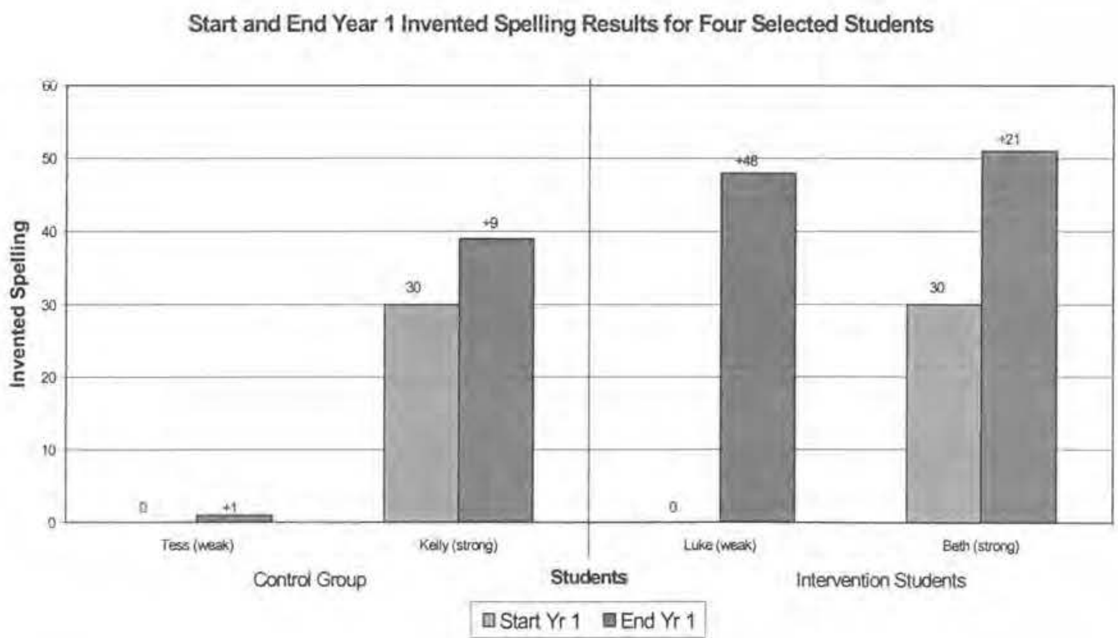


Figure 10 Bar graph Showing Start and End Year 1 Invented Spelling Results for Four Selected Students

At the end of Year 1 the invented spelling responses of Luke (IAM4) the 'weak' student from the intervention group scored a possible 48 out of 60 marks (see Appendix H). This score reflects Luke's ability to isolate sounds in words and match sounds to letters. He spelt two words correctly, *lap* and *hunt*. Five words were awarded near perfect scores, for example, 'sic' for *sick*, 'elefent' for *elephant* and 'prity' for *pretty*. Luke's spelling of these three words indicates he was able to isolate all sounds in the target word, but did not use all the correct letters to represent all the sounds. His spelling of the word *kissed* as 'cest' and 'ordr' for *order* is a strong indication he was able isolate the phonemes in each word and represent each using the correct letter-sound combinations, or a phonetically reasonable alternative. At the end of Year 1 Luke remained one of the weaker students in the intervention group, where the weakest score overall was 37 out of 60 marks. Luke's invented spelling samples indicate considerable improvement in phoneme segmentation and letter-sound knowledge.

Thus, there was a clear difference between these two subjects by the end of Year 1 in phoneme segmentation and letter-sound knowledge evident in the spelling samples gathered to measure invented spelling.

5.5.2 Students considered 'Strong Invented Spellers'

The student from the control group 'Kelly' (CAF5) and the student selected from the intervention group given the pseudonym 'Beth' (IBF11) both scored 30 on the DST administered at the beginning of Year 1 and were within two months of each other in age.

Kelly attempted all ten words, and her responses were a combination of correct letters, phonetically appropriate substitutions, intrusions; that is, letters included in the invented spelling but not in the target word, and unrelated strings of letters (see Appendix I). Kelly spelt one word *lap* correctly and scored partial marks for 'odr' for *order* and 'traenn' for *train*, 'sk' for *sick*. These three invented spellings indicate she was able to isolate most sounds in the target word and match these sounds to the correct letter, or a phonetically appropriate substitute. The remaining words indicate Kelly's difficulty isolating and representing phonemes in longer words and the following words scored two or three marks, 'pee' for pretty, 'elrf' for *elephant* and 'sret' for *street*. Kelly's attempt at *kissed* scored zero because she produced a string of unrelated letters. These invented spellings indicate she had difficulty consistently isolating sounds in words with one response unrelated to the target word. Yet, other invented spellings such as 'traenn' indicated Kelly's ability to isolate and correctly represent all phonemes in the target word.

Beth, the 'strong invented speller' from the intervention group attempted all words, spelt none conventionally, but scored between two and four marks for her invented spellings (see Appendix J). Her invented spellings included some intrusions, omitted sounds and phonetically reasonable substitutions. For example, the student omitted phonemes in the following words 'elfe' for *elephant* and 'snw' for *snowing*. Other invented spellings such as 'oder' for *order* and 'stoot' for *street* suggest Beth did not know how to represent a particular sound correctly.

Thus, analysis of the DST papers of both students considered 'strong' invented spellers showed a competent level of phoneme segmentation and letter-sound for students at the beginning of Year 1.

At the end of the year both students completed the DST again (Tangel & Blachman, 1995). Kelly, the student from the control group (CAF5) achieved a pre test score of 30 and a post test score of 39 (see Appendix I). She attempted all ten words and scored between three and five marks for each invented spelling. The student's invented spellings included phonetically reasonable substitutions with some phonemes omitted. For example phonemes were absent in 'elpnt' for *elephant* and 'piri' *pretty* and 'sret' for *street*. Compared to her performance at the beginning of the year, this student did show some improvement with select words, but this was inconsistent. Kelly's invented spelling responses indicate that her lack of letter-sound knowledge, in particular, the letter combinations *ph, ee, or* and *ow* prevented her from achieving a higher score for each word. Despite this lack of orthographic knowledge Kelly demonstrated she was able to isolate and represent the majority of sounds, albeit inconsistently in most words. At the end of the year Kelly was no longer the highest achieving student and had slipped in the ranking with 26 students achieving the same or better scores on the DST.

Beth (IBF11), the student from the intervention group achieved a pre test score of 30 and a post test 51 at the end of Year 1 (see Appendix J). This student spelt four words correctly and scored mostly four and five marks for each invented spelling. These scores indicate she was able to represent all the phonemes in the target words with the exception of 'elpant' for *elephant.* Lack of orthographic knowledge indicated by Beth's spelling of 'kised' for *kissed*, 'pritee' for *pretty* and 'ordur' for *order* prevented the student from achieving a higher score. At the end of the year this student held her position as a 'strong' invented speller. Her invented spelling samples were very close to the target words, there was no evidence of intrusions and she omitted one phoneme in ten words. Thus Beth demonstrated superior ability segmenting phonemes and applying letter-sound knowledge at the end of Year 1 to Kelly, her matched student from the control class.

The invented spelling scores of students from the intervention group indicate evidence of greater phoneme segmentation and letter-sound knowledge than the control group. This was demonstrated by data analysis conducted for Question 7 and illustrated in Figure 10. In addition, the analysis of invented spelling samples from these four students also showed the students in the intervention group, considered to be 'weak' and 'strong' invented spellers, demonstrated greater phoneme segmentation and letter-sound knowledge than the control group at the end of the year. The degree of improvement in phoneme segmentation and letter sound knowledge was most evident in the weakest performing students.

> **Research Question 8:** Will four children (single-subjects) chosen on the basis of their pre-test TOPA scores and classroom teacher's observations that they are poor spellers, two from the Intervention group and two from the Control

group, show evidence of improved invented spelling following the introduction of explicit instruction in segmenting words into sounds combined with prompts to use these skills in spelling?

This question requires the examination of each single subject's performance across baseline – treatment conditions in order to document whether or not there is evidence at the individual subject level of the impact of treatment, particularly with children identified at the outset as 'weak spellers'. First the rationale for single-subject design will be summarised then descriptive evidence of each child's performance over baseline and treatment conditions provided.

5.6 Single-subject design

Single-subject designs feature repeated measurement over time of student behaviour with and without some sort of intervention, program or change of conditions. The rationale of single-subject designs is similar to group designs: comparison on performance under different conditions. In single-subject designs the individual generally acts as his or her own control. This eliminates the need to match or equate experimental and control subjects. Single-subject designs begin by establishing baseline data (represented by the symbol A). This is collected over a series of days and before any intervention (represented by the symbol B) occurs. It is essential that a 'stable baseline', that is, a level of performance that is constant, is established, for two reasons: First, it describes the existing level of performance and provides a point of comparison when the intervention is introduced. Second, a baseline (A^2) functions as a basis for predicting the level of performance in the immediate future if all conditions remain the same. Thus, after the introduction of a new condition, with all other conditions remaining the same, any change in behaviour can be attributed to the intervention. Further, a stable baseline predicts what would have happened if no intervention occurred.

Once a stable baseline has been obtained for each subject intervention may begin. The process of data collection continues to determine if the subject's performance departs from baseline performance. Data is usually collected on at least fifteen occasions and is graphed to indicate treatment periods. A single treatment or different treatments are introduced to monitor the difference in subject's responses. Single-subject designs permit the examination of functional relationships between independent and dependent variables under conditions where the only variable that changes is the introduction or withdrawal of treatment.

5.6.1 Multiple baseline design used in this study

In relation to the present study, a period of stable baseline followed by an intervention period was implemented and graphed with four separate subjects. The replication of baseline and treatment conditions (AB design) for each subject at different stages enables an examination of the replication of the effect of the intervention across different subjects. While some subjects may begin with a generally lower score than others, a general trend associated with the introduction of the treatment variable can still be clearly demonstrated. Because all other conditions remain the same this change in level of behaviour can be attributed to intervention. When this pattern is replicated over further pairs of subjects evidence of the efficacy of intervention is strengthened.

While the multiple baseline design is not as rigorous as a reversal design (ABA), ethical considerations are of paramount importance when considering the withdrawal of treatment. The use of a multiple baseline design in the present study ensured that subjects were not exposed to withdrawal of intervention when there was evidence that the intervention condition was associated with improvement.

In this study, data collection consisted of written responses to a set topic for 15 minutes three mornings a week for five weeks for two students from the control and two from the experimental group. Each student was seen individually. Writing was analysed after each session and the percentage of total correct letters recorded and graphed using arithmetic precision teaching charting procedures. This data was graphed manually and provided a visual indication of changes in performance. Data collection procedures during nontreatment (A) and treatment (B) conditions were exactly the same for each student. Nontreatment involved introducing the set topic followed by a short period of discussion, then the student was given 15 minutes to write as much as they could with no adult support.

Students from the intervention and control group were paired, with the second student in each pair replicating the AB design. Treatment consisted of teaching the students to segment a set list of words (see Appendix L) using the format for segmentation from *Let's Decode.* Before the student commenced writing they were prompted to 'listen for the sounds'. If they asked for help they were again prompted to 'listen for sounds' and 'do your best'.

5.6.2 Description of behaviours associated with introduction of explicit instruction in single subject design

The first student to commence treatment was given the pseudonym 'Will' (CBM3). This student's baseline scores indicated a median score of 71.5% correct letters with a range of 62-81%. Compared to the other students Will was the strongest speller and his baseline writing samples showed he attempted all words, spelt most small high frequency words such as *I*, *like*, and, *the* correctly and almost always included the first one or two letters in most words he attempted that were unknown. For example, 'behk' for bedroom, 'grid' for green, 'we' for went and 'crton' for cartoon. Longer words presented a greater challenge to this student as indicated by 'buduna' for brother, 'codlll' for called and 'padcd' for played. During this baseline phase, Will showed some evidence of isolating the first sounds in words, however, there was limited evidence that he was able to sustain this process when words attempted were unknown and longer.

When the treatment phase for Will commenced there was a gradual, but sustained increase in the percentage of letters he successfully represented in words. As each treatment session followed this student's score improved, peaking at 92%. The median score in the treatment phase was 82% and the range 78-92%. Visual evidence of this upward slope was apparent upon examination of the student's graphed data. Evidence of improvement was also apparent in the quality of Will's invented spelling as he completed each writing task (see Appendix M). In particular, the two writing samples gathered after explicit phoneme segmentation instruction combined with prompts showed this student attempting to represent a greater number of sounds in words. For example, 'frend' for *friend* and 'sandwihs' for *sandwiches.* Spelling of the word *because* gradually improved from 'bec' (Nontreatment 1), 'becs' (Treatment 1) to 'becos' (Treatments 3, 4, 5, 7, 10). Further instances of improved phoneme segmentation were apparent in the invented spellings of unknown words the student attempted. The nature of the writing topics discouraged students from using familiar words in their writing and the student attempted to spell a number of challenging words. He spelt 'acsdant' for *accident* (Treatment 4), 'cusols' for *castles* (Treatment 5), 'nerge' for energy (Treatment 7) 'mewsic' for *music* (Treatment 9). It was while attempting to spell each of these unknown words Will was observed to pause and say the words slowly out loud. Will progressed in a systematic manner through all the sounds in each word writing down a letter or letters for each he isolated. This behaviour was not observed during the baseline phase and commenced when the intervention began. By the seventh treatment session Will informed the researcher "you have to listen for the sound if you want to spell a word you don't know how". After the fifth treatment session Will's teacher had noted his spelling had improved in unassisted written tasks and asked to observe the present researcher working with the student.

The second student commenced treatment after 11 baseline sessions. This student given the pseudonym 'Les' (CAM14). Of all the single subjects Les was the weakest at spelling. His median score during baseline was 21% correct letters with a range of 17-33%. Les' baseline writing samples were shorter and the first letter usually represented words but was followed by a string of phonetically appropriate substitutions or unrelated letters. For example Les wrote, 'MI f is saf' for *my family is small,* 'M M C M C' *my mum cooks macaroni cheese* and 'M B S R M' for *my bedroom is really messy.* During the period of nontreatment it was apparent that Les did not know how to write some alphabet letters. Les was the only single subject to closely examine the alphabet chart provided at each session and say out loud on occasions "which one makes the rrrr (sound)?" This process of trying to locate letters occurred arbitrarily, that is, on occasions the sound the student was looking for did not relate to the target word. This behaviour was noted, but no assistance was given. During the intervention period after being taught to segment words orally, Les tried to locate a letter for a sound he had successfully segmented, the researcher pointed to the correct letter if asked. For example, during the first intervention session the prompt to 'listen for the sounds' resulted in Les isolating the second vowel and all consonants of the word *football*. Les looked at the alphabet chart, but was unable find the letters to match the sounds. The researcher pointed to the letters and the student wrote 'fortbl'. The same procedure was repeated for the word *weekend* (Treatment 2) and the student wrote 'wkennd'. Compared to Les' performance during the nontreatment period, it would appear that despite poor knowledge of letter-sound correspondences, he was able to isolate a greater percentage of sounds per word once he was taught to segment words orally.

The third student 'Mat' (IAM15) repeated the pattern of improvement shown by Will. Mat's median score in the baseline phase was 58% and the range 50-73%. Like the first student, Mat showed an immediate change in the correct letters represented in words jumping from 55 to 81% after the first intervention session. Mat maintained and increased this score to 91% remaining within one point of this score when the intervention period was complete (see Appendix N). Mat's nontreatment spelling samples showed omitted medial and final phonemes in words 'pl' for *playing*, 'bfiwda' for *birthday* and 'faf' for *favourite*. When treatment commenced, Mat showed a noticeable improvement segmenting and spelling these same words 'plaing' for *playing* (Treatment 3) and 'brthday' for *birthday* (Treatment 5). Other examples of this improvement include, 'tekse' for *Trixie* (Treatment 1), 'basetball' for *basketball* (Treatment 3) and 'purtie' for *party* (Treatment 5). This student's writing samples are shorter than those submitted by the first student. As well as his reticence to write, Mat also required constant prompting during the treatment sessions to segment words. Despite this, there was clear evidence of improvement in the number of phonemes Mat isolated and correctly spelt during intervention sessions. His median treatment score was 69.5% correct and the range 42-75%.

The final student to commence treatment was given the pseudonym 'Ben' (IBM3). Ben's median baseline score was 57.5% correct letters and the range 40-68%. Ben repeated the pattern of improvement demonstrated by the other single subjects by showing an immediate change in the correct letters represented in words. During the thirteen nontreatment sessions Ben represented most consonants in words and omitted some vowels (see Appendix P). He also had poor letter-sound knowledge, for example, Ben was able to isolate most sounds in *football* spelling the word as 'fbal', but not knowing how to make the vowel sound, omitted it. When the treatment sessions began Ben was prompted to listen for the sounds and was noted to repeat the process of segmenting words orally, something not observed during the nontreatment period. When this occurred Ben isolated and represented more sounds in words, for example, 'wekend' for *weekend* (Treatment 1) and 'berthda' for *birthday*. Ben's median treatment score was 85% correct letters and the range 81-86%.

Thus, each of the four single subjects identified as 'poor spellers' at the start showed evidence of improved invented spelling following the introduction of explicit phoneme segmentation instruction combined with prompts to use these skills in spelling.

5.6.3 Single-Subject graphs

The results of the multiple-baseline design are represented graphically. Fifteen data points were collected and the percent correct letters obtained by these students are recorded in Appendix Q. Students belonging to the intervention and control groups are paired. The vertical line between points denotes the start of treatment and permits visual scrutiny of the baseline data against the intervention.

Figure 11 shows the multiple baseline design across two Control Group students, 'Will' and 'Les'. Before a student was introduced to the treatment phase it is necessary to ensure they have a 'stable' baseline. In practice, this means a baseline that is either flat in general trend or decreasing. Treatment was introduced to 'Will' after four baseline points. 'Les' the student from the control group, stayed on baseline conditions and his baseline continued much as before. In contrast, 'Will's' scores showed a steady increase. When the treatment phase was introduced for 'Les' he also showed a clear increase in percent correct letters. This increased score associated with treatment was replicated across two independent subjects is taken as evidence of the effectiveness of the treatment.

Examination of the multiple baseline design across the two Intervention Group students shows the same pattern of results. Figure 12 shows the immediate and clear change in scores following the introduction of the treatment condition. It is also useful to examine the median scores and range of scores for each of the single subjects in the baseline and treatment phases. Table 6 shows the contrast between scores in baseline and treatment conditions for each child.

Table 6 Percent Correct Letters: Median Scores and Range for Four 'Weak' Spellers

		Median		Range	
Group	Student	Baseline	Treatment	Baseline	Treatment
Control	'Will'	71.5	82	62-81	78-92
	'Les'	21	69.5	17-33	42-75
Intervention	'Mat'	58	85	50-75	81-91
	'Ben'	57.5	85	40-68	81-86

5.6.4 Sensitivity to instruction

These results indicate that the intervention had a significant effect on the quality of the invented spelling produced. As the pattern of improvement was replicated over the pairs it is unlikely that another variable, such as classroom instruction, contributed to this outcome. Thus it appears that irrespective of the knowledge and skills each subject brought to the task of spelling, subjects from the intervention and control groups responded positively to the introduction of explicit phoneme segmentation instruction combined with prompts to use these skills in spelling.

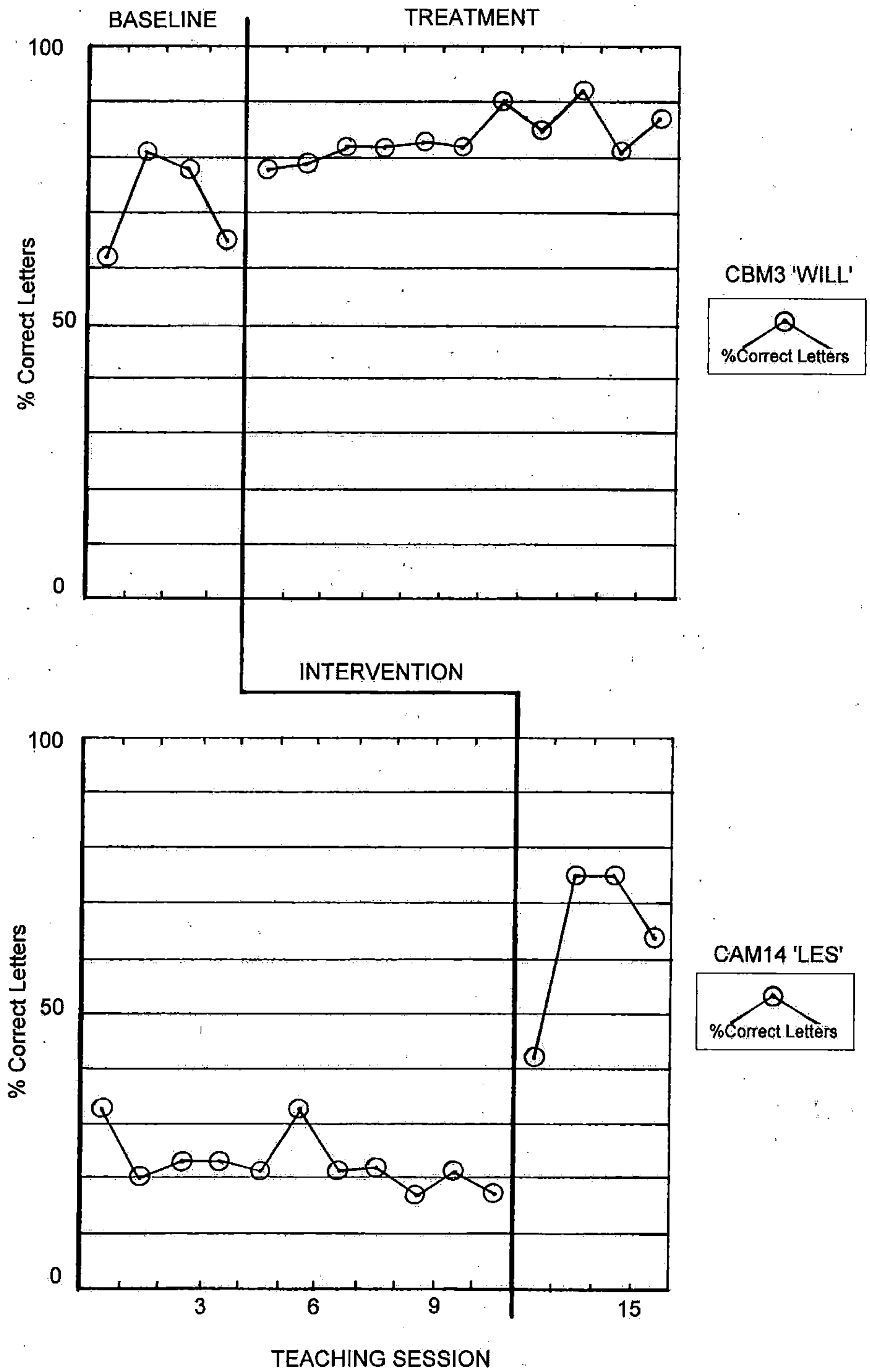


Figure 11 Percent Correct Letter Scores Before and During Phonological Segmentation Instruction for Control Group Single Subjects

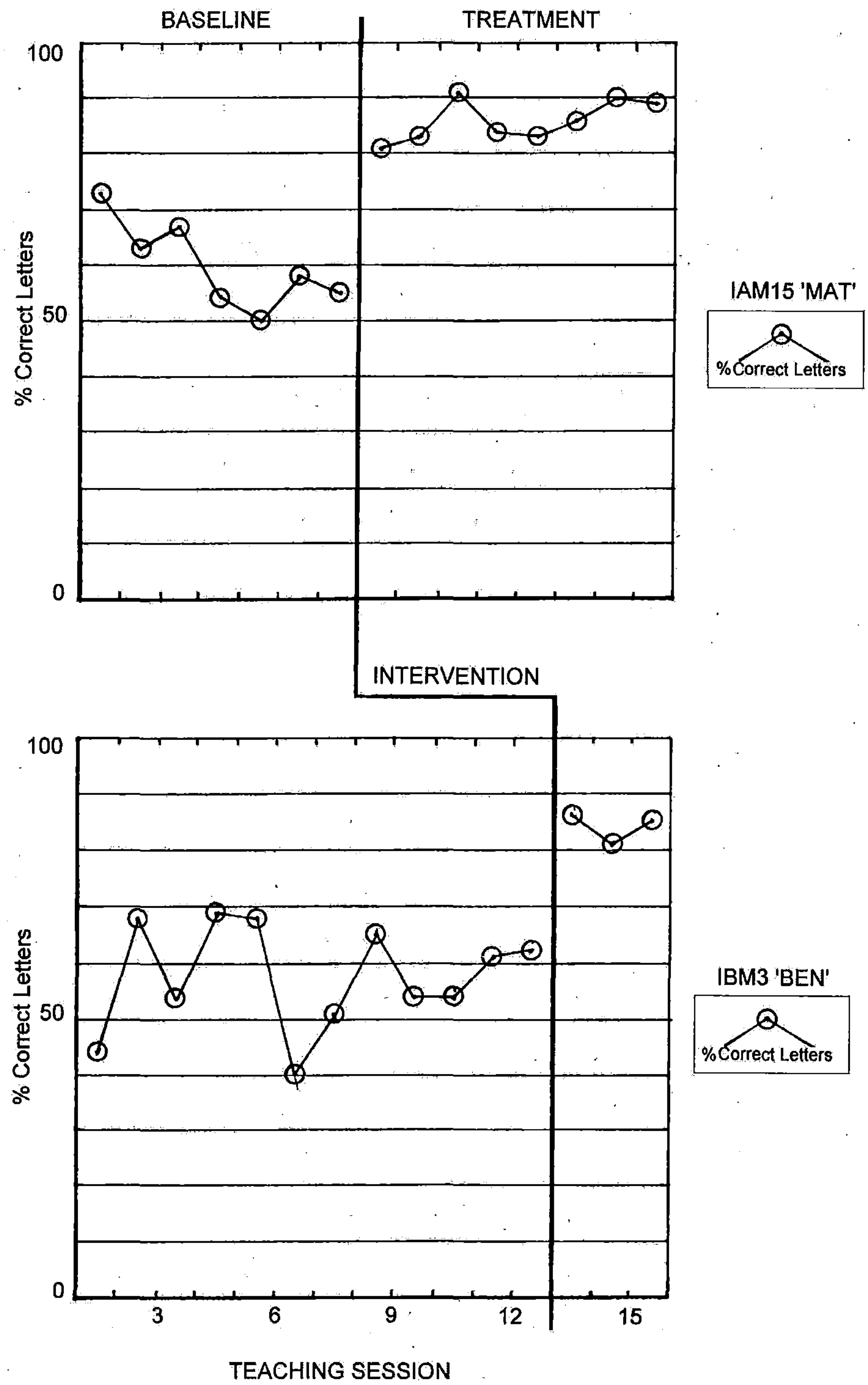


Figure 12 Percent Correct Letter Scores Before and During Phonological Segmentation Instruction for Intervention Group Single Subjects

CHAPTER 6
DISCUSSION

The central theme investigated in this thesis is the relationship between spelling and reading. More specifically it focussed on the relationship between early reading and spelling in a context where the approach to early reading instruction included systematic phonological awareness and decoding instruction. In particular whether skills attained as a consequence of learning to read transfer to the process of learning to spell was examined.

Before undertaking a detailed discussion of the findings of the studies reported here, it is useful to outline briefly the step-by-step deductive process from which the research design developed. The first step was unplanned and involved a case study in which no research control conditions were possible although data collection was undertaken with objectivity and a curiosity about the relationship between early reading and spelling. This case study led the author to formalise questions concerning the relationship between the early development of reading skills and spelling.

In order to explore variables influencing beginning reading and spelling further, data was gathered from a setting where children had received systematic phonological awareness and decoding instruction in a study by another author. By collecting post-test data on two additional measures, both measures of spelling, it was possible to explore further the relationship between early reading achievement and two measures of spelling: invented spelling and conventional spelling. This second step was also limited due to the lack of control conditions. It did however, lead to the third step: the formulation of a series of Research Questions 3-8, set in the context of the research literature, to investigate in a rigorous manner the relationship between the development of early reading and spelling.

The main study reported in this thesis was an investigation in a natural school setting of the reading and spelling skills of two sets of students – two classes of students who received systematic phonological awareness and decoding instruction compared to two classes who did not. The design of such a study raised a number of serious challenges to internal validity, brought about by a number of factors, namely:

- ethical constraints that prohibit random allocation of students to different educational conditions. As a consequence it was not possible to establish true experimental and control groups.
- ethical constraints that restrict the amount and nature of data that can be collected from young children. In this instance it was not appropriate to subject each child to lengthy testing on standardised reading (i.e., the Woodcock Reading Mastery Test) and conventional spelling measures (i.e., the Wide Range Achievement Test) prior to the commencement of formal instruction in literacy. There is a high probability that the collection of such pre-test data would amount to a negative experience for most children.
- psychometric limitations of pre-test data, had it been collected, where the majority of students could be expected to gain scores of zero. From a statistical perspective it is necessary to have variability in data in order to meet the assumptions on which statistical tests of difference are based.

On the other hand, it is important to use the most powerful procedures possible to control for differences between groups before the intervention is introduced and to provide conditions for the control group to compensate for extra time and attention to students that result form the intervention condition.

In the study reported here a covariant, the Test of Phonological Awareness (TOPA) was administered as a pre-test because phonological awareness has been reported consistently in the research literature as a close correlate of both reading and spelling, the two variables of interest here. This measure is particularly suited for this purpose because it is a standardised test that produces standard scores suitable for statistical analysis. It is also age appropriate and therefore it is less likely that an individual child will find the testing process a negative one. Use of the TOPA permitted comparison, using an Analysis of Covariance, of the reading and spelling performance of classes that did and did not receive systematic phonological awareness and decoding instruction in Year 1.

The issue of extra time and attention provided to the intervention group was also addressed in the design of the main study. Instructional time dedicated to literacy activities was equivalent for both control and intervention groups. The intervention condition was provided within the regular scheduled time for literacy activities and care was taken to ensure this did not result in increased time to this area of the curriculum.

The issue of possible increased time-on-task during the scheduled literacy sessions was impossible to control. It is a feature of direct instruction pedagogy that time-on-task is maximised and as a consequence, differences in performance that favoured the intervention group may have been, at least in part, brought about by this variable. The intervention condition in this study, *Let's Decode* (Formentin, 1992) is a complex approach to teaching early decoding strategies and includes a number of different variables, each of which may contribute to the overall impact. These variables include: scripted lessons, sequenced introduction of skills and reading materials, a mastery learning approach with close monitoring of student progress and clearly articulated strategies for correcting errors, clear procedures for providing feedback and acknowledging performance.

An investigation of the contribution of specific features of the *Let's Decode* instructional package was outside the scope of this thesis. However, it was possible, given that both pre and post test data from the TOPA were collected to gain some information relevant to the effect of the intervention used in this study. That is, the significant difference in phonological awareness between the two groups at the end of the study, not evident at the outset, suggests the intervention package was responsible for the difference in TOPA post test scores. The fact that the magnitude of the growth in phonological awareness for the intervention group was also in the order of one full standard deviation compared to a little over one third of a standard deviation for the control group adds further support.

Just the same, this study did not require a demonstration of a causal relationship between the intervention condition and the performance of the intervention group It did require groups of students with significantly different levels of reading achievement at the end of Year 1, i.e., differences in beginning reading development, in order that an examination of the relationship between reading and spelling could be undertaken. It was anticipated, based on the outcomes of previous research by Formentin and others (Formentin & Hammond, 1997; Formentin, Hammond, & Elderfield, 2000; Formentin et al., 1994), that use of *Let's Decode,* would be associated with superior reading achievement at the end of Year 1. Furthermore, *Let's Decode* includes explicit teaching of phonological skills and letter sound correspondence, two variables that have been reported in the research literature to correlate closely with the successful development of beginning reading.

While it was not the central focus of this thesis to examine the role of *Let's Decode* in teaching Year 1 students to read, it was of secondary interest to analyse the relationship between reading achievement, spelling achievement and the intervention condition, particularly in light of the inclusion of explicit phonological awareness instruction contained in it. Using the covariant, that is pre-test scores on the TOPA, to adjust for any differences in entry level, the effect of systematic instruction in phonological awareness and letter-sound correspondences on measures of beginning reading and spelling was examined in Research Questions 3, 4 and 5.

The purpose of Research Question 3 was to establish whether or not there was a significant difference in the ability to decode non-words between the two groups at the end of Year 1 in order that the relationship of that difference to spelling could be examined.

The purpose of Question 4 was to establish whether or not there was also a significant difference in invented spelling, and Question 5 a significant difference in conventional spelling, between the two groups. If there was, then the spelling and reading results could be examined to investigate the relationship between them. This investigation was carried out under Research Questions 7 and 8 in which the use of phoneme identification and letter-sound knowledge of individual students in the two groups was examined more closely.

Question 6, which focused on reading comprehension, was of more general significance. It was included to set the examination and discussion of the reading and spelling results obtained from the previous research questions in the context of 'meaningful reading' as distinct from lower level skills. This question provided an important 'anchor' to place the thesis in the broader context of reading research.

The rest of this chapter is devoted to discussion of the findings of the sequence of studies undertaken in the context of the literature reviewed in Chapter 2 and the theoretical framework outlined in Chapter 3. Implications for future research and educational practice are then provided.

6.1 Research findings

> **Research Question 1:** Given evidence of a single Year 1 child's competent reading of text and samples of her written work, considered by the school to be significantly better than her peers, what evidence is there that this child could decode simple Year 1 words in isolation, segment those words into phonemes and spell the same words without assistance?

This first question is based on a case study involving a child called 'Rosie'. The results of the case study showed that although her teacher considered Rosie to be an advanced reader for her age she actually had limited understanding of the alphabetic principle and little idea of how sounds map onto letters. Rosie's *Have-a-go-pad* provided clear evidence of her inability to segment words into separate sounds. Rosie's data is aligned with research indicating a relationship exists between phonological awareness, the alphabetic principle and the ability to read and spell unknown words (Adams et al., 1998) and that these skills cannot be assumed to develop without adult intervention (Chall, 1983; Ehri, 1997; Gough & Hillinger, 1980).

When applied to the task of spelling unknown words 'by the ear' (Moats, 1995) the conscious ability to isolate the constituent sounds in words has been identified as critical (Goswami & Bryant, 1990; Perin, 1983). It appears that because Rosie could not isolate sounds in words, she was unable to approximate the spelling of unknown words. Goulandris (1994) observed the same behaviour and explained that it is the typically poor speller who does not "resort to these simple tactics, having not yet understood the invaluable spelling cues which can be extracted from a word's pronunciation" (p.408).

Yopp (1988), one of the authors of the test administered to determine Rosie's phonological segmentation skills investigated the relationship between phonological segmentation and the development of early literacy skills. Yopp analysed longitudinal data and determined the predictive validity of tests of phonological awareness with performance on tests that measured such skills as word attack and spelling. Yopp reported moderate to strong correlations of r=.62 (Word Attack) and r=.67 (Spelling) between the ability to segment sounds in words in Year 1 and decoding words and spelling in Year 2. This reported correlation is of significance to the present study because a student who scored poorly on the Yopp-Singer Test of Phoneme Segmentation (Yopp, 1995) would be likely to be weak at encoding and decoding words. Rosie demonstrated this pattern of difficulty.

In the same way that encoding (spelling) words depends on an awareness of the relationship between phonology and orthography, decoding words (a component reading skill) is contingent on an appreciation of the 'alphabetic principle': that when blended together the sounds of letters in written words approximate spoken language (Liberman & Shankweiler, 1979). Rosie showed no evidence of the ability, or awareness of the necessity, to hold and "smoosh" (Adams, 1990 p.75) sounds together. To further exacerbate her difficulties with reading unknown words, Rosie confused letter names and sounds. In Rosie's case this pattern of difficulties revealed a poor grasp of the alphabetic nature of written English in conjunction with an inability to isolate, blend and accurately identify the most common sounds of letters.

The approach Rosie applied to reading and spelling words positioned her at what Frith (1980) referred to as the 'logographic' stage for reading and spelling. Reading and spelling at the logographic stage is almost totally dependent on memory for whole words and salient visual cues such as a letter or the shape of the word (Chall, 1983; Ehri, 1987). Children at the logographic stage of reading and spelling do not analyse words as sequences of letters (Frith, 1980). While Rosie's performance indicated she was applying some early 'alphabetic' stage strategies, such as isolating and writing the first sound then a string of unrelated letters to spell a word and using partial letter-sound cues to assist her memory of whole words (Ehri, 1997), her typical strategy was logographic. When examined in the context of neurological models of literacy development Rosie's whole word reading and spelling was consistent with right cerebral hemisphere processing (Galaburda, 1993; Joseph, 1993) and she was yet to make what some writers refer to as the 'giant intellectual leap' into left cerebral hemisphere processing (Preen & Townsend, 1992). This transfer is characterised by the perception and processing of word parts, such as "rhymes, consonant vowel syllables, nonsense syllables...and single phonemes" (Joseph, 1993, p.169). As Rosie was unable to attend to the phonological properties of language when reading or spelling words she relied on holistic cues mediated by the right hemisphere to read and spell words. This stage of literacy development has also been identified and described by dual route theorists as 'lexical' word processing (Barry, 1994). What is most significant about the logographic stage, irrespective of whether it is described as a neural or cognitive process, is that the individual is reliant on storing and recalling words as wholes, rather than utilising the alphabetic structure of language to transcribe words in and out of printed form.

Rosie's persistent application of whole word 'logographic' strategies to read and spell words has ramifications that may limit her literacy development. Stage model theorists acknowledge that logographic reading and spelling is dependent on memorising words as units of knowledge (Ehri, 1987; Frith, 1980; Gough & Hillinger, 1980). Many words children confront in the early stages of reading and spelling are visually similar, such as *went* and *want*, and become increasingly so as the amount of print children read expands such as *money* and *monkey*. As well as having to store all known words in visual memory, something researchers acknowledge humans have a finite capacity for (Adams, 1990; Ellis, 1993), when new words for which the student has no lexical access are encountered it is unlikely the child will correctly identify the word without adult intervention (Byrne, Freebody, & Gates, 1992).

Rosie's inability to decode and encode words stands in contrast to an assumption underpinning the model of reading and spelling development put forward by Frith (1980). Frith argued that children spend longer at the logographic stage for reading than spelling, because it is harder to spell words by rote. She maintained that the inherent difficulty of spelling words logographically induces children to begin spelling alphabetically. It would appear that as arduous as the process of reading and spelling whole words from memory appeared to be, Rosie favoured this approach. Another component of Frith's model is the basic premise that alphabetic spelling facilitates the transfer of letter-sound correspondences and phonological awareness, to the process of reading. This transfer of skills was not evident in Rosie's performance because she lacked the pre-requisite skills; in particular phonological awareness and alphabet knowledge, to begin to read and spell alphabetically. This finding lends weight to the argument put forward by Moats (1995) that children are influenced more by instruction, or lack of it, when learning to read and spell than following 'developmental blueprints'.

The assumption made by Rosie's teacher that she was a skilled reader and speller raises a number of issues. Rosie's teacher identified her as a good 'reader' and 'speller' because of the way she interpreted the particular strategies this Year 1 student employed. Students who predict words using salient letter cues and the context of a text are characterised by those who subscribe to the Whole Language approach to literacy development as 'skilled readers' (Goodman, 1976; Smith, Simmons, & Kameenui, 1998). In contrast, other theorists believe that good readers are less likely to guess or predict words from context (Perfetti, 1985; Stanovich, 1986). Instead, they argue it is poor readers who are thought to rely on context because they are unable to systematically decode a word while skilled readers use context to verify the reliability of their decoding. Rosie's teacher described her reading and spelling program as "based on talking, reading and writing about meaningful literature" and evidence of teaching strategies outlined in *First Steps* (Western Australian Ministry of Education, 1995) were apparent. In short, the strategies Rosie used to read and spell words can be interpreted two different ways and it can be argued that the value Rosie's teacher assigned to her literacy behaviours gave Rosie no reason to change.

The belief that Rosie was a capable student is not in question, because she certainly demonstrated her resourcefulness and capacity to use alternative strategies, albeit complex and at times unsuccessful, to read and spell unknown words. However the view that Rosie was a proficient reader and speller was incorrect. This observation has ethical ramifications. Mis-classification of high achievers may set up false expectations about the ease with which they will perform on literacy related tasks; may determine the reading or spelling group into which they are placed; and most importantly, denies students with weak phonological awareness skills to access to appropriate instruction. While teachers generally accept that there will be some students who experience early difficulties learning to read and spell and require additional support, Rosie's experience suggests that supposedly able students, may in fact have areas of weakness.

While it is accepted that the majority of beginning readers will become aware of the alphabetic nature of the English language, regardless of the method of instruction employed (Liberman & Liberman, 1990; Tunmer, Herriman, & Nesdale, 1988) those students most at risk of failing to discover the 'alphabetic principle' without formal instruction, are generally thought to have limited pre-literacy experiences or be experiencing learning or language difficulties (Adams, 1990; Blachman, Ball, Black, & Tangel, 1994; Hill & Crevola, 1998; Kamhi, Catts, Mauer, Apel, & Gentry, 1988). This explanation clearly does not provide a true picture of Rosie's background and overall abilities. What Rosie's data do suggest is that it is dangerous to conclude on the basis of one literacy indicator that others, especially the critical variable of phonological awareness, is at a commensurate level.

Evidence of Rosie's difficulties in reading and spelling unknown words highlights the critical importance of phonological awareness, letter-sound knowledge and the strategy of blending to reading and spelling unknown words. Her data support the view that the ability to encode and decode words is dependent on shared pre-requisite skills, and phonological awareness and alphabet knowledge are central to both processes (Waters, Bruck, & Seidenberg, 1985). Thus, it is likely that this Year 1 student could neither read nor spell words independently because she lacked pre-requisite skills and knowledge.

While Rosie's reading and spelling performance support the critical role of phonological awareness and alphabet knowledge, the second research question provides a closer look at the relationship between reading, especially decoding achievement, and spelling achievement, this time based on the results of a cohort of Year 1 children from a single school who received the intervention *Let's Decode* (Formentin, 1992).

> **Research Question 2:** Given that a cohort of Year 1 students received systematic decoding instruction in Year 1, will students classified as 'Good Decoders' (more than 1sd above the mean on Woodcock Reading Mastery Word Attack subtest) include any 'Poor Spellers' (more than 1sd below the mean on Wide Range Achievement Spelling Test) and if so, what evidence does their spelling performance show of the use of segmenting words into phonemes and letter-sound knowledge when spelling words?

The results showed that not a single student met the criteria of 'good decoder' and 'poor speller'. This finding is supported by literature on the relationship between reading and spelling ability and also explained reported differences in performance in both abilities, most commonly the conundrum of apparently able readers, who are poor spellers.

When Frith (1980) noted that is was rare to find an individual who could spell well but could not read, she reasoned this was because reading words is easier than writing them down. She based her assertion on the argument that there are a variety of cues to assist with the recognition of words, such as a salient visual cue, the context of a text, or a picture. Words may be read correctly with the most limited information and fortuitous guessing, without necessarily applying the alphabetic code. By contrast, producing the spelling of a word is neither as instantaneous or facilitated as easily by the same cues used to recognise that word. For spelling the full letter-by-letter sequence must be produced. Similar observations that young children "read by the eye and write by the ear" (Frith, 1980) have been made by other researchers (Bryant & Bradley, 1980; Catalado & Ellis, 1990).

The hypothesis that it is possible to find 'good' readers that were 'poor' spellers was tested when Frith and Frith (1983) divided a group of twelve year olds into three groups, good and poor performers in both skills, and 'good readers' who were 'poor spellers'. Frith and Frith explained the dissociation between reading and spelling ability reasoning that 'atrocious' spellers had difficulty remembering spellings that did not conform to phonological rules because their development in spelling had arrested at the alphabetic phase, and they had not learned orthographic conventions.

The debate about good readers and poor spellers is fraught with issues about the way reading is defined and the assessment of reading that Frith and Frith applied to their three groups of students exposed a number of important issues. In the first instance, the writers defined 'good readers' as avid readers who were exceptionally precocious in learning to read and had never experienced any reading difficulties. The writers amended this definition when they found that the 'good' readers who were also 'good' spellers achieved comparable scores of measures of identifying single words, but the students who were experiencing spelling difficulties made twice as many errors decoding nonsense words. Thus, when reading real words it would appear the students in Frith's studies, as well as the single case study reported here, were able to utilise strategies other than systematic decoding to identify words and were therefore thought not to be experiencing reading difficulties. Had Frith and Frith (1983), by their own admission, defined 'good' reading in terms of the ability to identify unknown words the actual decoding ability of the cohort would have been considered a variable contributing to poor spelling.

In her model of reading and spelling development Frith (1985) described the way in which partial-cue reading may impede spelling development. To move beyond the alphabetic stage of spelling it is thought competent spellers must access a sophisticated repository of English orthography that is compiled and updated for the most part unintentionally during their interactions with print (Ehri, 1987; Seidenberg & McClelland, 1989; Templeton & Morris, 1999). This metaphorical storehouse of orthographical data in the brain provides information on orthography that governs the unconscious, but calculated choices individuals make when attempting to spell a word they have never seen before (Adams, 1990). Such an orthographic database cannot be established by partial cue reading alone and this has led others to conclude that the inability to systematically decode may contribute to poor spelling (Brown & Ellis, 1994; Ehri & Robbins, 1992; Moats, 1995; Snowling, 1994).

In the research reported here the post-hoc cohort who received phonological awareness and systematic decoding instruction and were classified as 'good decoders', showed no incidence of 'poor spelling'. This result supports the view that early decoding ability may make an immediate, as well as delayed contribution to spelling achievement (Ellis, 1994). This finding is also a replication of the 'good speller/good reader' classification Frith outlined in her research and evidence of the need to clarify in the research literature what is meant by the term 'good' reading when it is used to define groups of students.

In her studies of literacy development Frith observed and reported the strategies children apply to reading and spelling, whereas this study investigated the effect of teaching pre-requisites on measures of reading and spelling. After providing instruction in phonological awareness, alphabet knowledge and the strategy of blending, the spelling skills of the post-hoc cohort were comparable with their ability to accurately decode words. This evidence lends further weight to the view that reading and spelling are related in as much as the ability to encode and decode words is dependent on a similar set of pre-requisite skills which if taught explicitly yield positive results in measures of both abilities. While findings from the post-hoc data in this research and Rosie's case study provide a basis for this hypothesis, the strength of argument is open to question due to the lack of control conditions. In order to examine the effect of phonological awareness and systematic decoding instruction on reading and spelling development the results of the main study involving controls were examined.

> **Research Question 3:** Will two classes of Year 1 students who receive systematic decoding instruction including phonological awareness (Intervention Group) achieve significantly better standard scores at the end of Year 1 on the Word Attack subtest Woodcock Reading Mastery Test than those of two other classes who did not receive such instruction (Control Group)?

This study is underpinned by the assumption that reading and spelling are 'unnatural acts' (Gough & Hillinger, 1980) and children must be taught particular strategies to learn to read and spell such as phonological awareness, alphabet knowledge and the strategy of blending (Chard, Simmons, & Kameenui, 1998). These pre-requisite skills are included in *Let's Decode* (Formentin, 1992) the intervention featured in this study. However before any effect on reading and spelling performance can be attributed to the intervention it is necessary to establish whether there was any difference between the ability of the control and intervention group to decode. In order to eliminate the possibility that the children were identifying words by strategies other than decoding, non-words are used to investigate this question.

Results indicate the two classes of students who received systematic decoding instruction including phonological awareness achieved significantly better standard scores on the Word Attack subtest Woodcock Reading Mastery Test-Revised than those of two other classes who did not receive such instruction. This finding adds support to previous research on reading development that has shown explicit, systematic and intensive early teaching of phonics information is the most productive way to develop children's automatic word recognition skills (Adams, 1990; Bradley & Bryant, 1983; Juel, Griffith, & Gough, 1986; Snow et al., 1998; Stanovich, 1986). In particular the superior performance of the intervention group strengthens previous research findings that strategies in *Let's Decode* effectively teach children how to decode unknown words (Formentin & Hammond, 1997; Formentin et al., 2000; Formentin et al., 1994). This finding also has implications for the larger body of research on instruction-centred approaches.

Since Adams (1990) concluded that phonological awareness and systematic decoding were important components of the reading process momentum has gathered and recently the National Reading Panel recommended that these skills are essential and should be taught explicitly to all children (Panel, 2000). The Panel investigated the effect of teaching specific components of phonological awareness and alphabet knowledge that children require to decode words and concluded that phonological segmentation, letter-sound correspondences and the strategy of blending were paramount. As *Let's Decode* (Formentin, 1992) has been proven to be very effective in teaching these pre-requisite skills the superior decoding performance of the intervention group was not surprising.

The National Reading Panel reported that beginning reading approaches that included explicit and systematic teaching of phonics produced superior reading results than programs that did not. This finding is not new, and was first asserted when Jeanne Chall (1967) wrote *Learning to read: The great debate.* The concepts and strategies included in *Let's Decode* (Formentin, 1992) are not new either. *Let's Decode* is an approach that explicitly and systematically develops decoding and phonic analysis subskills and complies with the Panel's findings that systematic phonics instruction in the early years of schooling must begin with foundational knowledge involving letters and phonological awareness. Evidence of the efficacy of *Let's Decode* has been shown in a Western Australian context and is supported by the findings of other studies that report similar interventions based on a task-analytic approach to reading. Namely that children should be taught essential pre-requisites in a logical order and to mastery; and practice decoding strategies (Adams & Englemann, 1996; Chard & Dickson, 1999; Snow et al., 1998; Stahl & Murray, 1998; Torgeson, 1998). What is unique about *Let's Decode* is that the strategies are designed to fit within teachers' existing language programs. In the case of the post-hoc study and the main intervention study reported here the teachers who introduced *Let's Decode* continued to teach meaning-based strategies. A brief overview of the differences in reading instruction follows.

While the teacher of both control and intervention groups all received professional development, the control group in the main study only received instruction aligned to the child-centred approach to literacy instruction commonly known as Whole Language. The intervention group received *Let's Decode* (Formentin, 1992) in addition to the same type of language development activities observed in the control classrooms. The main difference between the two groups was the systematic and explicit way that phonological awareness, alphabet knowledge and the strategy of blending were presented to the intervention group. While the control teachers were observed reading a rhyming story aloud and asking children to identify rhyming words, the concept of rhyme was not taught explicitly. Similarly, the teaching of letter-sound knowledge was presented mostly in the context of meaningful literature and sometimes in isolation. When treated in isolation the control teachers were observed telling children both the name and sound of the letter. Again, no explicit instruction or evidence of children learning letter-sound knowledge to mastery was observed. Finally, the control teachers conducted big book sessions each morning whereby a text was read aloud to, and with the children. This included the teacher demonstrating a number of ways of identifying unknown words. Children were told in the first instance to "read around words" or "look at the first letter or a picture for a clue", and then if they could not work out the difficult word to "try and sound it out". Teachers modelled how to sound out words, but both control teachers were observed stopping between sounds resulting in a staccato rendition of words such as *m.a.n*, rather than blending sounds together as *mmmmmaaaaannnnn.*

In recent times many researchers have championed the need in schools to balance the components of reading instruction (Adams, 1991; Chall, 1989; Salvia & Ysseldyke, 1998; Stacey & Wheldall, 1999), but the logistics of melding two different approaches appear to have thwarted successful integration (Snow et al., 1998). Assertions that the inclusion of phonological awareness and alphabet knowledge in Whole Language programs is either tokenistic (Stahl, Duffy-Hester, & Stahl, 1998) or excessive (Smith, 1999) typifies the response from code-emphasis and meaning-emphasis practitioners when approaches are 'married' (Beilby, 1994). However the results reported here show these two approaches can be reconciled and produce positive literacy outcomes: phonological awareness and systematic decoding instruction when combined with meaning-emphasis reading activities, produced superior outcomes than meaning-emphasis strategies alone.

The National Reading Panel (2000) also investigated the optimum time for phonological awareness training and reported that programs of approximately eighteen hours in total, lasting no more than 25 minutes per session, produced superior outcomes than shorter or longer treatment. Put simply, phonological awareness instruction need not consume long periods of time to be effective. However, as the Panel noted, the explicit nature of the instruction is critical. In this study, the time allocated per day (average 15 minutes) of phonological awareness was the single difference between the instruction provided to the intervention group. The intervention teachers taught phonological awareness in isolation and to mastery for at least the first ten weeks of Year 1, and then combined phonological awareness training with systematic decoding instruction. The time spent teaching phonological awareness and the explicit nature of the delivery of the instruction, particularly when combined with alphabet knowledge and the strategy of blending complies with the conditions outlined by the National Reading Panel as likely to produce superior results. Thus it seems certain that the superior decoding performance of the intervention group can be attributed to the content and instructional design of *Let's Decode* (Formentin, 1992).

The comments of the research assistants who administered the non-word decoding test also support this finding. They noted, without conferring, that many of the control group children had attempted to decode the non-words using letter names, a combination of letter sounds and names and random guessing. This suggests that despite incidental instruction in alphabet knowledge the control group were unable to read words they had never seen before. Snow, Burns and Griffin (1998) highlighted the necessity to teach letter sounds first, then letter names, but to show children explicitly how to 'sound out' words. The writers noted that incidental instruction that required students to infer how to decode words independently was insufficient, and as evident by the results reported here, likely to confuse students.

These anecdotal observations and the data provided by the Word Attack subtest of the Woodcock Reading Mastery Test–Revised (Woodcock, 1998) would be rejected by some researchers on the grounds that reading non-words is not a valid measure of reading ability. Cotter (1988) discussed this issue and concluded that the WRMT–R was a highly reliable measure of reading. Salvia and Ysseldyke (1998) reviewed the previous edition of the WRMT–R and reported the Word Attack and Passage Comprehension subtests correlate highly with subtests measuring similar reading skills. Jaeger (Institute, 1994) reported similarly favourable finding and his only concerns pertinent to this study were related to the issue of non-words. Further, Mann, Tobin and Wilson (1987) used the WRMT-R in studies of the relationship between phonological awareness, beginning reading and invented spelling and noted the word attack subtest correlated with phonological accuracy as measured by invented spelling, $r(48)=.59$, $p<.0005$. The view that learning to read words improves children's ability to spell words has been consistently put forward by Ehri (1980; Ehri, 1985; Ehri, 1989) and following on from Mann et al's findings, the next area investigated in this study is whether differences in spelling performance can also be attributed to the effects of decoding instruction.

Research Question 4: Will the Intervention Group achieve significantly better scores of invented spelling as measured by the Developmental Spelling Test than the Control Group?

The results of this study showed that the invented spelling of the intervention group was superior to that of the control group. It is accepted that young children who are restricted by their limited print experience will 'invent' or approximate the spellings of words they have not seen before. The superiority of the intervention group's results reported here suggests the type of instruction they received may have developed invented spelling ability. This result is similar to the outcome of Tangel and Blachman's (1992) study of children from low-income inner-city schools who had extremely limited knowledge of the alphabet in preschool. The writers reported that those children who received phonological awareness training and letter-sound correspondences produced superior invented spellings than their control peers. The writers argued that this was mainly due to learning the pre-requisites to spell alphabetically. These findings, and the results reported here relate specifically to the relationship between early reading and spelling development and also form the basis to examine the invented spelling performance of individual children.

The ability to invent spellings is dependent on two essential skills: phonological segmentation and alphabet knowledge (Ehri, 1989; Griffith, 1991). As the intervention teachers implementing *Let's Decode* (Formentin, 1992) taught phonological segmenting and letter-sound relationships explicitly it could be inferred that the relationship between reading and spelling is simple and children who can systematically decode can apply the same pre-requisite skills to spelling. Rosie's data support this position because she was unable to apply the alphabetic code to reading or spelling. However, the relationship is not as straight forward as it may at first appear.

The group of children who received *Let's Decode* were taught to segment words into constituent phonemes explicitly so that they could understand and apply the alphabetic principle to reading, not spelling words. At no stage were the post-hoc cohort or intervention group from the main study prompted to apply this strategy to spelling. As the quality of the control group's invented spelling was weak by comparison, it is likely that knowledge and skills included in *Let's Decode* transferred to spelling ability. In order to examine this issue in more detail it is necessary to consider how teachers explained the process of invented spelling.

The way in which all the teachers introduced the use of *Have-a-go-pads* was recognised as an important variable and the lesson during which this occurred was observed. Each teacher demonstrated the procedure for invented spelling by saying words aloud, isolating sounds and writing letters down. The teachers modelled how to spell unknown words during whole class writing sessions, but at no stage during writing lessons were children taught explicitly how to segment words. This approach was consistent across both intervention and control groups. The intervention teachers continued to teach *Let's Decode* strategies during times prescribed for 'reading' and they programmed similar meaning-based activities to teach reading and writing at other times during the day. It would therefore appear that the children who received the intervention *Let's Decode* transferred these skills to spelling on their own initiative because teachers did not link the format for segmenting words with the process of invented spelling.

This finding raises issues about the efficacy of introducing *Have-a-go-pads* without explicit instruction in phonological segmentation and letter-sound correspondences. The National Reading Panel (2000) reported that while encouraging children to invent spelling supported phonological awareness development and early spelling achievement, it was preferable to teach children how to segment words into phonemes and to teach alphabet knowledge explicitly. The Panel also noted that it was critical to help children to make the connection between phonological awareness and reading and writing and suggested that the effect of such explicit instruction could have a significant impact on children's performance. The readiness of children to make the connection between phonological segmentation skills taught in the context of reading to spelling is examined in much greater detail in the single-subject case design (Research

Question 8). In the meantime, issues pertaining to the measure of invented spelling will be examined.

Interest in children's early spelling development began to appear in the literature as researchers became aware of the need to find a system to measure the qualitative changes in 'invented' or phonetic spelling observed in children's spontaneous writing samples (Beers & Henderson, 1977; Read, 1971). Scales were developed that not only rated errors according to children's partial knowledge and finesse in naturalistic settings, but also measured their invented spellings of selected words that contained particular elements, such as preconsonantal nasals: the final two letters in the words *ha<u>nd</u>* or *ju<u>mp</u>*. This shift in emphasis came about as the developmental relationship between beginning spelling and reading was first investigated in the literature (Bissex, 1980; Chomsky, 1979; Clarke, 1988; Griffith, 1991; Richgels, 1986). Subsequent analysis of children's invented spellings enabled researchers to examine phonological awareness levels (Mann et al., 1987; Morris & Perney, 1984; Zutell, 1980), however the rating scales developed to measure beginning spelling gave little credit to lower level responses such as the representation of a word by a phonetically related letter (e.g., *dr* for *train*).

The measure employed here to capture and discriminate between the quality of children's beginning spelling was written by Tangel and Blachman (1992; Tangel & Blachman, 1995) and was chosen primarily because of the sensitivity of the rating scale to discriminate between early and advanced phonetic spelling ability. The more advanced words included a preconsonantal nasal, a three-consonant cluster, an r-controlled vowel and two inflections. Another important factor was the subject of the research Tangel and Blachman were investigating when they developed the test of invented spelling: the effect of phonological awareness training on beginning literacy development. The writers initially developed a spelling test containing five words selected to represent the early developmental spelling patterns noted by Read (1986). When this test was administered to pre-school aged children the writers concluded that children who received phonological awareness training outperformed the control children on measures of alphabet knowledge, word reading and invented spelling (Tangel & Blachman, 1992). This finding has particular relevance to the research reported here because phonological awareness training was shown to produce superior invented spellings (Tangel & Blachman, 1992; Tangel & Blachman, 1995). In a follow up study one year later, Tangel and Blachman (1995) expanded their original Developmental Spelling Test and rating scale to ten words to assess the spelling achievement of the same cohort of pre-school children after six months of Year 1. Again, superior spelling results were reported for those children who have received instruction in phonological awareness.

The subjective nature of quantifying children's invented spelling performance is another contentious issue. This was acknowledged by Tangel and Blachman (1992; Tangel & Blachman, 1995) and also considered a critical variable in the research reported here. Wary of the need to validate the scoring scale of their Developmental Spelling Test, Tangel and Blachman (1992) used two different methods to establish reliability. First, the percent of agreement between two assessors who analysed the invented spellings of a cohort of 149 children was calculated and found to be 93%. The second method involved computing the Pearson correlation between the scores of the two assessors. Based on 48% of the interrater reliability was r (69) =.98 p<.0001. Tangel and Blachman also reported that Ball and Blachman (1991) used the same scoring system and reported interrater reliability of r=.99 for this scale. Tangel and Blachman reported a reliability coefficient for their kindergarten sample on this measure of r=.98 and in an unrelated study McBride-Chang (1998) obtained internal consistency reliability of r=.93.

McBride-Chang (1998) also noted the Kindergarten version of the Developmental Spelling Test was a highly reliable measure of invented spelling ability. She reported the DST was stable over time and an appropriate assessment of spelling development because it took into account children's "multi-faceted linguistic awareness" and awarded partial scores for the representation of phonological and orthographical information (McBride-Chang, 1998, p. 148). In their description of the expanded Developmental Spelling Test for Year 1 children, Tangel and

Blachman reported the ten word version and accompanying rating scale was as robust as the original Kindergarten scale and reported Pearson correlation $r=.999$ $p<.0001$ for scores between assessors, and agreement between raters of 98.5% (1995).

In this study careful attention was given to the random selection of test papers for re-scoring and frequent discussions with the single marker to ensure all responses were scored correctly across the sample. Tangel and Blachman (Tangel & Blachman, 1992; Tangel & Blachman, 1995) noted that the majority of disagreement between markers surrounded unclear letter formation produced by the children. This issue was also the prevalent concern reported by the research assistant who scored test papers for this study and was addressed by stipulating consistent procedures. For example, a mixture of upper and lower case letters was scored the same as all upper or all lower case letters. As some scores allocated to the 'invented spellings' and unorthodox letter formations were not included in the rating scales provided by Tangel and Blachman, but were decided upon by consulting the scoring criteria, the scores reported in this study were consistent across the four classes. While this factor affects the generalisability of the research findings to other studies involving the Developmental Spelling Test, the majority of incorrect spellings were included in the list provided by the writers and the single marker followed this scale precisely.

As a means of addressing whether children have learned the spelling of a particular word because the word is known to them, or was recalled as a sequence of letters and not sounded 'by the ear', some writers have advocated the use of dictating non-words as an authentic measure of invented spelling ability (Ellis, 1994; Moats, 1995). This argument parallels debate about the importance of using non-words to test decoding ability 'purely'. At the same time the use of non-words to test spelling has been endorsed as an effective way of testing the encoding ability of older children who have greater experience with print than the Year 1 sample involved in this study (Moats, 1995). However, while the use of a non-word spelling test may have discriminated between those students with superior phonological segmentation and alphabet knowledge, the Developmental

Spelling Test did discriminate between children in this regard. Further, there was no evidence that the ten words were used regularly by children in their spontaneous writings or taught explicitly.

While considered a 'window' on children's early literacy development by some (Read, 1986), the qualitative assessment of children's invented spelling is not regarded as an appropriate measure of spelling ability by others (Groff, 1986). To address this issue and to further consider the effect of phonological awareness and systematic decoding instruction on accurate spelling, the conventional spelling results of the two groups will be examined.

> **Research Question 5:** Will the Intervention Group achieve significantly better scores of conventional spelling as measured by the Spelling subtest of the Wide Range Achievement than the Control Group at the end of Year 1?

The second aspect of spelling ability investigated revealed that the conventional spelling of the intervention group was significantly better than the control group. This finding, when taken in conjunction with the outcome of the previous question provides further insight into the relationship between reading and spelling development. Not only were the children who received *Let's Decode* better at spelling alphabetically, they could spell accurately as well. As the ability to spell conventionally is considered the final stage of spelling development this finding is important.

The premise underpinning Frith's Stage Model (1980) is that there is an alternating 'parasitic' relationship between reading and spelling development. Frith maintained that alphabetic spelling facilitates children's movement into the same stage for reading, and to enter the orthographic stage children must draw upon their knowledge of letter strings gathered at the alphabetic stage of reading while paying close attention to the sequences of sounds and letters. It would appear that according to Frith's model the superior conventional spelling performance of the intervention group may have been due in part to the transfer of knowledge from reading to spelling, in particular information acquired through the process of systematically decoding words.

Regular words can be written down using the most common spelling of the letter sound. It could be assumed that simply being taught the pre-requisite knowledge in order to decode words was sufficient to permit transference to spelling. Yet, this strategy would only work for the first 20 words on the test. However, letter combinations and generalised rules featured in the test items of the conventional spelling measure (e.g., the letter combination *igh* and the Cve rule) are included in *Let's Decode* (Formentin, 1992) and were taught explicitly by the intervention teachers. Thus, *Let's Decode* provided reading instruction which covered the word types in the spelling test.

Another way of interpreting the superior conventional spelling that takes into consideration the superior non-word decoding scores of the intervention group is the reading phenomenon coined the 'Matthew Effect' by Stanovich (1986). In his biblical reference to 'rich readers' getting 'richer' Stanovich argued that the early, rapid acquisition of reading skills including phonological awareness and the strategy of blending was the key to 'rich' readers. According to Stanovich early reading success fosters an enthusiasm for reading which in turn results in greater reading practice and 'richer' readers. In contrast to the upward spiral of development Stanovich described a category of 'poor' readers who experience early difficulties because of weak phonological awareness, are reticent to practise and spiral further downwards as they get 'poorer'. In a recent study of beginning readers Cunningham and Stanovich (1998) reported that "not only do the rich get richer in absolute terms, but in their levels of print exposure as well" (p.258). The writers described the reciprocal relationship between early reading success and print exposure as a 'positive feedback loop'. It would appear that given the reading success demonstrated by the intervention group it is possible that superior conventional spelling was the result of greater reading practice and exposure to words brought about by learning to decode. In either case, systematic decoding instruction has been shown to be critical to word recognition and related to the development of conventional spelling.

The relationship reported between the invented and conventional spelling ability of the intervention and control groups also suggests that *Let's Decode* may have contributed to the positive performance reported in both spelling measures. This relationship was first noted in the spelling performance of Rosie, the subject of the case study. Rosie was unable to invent the spellings of unknown words and could not spell supposedly known words without assistance. Rosie's poor level of phonological awareness and limited knowledge of letter-sound correspondences, lends weight to the view that not teaching these skills affects the development of invented and conventional spelling ability.

While the superior spelling performance of the intervention group supports the relationship between phonological awareness and systematic decoding instruction and conventional spelling, the selection of the WRAT–R raises issues concerning the reliability and validity of the test. The authors of the WRAT–R put forward only limited evidence in this regard. For example, median reliability coefficients for the Spelling subtest range from .92 to .99. The authors also claimed content and construct validity of the WRAT–R, citing moderate correlations between the California Achievement Test and WRAT–R Spelling (Jastak & Wilkinson, 1984, p.63). This was noted by Clarke (Institute, 1994) who argued the test has 'face validity' only. Harrison, cited in the same text, questioned the test-retest reliability, content validity and standardization procedures of the WRAT-R. In a recent review of the WRAT–R reviewers Salvia and Ysseldyke (1998) noted the test had adequate reliability, robust construct validity, but queried the test's content validity. In Harrison's view, which was a concern shared by other reviewers, the evidence put forward by the authors of the WRAT–R in support of content validity made it impossible to say whether the subtests "systematically and adequately sample the content taught in today's schools" (Institute, 1994, p.67).

These criticisms involve the use of the conventional measure of spelling and its appropriateness for making judgements and comparisons of performance between populations on all measures of the WRAT-R, rather than the actual words used in the Level 1 Spelling subtest. These issues are addressed as they apply to this study. First, the initial 30 spelling test items does discriminate between good and poor spellers and, in the context of this study, permit examination of the effect of the instruction variable. Second, determining the 'content validity' of any Year 1 spelling program is problematic in the present educational climate because teachers following a child-centred approach to spelling would not stipulate a list of words, rather, they would teach words in the context of meaningful print and allow children to select the words they wished to learn. Teachers adopting an eclectic approach that includes both child-centred and instruction-centred strategies may allow children to self select words but also teach a list of spelling words. These words may be from a particular word family or be unrelated and grouped thematically. In either case, in the author's opinion, the first thirty words of the WRAT–R are a reasonable representation of words Western Australian children in Year 1 might be expected to spell in a child-centred or instruction-centred classroom. Nolen and McCartin (1984) supported the appropriateness of the test items when they classified the misspellings of first through fifth grade students on the Wide Range Achievement Test–Revised. The writers reported the WRAT-R items tapped children's basic encoding ability as well as their varying knowledge of spelling patterns and rules. Nolen and McCartin also noted the test items the Year 1 children found easiest were among the most common high frequency and regular words determined by 'sight word' lists and analyses of beginning reading materials.

While these criticisms of the WRAT–R are duly noted, some concerns raised by the reviewers pertained to subtests other than spelling, and when the spelling subtest was criticised the advanced level spelling test was of interest, as opposed to the level used here. Moats (1995) summarised the sentiments of others when she noted "there is no perfect test of spelling commercially available" (p.76). While Moats proceeded to point out the relative strengths and weakness of the WRAT–R including concerns already articulated, it was her preferred choice throughout a recent text on spelling difficulties. As Clarke and Harrison cited in Buros (1994) both acknowledged, while the WRAT–R yields a limited sample of behaviour and is unsuitable for individual assessment, it remains one of the most popular research tools available to test basic skills (Institute, 1994).

The use of the WRAT–R in this study was employed to measure the conventional spelling of Year 1 children. Since the first 20 test items represent a valid range of words both the control and intervention groups would be expected to be able to spell as a string of letters from memory or systematically encode from sound to print, the measure is appropriate.

So far the discussion has centred on the decoding and spelling performance. In the long run, comprehension is the critical issue for educators.

> **Research Question 6:** Will the Intervention Group achieve significantly better standard scores on the Passage Comprehension subtest of the Woodcock Reading Mastery Test than the Control Group at the end of Year 1?

An important issue that has wider implications for the efficacy of systematic decoding instruction is the relationship between *Let's Decode* and the ability to comprehend text. The results of this study showed the intervention group demonstrated superior ability in this regard. This question is of critical importance because everyone, irrespective of theoretical position, regards reading comprehension as the goal of reading.

In a recent article Smith (1999) a child-centred reading theorist argued that systematic phonics and phonemic awareness constitute an 'educational hazard'. Over twenty five years ago the same author maintained that teaching children to master phonics and apply it when reading was one of the 12 easy ways to make learning to read difficult (Smith, 1973). Smith's comments encapsulate a central tenet of the child-centred philosophy to reading instruction: teaching children sub-skills is irrelevant because children learn to read, and understand print in the same way that they learn to talk and comprehend speech - naturally. Thus, from the child-centred perspective learning to decode is not only unimportant, but detrimental to children's literacy development.

The results reported here suggest otherwise and add to a large body of empirical evidence that supports the efficacy of teaching phonological awareness and decoding explicitly and systematically (Panel, 2000). Furthermore, the relationship between decoding and reading comprehension has established that children who can accurately and rapidly decode words are more likely to understand print than those that cannot identify words on the page (Gough, Juel, & Griffith, 1992; Samuels, 1976; Stanovich, 1986). Therefore, while systematic decoding instruction does not teach children how to understand text, reading comprehension depends first on fluent word recognition (Stanovich, 1991), then on language comprehension skills (Carnine, Silbert, & Kameenui, 1997). As the intervention group reported superior performance on two separate, but related measures: word attack and passage comprehension, it would appear that the children's reading comprehension performance can be attributed to *Let's Decode* (Formentin, 1992).

This result is the complete antithesis of the position put forward by child-centred reading theorists who argue reading is not decoding to sound. Smith (1999) argued this point vehemently when he claimed children do not learn to read by memorising whole sets of meaningless components that are "imposed systematically" that is, in Smith's view 'blindly' and 'mindlessly' (Smith, 1999, p.152). As the poor performance of the control group on measures of decoding and passage comprehension can be attributed, in part, to not receiving phonological awareness and systematic decoding instruction, Smith's comments in the context of this study are not supported. The reading instruction the control group received followed the principles of child-centred models, and this did not result in superior comprehension skills. Instead, systematic instruction in phonological awareness, letter-sound correspondences and the strategy of blending was effective.

Having established that reading comprehension was not limited by systematic decoding instruction, rather it was superior, we are able to return to the relationship between spelling and phonological awareness which was examined by comparing the results of two pairs of matched students, two from the intervention group and two from the controls.

> **Research Question 7:** Will there be evidence of greater use of phoneme identification and letter-sound knowledge in the invented spelling samples of children in the Intervention Group compared to the Control Group?

This question is central to this thesis. In order to examine the relationship between a child's level of phonological awareness, alphabet knowledge and the development of invented spelling, two students matched on their initial invented spelling scores, were selected from each of the control and intervention groups. Reference to Figure 10 (p. 179) showed the small gains made by the control group students in invented spelling over the year, irrespective of their starting position. By contrast the two intervention group students made large gains.

Given the statistically significant difference between the intervention and control group invented spelling, already discussed, the examination of individual children's invented spelling tests provides a more detailed picture of the effect of phonological awareness and systematic decoding instruction on the quality of invented spelling. These children were chosen as matched pairs of equivalent invented spelling ability at the beginning of the year.

The 'weak' students showed no evidence of phonological awareness and did not score on the measure of invented spelling at the start of the year. The student 'Luke' who received the intervention demonstrated a large improvement, that placed him in the average range for invented spelling achievement within the intervention group. The student 'Tess' by comparison showed a small improvement (one mark) on her invented spelling score and her position in the control group did not change. Tess was not an isolated case and this was indicated by the overall difference in invented spelling performance of the control group to that of the intervention group. The change in the quality of Luke's invented spelling may be attributed to the intervention.

Tess' difficulties appear, in part, due to an inability to isolate sounds in words and a limited knowledge of the alphabet. These behaviours were characteristic of the poorest performing students in the control group and fit the description put forward by Bear and Templeton (1998):

> There are very few invented spellings that cannot be understood, however occasionally a student's incomprehensible spelling is the result of frustration that leads the student to throw letters at the page and plug in letters to fill the space (p.238).

The second pair of students were chosen to represent 'good' invented spellers and demonstrated approximately the same level of phonological awareness at the beginning of the year (30 marks out of a possible 60). Kelly showed only marginal improvement (9 marks) compared to Beth, her match in the intervention group who improved by 21 marks. This result supports the argument that the intervention was the most likely cause of change in student spelling performance because all 'good' students from intervention group like Beth recorded a commensurately high level of improvement by the end of the year.

Considered together the results of the two 'weak' and two 'good' pairs of students permit a more detailed inspection of the effect of phonological awareness and systematic decoding instruction on invented spelling. It appears, and this is substantiated when compared to all students considered as 'good' and 'weak', that the intervention has a greater effect on 'weak' students than those considered within the average range at the beginning of the year, but resulted in a positive change in the invented spelling performance of all students.

Liberman and Liberman (1990) observed that up to 25% of students do not develop an understanding of the alphabet principle without explicit instruction. This is consistent with Luke's results because teaching him these skills resulted in an immediate improvement. This finding may be interpreted in a number of ways. The significant improvement of 48 marks by 'Luke', the weak student from the intervention group, is very likely because he lacked the pre-requisite skills required to invent the spelling of words, and the intervention provided these skills. By contrast, Kelly the 'good' control student entered Year 1 with adequate phonological awareness and alphabet knowledge, but she did not develop these skills to the extent that the average students in the intervention group did.

Another interpretation is that the 'good' spellers may not have shown a commensurate level of improvement as their 'weak' counterparts because there is a limited number of marks available (30) before the maximum is reached. In either case the data indicates that all students, irrespective of prior learning, benefit from phonological awareness and systematic decoding instruction in reading and spelling.

The examination of the spelling performance of the individual students also raises the issue of transference of phonological awareness and systematic decoding skills from reading to spelling words. It is assumed that the key skills required to invent spellings are the ability to segment words into phonemes and knowledge of letter-sound correspondences. Both control and intervention students classified as 'weak' began with no skills in either area, however, the intervention student managed to transfer knowledge he learned to read words to spell. These results support the position that alphabet knowledge transfers from reading to spelling. In order to investigate this issue more thoroughly, an examination of the relationship between teaching phonological segmentation and spelling was carried out using a single-subject multiple baseline design across four students.

> **Research Question 8:** Will four children (single-subjects) chosen on the basis of their pre-test TOPA scores and classroom Teacher's observations that they are poor spellers, two from the Intervention Group and two from the Control Group, show evidence of improved invented spelling following the introduction of explicit instruction in segmenting words into sounds combined with prompts to use these skills in spelling?

This question required the examination of the subject's performance across baseline and treatment conditions in order to document whether or not there was evidence at the individual subject level of the impact of treatment. Two 'weak spellers' identified by teachers were selected from the control and two from the intervention group in Term 3 of the school year.

The results showed that each of the four single subjects identified as 'weak spellers' showed evidence of improved invented spelling following the introduction of explicit phoneme segmentation instruction combined with prompts to use these skills in spelling. This finding is significant because it demonstrates the effect, in quantifiable terms, of teaching children how to segment words into sounds and prompting them to apply this strategy prior to spelling words.

First and foremost, the performance of the four 'weak' students illustrates the value of systematic instruction. A positive change occurred when each student was shown how to segment words into phonemes and prompted to apply this strategy before spelling a word. Even the weakest students across the cohort demonstrated a capacity for improvement when provided with the appropriate instruction. This highlights the necessity of explicit instruction and reinforces the view that no matter how 'weak' the students were perceived to be, the intervention in the treatment phase was effective. As the control students had not received explicit instruction in sound segmentation prior to this stage of the study, their immediate improvement shows that 'weak' students can attain these skills with appropriate instruction. The humanitarian philosophy that failure to learn is the fault of the instruction not the fault of the child underpins the theory of instruction-centred learning (Englemann & Carine, 1982) on which the intervention *Let's Decode* (Formentin, 1992) is based.

This result also highlights the vulnerability of 'weak' students because students classified as 'weak' spellers are less likely to improve without explicit instruction than their able peers. While on baseline each 'weak' student maintained a level of performance that did not change until the treatment commenced. From an ethical point of view to have denied the 'weak' spellers the knowledge and skills they required to become proficient spellers would be tantamount to educational neglect. By contrast, the 'good' spellers discussed in the previous research question had already demonstrated some ability to approximate the spelling of words at the beginning of Year 1 and the quality of their invented spelling improved when retested at the end of the year. While the data showed both 'strong' and 'weak' students would be likely to improve if explicitly taught the phonological awareness skills and alphabet knowledge necessary to approximate the spelling of words, such instruction was critical for the 'weak' students.

The results of the single-subject design also highlighted the significance of the prompt for children to 'listen for sounds' before beginning to write. As already evident, some able children appeared to have made the connection between phonological segmentation for reading to spelling words without this explicit prompt. Indeed, it could be argued that like the children Charles Read observed in his ground breaking study (Read, 1971), a large proportion of the cohort came to school already attuned to the necessity to reflect on the phonological properties of words, isolate sounds and spell words phoneme by phoneme. However, for the weak students, two of whom had already learned to segment words into sounds during *Let's Decode* lessons, the explicit reminder to attend to the sound structure of words was critical.

In the single-subject phase of the study all children received instruction on phonological segmentation on a one-to-one basis. Because the two children from the intervention group failed to learn the skill in a whole-class situation does not imply they cannot learn the skill. In fact, the children did learn to segment words orally and match letter-sound correspondences, what they did not do was infer that this knowledge should be applied consistently to spelling words. These results show that individualised instruction may be necessary for some children to attain some skills, in particular, the transfer of phonological segmentation from reading to spelling words. In addition, the importance of monitoring children's mastery of particular skills and knowledge is highlighted.

Interestingly, the control teachers received professional development on *The Literacy Net* that alerted them to the importance of monitoring children's attainment of particular 'Literacy Checkpoints' such as phonological segmentation and letter-sound knowledge (Education Department of Western Australia, 1999). In the case of 'Les' the weakest student from the control group, his classroom teacher was aware of his weak phonological awareness and alphabet knowledge but did not change the content of her language program. By contrast, the teachers implementing *Let's Decode* were asked to teach particular skills and knowledge to mastery alongside their existing language program. They were also asked to monitor student progress regularly. The main difference between the two groups of teachers was that intervention teachers were trained to teach phonological awareness and systematic decoding instruction, not just to identify students who did not attain these skills. This finding has practical implications for teaching training, because it was apparent that the control teachers were not lacking in enthusiasm or willingness to support the weakest students, but instead did not know how to teach phonological awareness and letter-sound knowledge systematically and explicitly.

Despite receiving explicit instruction in phonological awareness and letter-sound correspondences, the quality of the intervention students' invented spelling improved when prompted to 'listen for sounds'. This finding reveals a critical implication of the results of the single-subject design for classroom teachers. While phonological awareness and systematic decoding instruction provided the pre-requisite skills to decode words, children will not necessarily infer how to use this information to spell words. The National Reading Panel referred to this as teachers 'making connections' for children (2000) and it would appear that for all students, in particular those who do not begin writing spontaneously, that it is essential to demonstrate exactly how to spell alphabetically.

Based on the results of this study, it would appear arguments about whether children should 'write first, read later' that developed in response to studies of invented spelling prevalent in the early seventies (Chomsky, 1971; Read, 1971) are of lesser importance than teaching the pre-requisite skills central to both processes: phonological awareness and alphabet knowledge and making explicit connections for children between the application of these skills to read and spelling words. As researchers who followed the debate about the value of encouraging children to write spontaneously in order to support beginning reading noted, the relationship between reading and spelling is not transparent. Although some knowledge may transfer between the two, such as letter-sound correspondences, some skills must be taught explicitly (Bryant & Bradley, 1980; Ehri, 1986; Ehri & Wilce, 1987a; Ehri & Wilce, 1987b). Clearly, the necessity to teach pre-requisite skills explicitly, such as phonological segmentation and blending challenges the assumptions underpinning theories of developmental spelling, in particular that learning to spell unfolds spontaneously in children without the need for instruction. This has practical implications for the way beginning reading and spelling is taught in schools.

The section that follows will present a discussion of the results of this thesis in the context of the theoretical framework and literature review.

6.2 The relevance of invented spelling

> When I wrote the original study, I was afraid people would dismiss it because they were only twenty children and they were exceptional in many ways….or because people would call the 'misspellings' stupid and think that invented spellings took children off in the wrong direction, as in away from correctness. I never imagined that invented spelling, as an activity in and of itself, would become so accepted (Read, 1991 cited in (Invernizzi, Abouzeid, & Gill, 1994).

Charles Read's (1971) original study is credited by some educators as having revolutionised writing in the primary classroom because it gave teachers 'some kind of logical assurance' that spelling is a developmental process and invented spelling is an important part of learning to write words (Morris, 1989). Read's work has had a significant impact on child-centred approaches to literacy instruction in many parts of the world, including Western Australia. In Read's original study he argued that very young children "first learned the conventional names of alphabet letters: then with blocks or some other moveable-alphabet toy, begin to spell words; and finally produce written messages" (Read, 1971 p.3). He maintained that writing usually occurred before the child was able to read, but noted that spontaneous spelling was relatively rare and depended on the co-incidence of the child's interests and abilities with other mitigating factors such as experience with print and parental encouragement and acceptance of invented spelling.

It appears that some educators have overlooked the fundamental premise of Read's work: invented spelling is not a naturally occurring phenomenon. The dominant approach for teaching reading and spelling in Western Australia at the time of this study was *First Steps* (Western Australian Ministry of Education, 1995) a common program of strategies and activities based on child-centred philosophies about literacy instruction. The writers of *First Steps* advise teachers to include opportunities for students to invent spellings each day in the context of meaningful writing activities. At no stage are teachers advised to teach phonological awareness and letter-sound correspondences explicitly.

The influence of child-centred philosophy was evident in the way invented spelling was introduced to all children included in this study, and arguably, most primary schools in Western Australia. Rosie's teacher, teachers at the school involved in Research Question 2 and the teachers involved in the main study appeared to assume that students instinctively knew how to use a *Have-a-go-pad* and did not need to be taught the pre-requisite skills of isolating sounds in words and letter-sound correspondences to spell alphabetically. The introduction of the reading intervention *Let's Decode* demonstrated the problem with this assumption and the children who received explicit instruction in essential reading pre-requisites transferred this knowledge to spelling and achieved superior invented and conventional spelling results. The results of the single-subject design highlighted the necessity to show weak students explicitly how to segment words into phonemes and the need to prompt students to use this strategy before spelling words.

Some writers, notably supporters of developmental reading and spelling models (Ehri, 1998; Frith & Frith, 1983; Gentry, 1982) view this transfer of skills and knowledge of an indication of children's ingenuity, however, the control group did not demonstrate such improvement. Instead, the intervention children's ability to invent spelling was more likely attributable to explicit phonological awareness training and practice, than fortuity (Mann et al., 1987; Stage & Wagner, 1992). Moseley (1994) noted that the "lassez-faire approach" adopted by advocates of invented spelling who refuse to tell children how to spell words, does not work" (p.473), and this was shown by the data reported here. Gough, Juel and Griffith (1992) shrewdly observed that the role of the orthographic cipher and the knowledge required to apply this tool has been largely ignored by those promoting the strategy of invented spellings.

Indeed, the status of invented spelling in child-centred approaches such as *First Steps* is problematic. Supporters of the Whole Language approach encourage teachers to allow children to invent spellings by decomposing words into sounds, then match sounds to whatever alphabetic knowledge children have discovered or been exposed to. However, when advising on reading instruction Whole Language proponents relegate the application of the alphabetic code as a 'last resort' if meaning based cues do not enable the child to recognise an unknown word. Moffett and Wagner (1993) two well known proponents of the Whole Language approach, acknowledged the obvious contradiction in the Whole Language approach between encouraging children to use word 'particles' to spell, but not to read. They explained this 'conspicuous violation' by explaining that it was harder for children to learn to spell because they needed more knowledge to become literate. Moffett and Wagner conceded that writers must know the letter-sound correspondences much more explicitly and more precisely, and because of this alphabet knowledge should be taught to children. This view is rarely articulated by writers sympathetic to the Whole Language approach because children's competence in spoken language is viewed as sufficient to induce alphabet knowledge and invent spellings (Walshe, 1981).

The shift in position put forward by Moffett and Wagner (1993) is both significant, yet, in the context of this study, incomplete. After describing the process of inventing spelling and accepting the importance of alphabet knowledge, Moffett and Wagner overlooked the need to teach phonological segmentation. The writers assumed that children would 'naturally' know that when broken down into its constituent sounds, sound can be matched to letters and words can be spelt. They argued that if beginning spellers learn the names and sounds of some alphabet letters through "playing a game that exercises their mind" they will begin to invent spellings (p.35). The research findings of this thesis do not support this claim. Alphabet knowledge is insufficient to guarantee all students learn how to encode words, instead it is the underlying skills that enable children to apply the alphabetic code, such as phoneme segmentation that are critical (Nation & Hulme, 1997; Panel, 2000; Snow et al., 1998).

As *Have-a-go-pads* and the process of inventing the spelling of words are included in the language programs of most junior primary school teachers in Western Australia, the results of this study are highly significant. Above everything else, invented spelling is a popular practice and teachers appear to respond positively to connotations that invented spelling is a natural stage in a child's literacy development. *Have-a-go-pads* are a reflection of the child-centred belief that speaking, reading and writing are related developmental processes with invented spelling characterised by one researcher as comparable to the 'incessant chatter' of toddlers (Walshe, 1981). At the same time, irrespective of how children acquire the skills to begin writing, the process of inventing spellings has been shown to develop spelling and reading achievement because the act of representing speech in print necessitates a high level of explicit phoneme awareness and promotes children's interest about the phonemic composition of (Chomsky, 1979; Mann, 1986; Morris & Perney, 1984). It is for this reason, and teacher's willingness to encourage children to invent spelling, that the addition of explicit instruction in phonological segmentation and letter-sound correspondences should be addressed.

6.3 Practical implications

Conclusion 1: Early spelling approaches should include systematic and explicit instruction in phonological awareness and alphabet knowledge.

Instruction that fails to teach phonological awareness and letter-sound combinations explicitly has been consistently identified as a significant cause of early spelling difficulties (Ehri, 1989). This view is shared by Moats who noted that although children's progress is mediated by their 'acquired' concepts of phonology and knowledge of the writing system, the majority learn faster if they are taught directly:

> One of the most common misinterpretations of the literature on spelling development is that children should be left to come to their skill naturally, in the course of experimentation with writing, and that direct instruction in spelling is unnecessary (Moats, 1995 p.43).

The instruction received by the intervention group was based primarily on a child-centred approach that was supplemented with phonological awareness and systematic decoding instruction. From a theoretical perspective the combining of two contradictory approaches is problematic, as encapsulated by one child-centred proponent who claimed that "invented spelling is prohibited by proponents of systematic phonics" (Smith, 1999, p. 153). However, as demonstrated by the results of this study combining approaches is not only achievable, but produces superior literacy outcomes in reading and spelling. Westwood (1994) put forward a similar case when he claimed "strong arguments can be mounted in favour of embedding far more explicit teaching of spelling, word study and phonic knowledge within whole language programs" (p.32). It would appear that what is required is a more flexible approach that acknowledges a phonological deficit is the single most influential factor in literacy failure and includes phonological awareness instruction that is systematic and explicit.

Conclusion 2: In order to invent spellings children require systematic and explicit instruction in two critical pre-requisites: phonological segmentation and alphabet knowledge

In a review of spelling theory and instruction Brown (1990) noted that while the theory of developmental spelling is intriguing, "the instructional applications remain shallow and the model needs more empirical testing" (p. 370). Brown observed that invented spelling could involve much time and effort largely wasted if children lacked pre-requisite skills and were allowed to "flail in a sea of incorrect and inconsistent spellings, and gradually meander towards the final goal of spelling mastery" (p.382). Groff (1986) voiced similar concerns when he argued that leaving novice spellers to their own devices was tantamount to educational neglect and pondered how children would learn to associate speech sounds directly to letters without direct and systematic tutelage.

In light of research reported in this thesis the following conclusion addresses the concerns raised by Brown (1990) and Groff (1986). That is, if children are taught the essential pre-requisite skills to spell alphabetically the benefits of allowing children to 'have-a-go' outweigh the common criticisms levied against invented spelling. This view was put forward by Moats (1995) who accepted the place of invented spelling as a stage of children's literacy development, but noted that teaching children directly the pre-requisite skills to spell words was more efficient than encouraging children's self-directed discovery.

Conclusion 3: When introducing the concept of invented spelling teachers should teach phonological segmentation and prompt children explicitly to 'listen for sounds' in words.

The superior spelling results recorded by the intervention group further supports the inclusion of *Let's Decode* strategies. It is recommended that the phonological awareness skill of segmenting words into phonemes be taught prior to and alongside the introduction of *Have-a-go-pads*. In particular, children should be prompted explicitly to 'listen for sounds' before they attempt to spell an unknown word. As teachers in the intervention group often conducted *Let's Decode* during morning 'mat' sessions prior to presenting a modelled writing lesson, it would be appropriate to teach the strategy of phonological segmentation and letter-sound knowledge to spell word at this time. The results of the single-subject research design indicated the value in circumventing the need for children to 'discover' the transferability of phonological awareness and alphabet knowledge between reading and spelling. Thus, the third recommendation is when teachers model how to spell known words they should teach the format for segmentation explicitly, then prompt children to apply the same strategy and 'listen for sounds' when spelling words independently.

6.4 Future research

The addition of the prompt to 'listen for sounds' appears to be a necessary addition to the process of spelling unknown words. The single-subject design demonstrated the effect of a combined approach in which children were taught phonological segmentation and prompted to 'listen for sounds' before writing. Further research should be carried out to investigate the extent to which such a prompt is essential.

Given the acceptance of invented spelling and the *Have-a-go-pad* it would also be valuable to investigate strategies that supplement the way invented spelling is introduced in Western Australian classrooms. In particular, whether teaching children how to segment words orally using the format from *Let's Decode* (Formentin, 1992) then demonstrating the format explicitly as a precursor to spelling unknown words during modelled writing activities or when asked to spell words by children, would facilitate the transfer of knowledge from phonological awareness activities to spelling words. In short, would extending the treatment phase from the single-subject design featured in this study to students in a whole class setting during writing lessons produce superior spelling outcomes. Such an investigation would address the need identified by The National Reading Panel for studies that measure the effect of teaching children to transfer knowledge between different skills (Panel, 2000).

6.5 Limitations

From the outset it was acknowledged that there were a number of potential and real limitations to a study such as this which was carried out in an applied setting where many variables could not be controlled.

One of the most significant issues to impact on the generalisability of the results reported in this study is the sample of students, in particular, the number and composition of the groups. Assumptions based on the early literacy performance of 'Rosie', the single subject of the case study, should be treated with caution. Similarly, the post-hoc and main study data was gathered from a statistically significant, but none the less small sample. Finally, the students included in this study were deliberately chosen from schools with an equivalent 'low-moderate' socio-economic status based on factors such as parental income. As such, similar results may not be obtained from schools in a different setting.

Variables related to the school setting, in particular the novelty effect and the effect of teacher enthusiasm must also be considered. It is possible that schools singled out to work on research projects perceived to be important may sustain a higher level of motivation than schools implementing an intervention without external influences. Indeed, that schools involved in professional development conducted 'in-school' time believe the course to be of more value than the same professional development conducted out of school hours is a factor to consider if replicating this study as teachers were released from their classes to attend the sessions.

A related issue pertains to the research design of the three components of the study. Descriptions of 'Rosie' the single subject were unavoidably subjective and alternative explanations for anomalies in her literacy performance are possible. Never the less an examination of this student's work was valuable because a number of critical themes were introduced. The post-hoc data also introduced another important issue addressed by the main study, but involved data gathered for other purposes and the control group was at another school. While the main study included control students these students were not randomly selected for ethical reasons. In order to address the issue of comparability a MANCOVA was used, however statistical adjustments are criticised for over correction and this factor must be taken into account.

In this study all statistical comparisons were significant. A probability level of $\alpha = 0.05$ was selected for a difference to be declared significant. Thus, there is a possibility (5%) that one of more of these differences represented a Type 1 error. However, it should be reiterated that demonstration of a causal relationship between the intervention condition and dependent variables was not required. The central focus of the thesis is the relationship of reading and spelling.

Measures were taken to address the 'Hawthorne' effect, including provision of a control group, however there is no guarantee other unknown variables have not impacted on the results. The professional development provided to teachers and the fidelity of implementation of *Let's Decode* (Formentin, 1992) strategies and *Have-a-go-pads* are such variables. *Let's Decode* is based on *Direct Instruction Reading* (Carnine, Silbert, & Kameenui, 1990) and was adapted for particular purposes. As any adaptation results in changes that may affect student performance particular care was taken to ensure the teachers implemented the strategies correctly. Despite this attention to implementation further adaptations that may have occurred at a classroom level must be considered. With regard to the introduction of the intervention, the professional development program was presented by the author of *Let's Decode* whose understanding of the original program and the reasons for adaptations will not be replicated by a lesser qualified presenter. As the quality of professional development and support provided to teachers has been shown to be a critical variable in the success of *Let's Decode* (Formentin, 1992), these factors must be considered.

While the intervention teachers attended professional development so did the control teachers and the same issues pertaining to the fidelity of implementation are applicable. Similarly, while no teacher was observed teaching phonological segmentation explicitly when introducing *Have-a-go-pads*, this may have occurred. It was inappropriate to discuss this critical strategy with teachers because to do so may have cued them to its significance. Therefore, the researcher questioned teachers about their approach to teaching invented spelling prior to their selection and observed a number of writing lessons in each class to ensure the teachers' practice was consistent with their views on this topic. Lessons were also observed to ensure *Have-a-go-pads* were introduced consistently across the four classes.

A related issue involves the selection of teachers. The teachers who implemented the intervention *Let's Decode* were volunteers. These teachers received support to implement the strategies and attended professional development that was delivered by the author of the program. Professional development sessions were spaced over a ten week period during school time. If as a consequence these results were to be applied in a Western Australian context serious consideration would need to be given to the quality of inservice. Western Australian schools are under increasing demands to conduct professional development in day long sessions or after school in teacher's own time, so the model of professional development delivery featured in this study would be difficult to replicate. Furthermore, if teachers were required to take up *Let's Decode* rather than volunteer, a different result may be reported.

It is also appropriate to note that the extent to which teachers implemented the intervention was a factor that may have affected the results reported here. The author of this thesis was present in all classes both control and intervention on a weekly basis to monitor beginning literacy instruction. In the intervention classes both control and intervention anecdotal notes were kept to record the implementation of *Let's Decode.* These notes included reference to the particular skills each teacher taught, how frequently each format was presented, whether the teachers followed the *Let's Decode* teaching scripts accurately and whether student performance was monitored. Evidence indicated that one teacher was more conscientious than the other. As the results of both classes were combined to report the effect of the intervention any difference in implementation was masked. Similar differences were observed in the teaching emphasis of the control teachers, and their results were also combined.

Let's Decode is an intervention that teaches the skills children require to systematically decode words. As such, the strategies are limited and do not teach reading comprehension. This factor must be considered in terms of the period of instruction and the effect of the intervention. Results were reported after four school terms and performance may plateau after the intervention ceases, or students require additional skills to develop. Longitudinal data would establish the extent to which children maintained their ability to decode words. Similarly, while the invented and conventional spelling performance of the children who received the intervention also improved, the lasting effects of the intervention on spelling are unknown.

The validity of various measures employed also raise a number of important issues. A major disadvantage of single subject research methodology is to be found in the level of confidence that may be placed in the generalisability of findings to other subjects. It is only by the systematic replication of single-subject designs that this issue can be addressed. Therefore, the implications of the intervention procedures, including the prompt to 'listen for sounds' are limited to the size and classification of the sample ($\underline{n}$ = 4) who were identified as 'weak' students. Replication of this phase of the study would be required with larger samples and representative groups of students before results could be generalised to other populations.

Issues of definition have featured at various stages of this thesis. Those students considered 'good' readers were defined in terms of their ability to decode unknown words. Accordingly, the word attack and passage comprehension subtests of the Woodcock Reading Mastery Test–Revised (Woodcock, 1998) were employed to ascertain children's decoding and reading comprehension performance. The word attack subtest of the Woodcock Reading Mastery Test–Revised has been criticised for the legitmacy of using non-words to test 'reading' by those researchers who subscribe to 'child-centred' theories of reading. As reading was defined in terms of children's ability to systematically decode words, the Woodcock Reading Mastery Test–Revised was an appropriate tool. It would be worthwhile for multiple reading tests to be used on critical measures of comprehension and decoding, however in this instance the availability and re-norming of the Woodcock Reading Mastery Test–Revised was an influential factor.

Similarly, the reliability and validity of the two spelling measures must also be considered. Application of the scoring key from the Developmental Spelling Test (Tangel & Blachman, 1995) resulted in a score based on quality of children's stages of invented spelling. While the scoring key was carefully adhered to those spellings not included in the sample responses had to be scored subjectively according to the stipulated guidelines. Furthermore, the raw and ceiling score of the Developmental Spelling Test was fixed at 60 marks and may not reflect improvement. Different problems with the Wide Range Achievement Test–Revised Spelling subtest (Jastak & Wilkinson, 1984) were noted elsewhere, including the appropriateness of the words in the test for Year 1 children. As there is a paucity of spelling tests, it is likely that each test would have been deemed in some way problematic, and as with all the tests employed, every child was equally disadvantaged, if this was the case, by the chosen measures. However while the effect of potential problems with tests held across all groups included in the present study, this doesn't answer the problems of these measures and the importance of selecting the most appropriate test.

6.6 Conclusion

The results of the eight research questions investigated in this thesis provide very strong evidence of the importance of phonological awareness and its role in early reading and spelling development. The children who received phonological awareness and systematic decoding instruction reported superior ability to decode words and comprehend connected text. These same children also showed superior invented and conventional spelling results. When combined with specific prompts to 'listen for sounds' before spelling words the quality of the invented spelling of the weakest students also improved.

The premise underpinning this study is that learning to read and particularly, learning to spell, are difficult tasks for which we have no biological disposition (Groff, 1998). Developmental theorists argue that student's spelling development reflects a "growth in sophistication of knowledge about letters, sounds and letter patterns" (Bear & Templeton, 1998, p.224). While most children do pass through the same stages, what developmental theories do not account for is how children acquire the necessary pre-requisite skills. The results reported here present a strong case for teaching essential pre-requisite skills for reading, some of which are shared by spelling.

REFERENCES

Adams, G. L., & Englemann, S. (1996). *Research on Direct Instruction: 25 years beyond DISTAR*. Seattle, WA: Educational Achievement Systems.

Adams, M., Foorman, B., Lundberg, I., & Beeler, T. (1998). *Phonemic awareness in young children*. Baltimore: Brookes.

Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Massachusetts: MIT Press.

Adams, M. J. (1991a). Beginning to read: A critique by literacy professionals and a response by Marilyn Jager Adams. *The Reading Teacher, 44*(6), 370-395.

Adams, M. J. (1991b). Why not phonics and whole language? In W. Elli (Ed.), *Language and the creation of literacy* (pp. 40-52). Baltimore: Orton Dyslexia Society.

Australian Council for Educational Research. (1997). *Literacy standards in Australia*. Canberra: Commonwealth of Australia.

Badenhop, A. M. (1993). Phonological awareness skills: The first two years of school. In A. J. Watson & A. M. Badenhop (Eds.), *Prevention of reading failure* (pp. 107-124). Gosford, NSW: Ashton Scholastic.

Bakker, D. J. (1979). Hemispheric differences and reading strategies: Two dyslexias? *Bulletin of the Orton Society, 29*, 84-100.

Bakker, D. J. (1990). *Neuropsychological treatment of dyslexia*. New York: Oxford University Press.

Ball, E. W., & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling. *Reading Research Quarterly, 25*, 49-66.

Barry, C. (1994). Spelling routes (or roots of rutes). In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 27-49). Chichester: Wiley.

Bear, D. R., & Templeton, S. (1998). Explorations in developmental spelling: Foundations for learning and teaching phonics, spelling, and vocabulary. *The Reading Teacher, 52*(3), 222-242.

Beers, J., & Henderson, E. (1977a). First grade children's developing orthographic concepts. *Research in the Teaching of English, Fall.*

Beers, J. W. (1980). Developmental strategies of spelling competence in primary school children. In E. H. Henderson & J. W. Beers (Eds.), *Developmental and cognitive aspects of learning to spell* (pp. 23-41). Newark, DE: International Reading Association.

Beers, J. W., & Henderson, E. H. (1977b). A study of developing orthographic concepts among first graders. *Research in the Teaching of English, 2*, 133-148.

Beilby, N. (1994). *Making sense of reading: The new phonics and its practical implications*. Warwickshire, UK: Scholastic.

Bentin, S., & Leshem, H. (1993). On the interaction between phonological awareness and reading acquisition: It's a two-way street. *Annals of Dyslexia, 43*, 125-148.

Bergeron, B. S. (1990). What does the term whole language mean? Constructing a definition from the literature. *Journal of Reading Behaviour, 22*(4), 301-326.

Berninger, V. W. (1996). *Reading and writing acquisition: A developmental neurological perspective*. Boulder, Colarado: Westview Press.

Bissex, G. (1980). *GNYS AT WORK: A child learns to write and read.* Cambridge, MASS: Harvard University Press.

Blachman, B., Ball, E., Black, R., & Tangel, E. (1994). Kindergarten teachers develop phoneme awareness in low-income, inner-city classrooms: Does phoneme awareness make a difference? *Reading and Writing: An Interdisciplinary Journal, 6*, 1-18.

Bond, C. L., & Dykstra, R. (1967). The co-operative research program in first grade reading instruction. *Reading Research Quarterly, 2*(4), 5-141.

Bormuth, J. R. (Ed.). (1975). *Reading literacy: Its definition and assessment.* New York: McGraw-Hill Book Co.

Bradley, L., & Bryant, P. E. (1978). Difficulties in auditory organisation as a possible cause of reading backwardness. *Nature, 271*, 746-747.

Bradley, L., & Bryant, P. E. (1983). Categorising sounds and learning to read - a causal connection. *Nature, 301*, 419-421.

Brady, S. A., & Shankweiler, D. (1991). *Phonological processes in literacy: A tribute to Isabelle Liberman.* Hillsdale, NJ: Erlbaum.

Brady, S. A., & Shankweiler, D. P. (1991). *Phonological processes in literacy.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Brown, A. (1990). A review of recent research on spelling. *Educational Psychology Review, 2*(4), 365-397.

Brown, G. D. A., & Ellis, N. C. (1994). Issues in spelling research: An overview. In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 3-25). Chichester: John Wiley & Sons Ltd.

Brown, G. D. A., & Loosemore, R. P. (Eds.). (1994). *Computational approaches to normal and impaired spelling*. Chichester: John Wiley & Sons Ltd.

Bryant, P. E., & Bradley, L. (Eds.). (1980). *Why children sometimes write words which they do not read*. London: Academic Press.

Bryant, P. E., & Bradley, L. (1985). *Children's reading problems*. Oxford: Blackwell.

Bryant, P. E., MacLean, L., Bradley, L., & Crosland, J. (1990). Rhyme and alliteration, phoneme detection and learning how to read. *Developmental Psychology, 26*, 429-438.

Bryson, B. (1990). *The mother tongue: English and how it got that way*. New York: Avon.

Burns, J. M., & Richgels, D. J. (1989). An investigation of task requirements associated with the invented spellings of 4 year olds with above average intelligence. *Journal of Reading Behaviour, 21*, 1-14.

Buros Institute, B. (1994). *Buros desk reference: Psychological assessment in the schools*. Lincoln, Nebraska: The University of Nebraska.

Butterworth, B. (1999). *The mathematical brain*. London: MacMillan.

Byrne, B., & Fielding-Barnsley, R. (1993). Evaluation of a program to teach phonemic awareness to young children: A 1-year follow-up. *Journal of Educational Psychology, 85*, 104-111.

Byrne, B., Freebody, P., & Gates, A. (1992). Longitudinal data on the relations of word-reading strategies to comprehension, reading time and phoneme awareness. *Reading Research Quarterly, 27*, 141-151.

Calfee. (1998). Phonics and phonemes. In J. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 315-340). Mahwah, NJ: Lawrence Erlbaum Associates.

Calkins, L. M. (1986). *The art of teaching writing.* Portsmounth, NH: Heinemann.

Cambourne, B. (1988). *The whole story - Natural learning and the acquisition of literacy in the classroom.* Sydney: Ashton Scholastic.

Carnine, D., Silbert, J., & Kameenui, E. J. (1990). *Direct instruction reading.* (2nd ed.). Columbus, Ohio: Merrill.

Carnine, D., Silbert, J., & Kameenui, E. J. (1997). *Direct instruction reading.* (3rd ed.). Columbus, Ohio: Merrill.

Castle, J. M., Riach, J., & Nicholson, T. (1994). Getting off to a better start in reading and spelling: The effects of phonemic awareness instruction within a whole language program. *Journal of Educational Psychology, 86,* 350-359.

Catalado, S., & Ellis, N. (1988). Interactions in the development spelling, reading and phonological skills. *Journal of Research in Reading, 11*(2), 86-109.

Catalado, S., & Ellis, N. (Eds.). (1990). *Learning to spell, learning to read.* Bristol: The Falmer Press.

Cazden, C. (1972). *Child language and education.* New York: Holt, Rinehart & Winston.

Chall, J. S. (1967). *Learning to read: The great debate.* New York: Mc Graw-Hill.

Chall, J. S. (1983). *Stages of reading development.* New York: Mc Graw-Hill.

Chall, J. S. (1989). Learning to read: The great debate 20 years later - a response to "Debunking the phonics myth". *Phi Delta Kappan, 70*, 521-538.

Chaney, C. (1989). I pledge a legiance tothe flag: Three studies in word segmentation. *Applied Psycholinguistics, 13*(4), 485-514.

Chard, D. J., & Dickson, S. V. (1999). Phonological awareness: Instructional and assessment guidelines. *Intervention in School and Clinic, 34*(5), 261-270.

Chard, D. J., Simmons, D. C., & Kameenui, E. J. (1998). *Word Recognition: Research bases*. Mahwah, NJ: Erlbaum.

Chomsky, C. (1971). Write first, read later. *Childhood Education, 47*, 269=299.

Chomsky, C. (1979). Approaching reading through invented spelling. In P. A. Weaver (Ed.), *Theory and practice of early reading* (Vol. 2, pp. 43-65). Hillsdale, NJ: Erlbaum.

Chomsky, N. (1957). *Syntactic structures*. The Hague: Mouton.

Clarke, L. K. (1988). Invented versus traditional spelling in first graders' writings: Effects on learning to spell and read. *Research on the Teaching of English, 22*(3), 281-309.

Clay, M. (1975). *What did I write?* London: Heinemann.

Clay, M. (1979). *Reading: The patterning of complex behaviour*. New York: Heineman.

Clay, M. (1985). *The early detection of reading difficulties*. Portsmouth: NH: Hienemann.

Cotter, R. B. (1988). Woodcock Reading Mastery Tests - Revised. *Reading Teacher, 42*(2), 154-155.

Crain-Thoreson, C., & Dale, P. S. (1992). Do early talkers become early readers? Linguistic precocity, preschool language and emergent literacy. *Developmental Psychology, 28*(3), 421-429.

Crawford, P. (1994). *Phonic blending and transfer of letter training to decoding of pseudo and regular words.* Unpublished Masters, Edith Cowan University, Perth.

Cunningham, A. (1990). Explicit vs. implicit instruction in phonemic awareness. *Journal of Experimental Child Psychology, 50*, 429-444.

Cunningham, P. M., & Cunningham, J. W. (1992). Making words: Enhancing the invented spelling-decoding connection. *The Reading Teacher, 46*(2), 106-113.

Cunningham, A. E., & Stanovich, K. E. (1990). Tracking the unique effects of print exposure in children: associations with vocabulary, general knowledge and spelling. *Journal of Educational Psychology, 83*, 264-274.

Cunningham, A. E., & Stanovich, K. E. (1998). The impact of print exposure on word recognition. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 235-263). Mahwah, NJ: London.

Dallas, S. (1992). Teaching reading - avoid failure: Preventative strategies in the regular classroom. In A. Watson & A. M. Badenhop (Eds.), *Prevention of reading failure* (pp. 125-144). Sydney: Ashton Scholastic.

Darwin, C. (1874). *The descent of man and selection in relation to sex.* (2nd ed.). New York: Hurst & Co.

Davidson, M., & Jenkins, J. R. (1994). Effects of phonemic processes on word reading and spelling. *Journal of Educational Research, 87*, 148-157.

de Sassure, F. (1974). *Course in General Linguistics*. London: Fontana.

Deese, J., & Hulse, S. H. (1967). *The psychology of learning*. New York: McGraw-Hill.

Denckla, M. (Ed.). (1983). *Learning for language and language for learning*. New York: Academic Press.

Denckla, M. B. (1987). Application of disconnection concepts to developmental dyslexia. *Annals of Dyslexia, 37*, 51-61.

Diack, H. (1965). *In spite of the alphabet*. London: Chatto & Windus.

Downing, J., Coughlin, R. M., & Rich, G. (1986). Children's invented spellings in the classroom. *The Elementary School Journal, 86*(5), 295-303.

Downing, J., & Valtin, R. (1984). *Language awareness and learning to read*. New York: Springer-Verlag.

Education Department of Western Australia. (1992). *Good Start*. Perth: EDWA.

Education Department of Western Australia. (1999a). *Commonwealth literacy program: Guidelines for operation*. Perth: Education Department of Western Australia.

Education Department of Western Australia. (1999b). *P-3 Literacy Net: Presenters Notes* . Perth: EDWA.

Ehri, L. (1980). The development of orthographic images. In U. Frith (Ed.), *Cognitive processes in spelling* (pp. 311-338). New York: Academic Press.

Ehri, L. (1985). Effects of printed language acquisition on speech. In D. R. Olson, N. Torrance, & A. Hildyard (Eds.), *Literacy, language and learning* (pp. 333-367). Cambridge, UK: Cambridge University Press.

Ehri, L. (1987). Learning to spell and read words. *Journal of Reading Behaviour, 19*, 5-31.

Ehri, L., & Wilce, L. (1980). The influence of orthography on readers' conceptualisation of the phonemic structure of words. *Applied Psycholinguistics, 1*, 371-385.

Ehri, L. C. (1979). Linguistic insight: Threshold of reading acquisition. In T. G. Waller & G. E. MacKinnon (Eds.), *Reading research: Advances in theory and practice* (Vol. 1,). New York: Academic Press.

Ehri, L. C. (1984). How orthography alters spoken language competencies in children learning to read and spell. In J. Downing & R. Valtin (Eds.), *Language awareness and learning to read.* New York: Springer Velag.

Ehri, L. C. (1986). Sources of difficulty in learning to spell and read. *Advances in Developmental and Behavioural Paediatrics, 7*, 121-195.

Ehri, L. C. (1989). The development of spelling knowledge and its role in reading acquisition and reading disability. *Journal of Learning Disabilities, 22*, 356-365.

Ehri, L. C. (1991). The development of reading and spelling in children: An overview. In M. Snowling & M. Thomson (Eds.), *Dyslexia: Integrating theory and practice* (pp. 63-79). England: Whurr.

Ehri, L. C. (1992). Reconceptualising the development of sight word reading and its relationship to recording. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 107-143). Hillsdale: NJ: Erlbaum.

Ehri, L. C. (1995). Phases of development in learning to read words by sight. *Journal of Research in Reading, 18*, 116-125.

Ehri, L. C. (1997). Research on learning to read and spell: A personal-historical perspective. *Scientific Studies of Reading, 2*(2), 97-114.

Ehri, L. C. (1998). Grapheme-phoneme knowledge is essential for learning to read words in English. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning reading* (pp. 3-40). Mahwah, NJ: Lawrence Erlbaum Associates.

Ehri, L. C., & Robbins, C. (1992). Beginners need some decoding skill to read words by analogy. *Reading Research Quarterly, 12*, 47-65.

Ehri, L. C., & Wilce, L. S. (1987a). Does spelling help reading? *Reading Research Quarterly, Winter*, 49-65.

Ehri, L. C., & Wilce, L. S. (1987b). Cipher versus cue reading: An experiment in decoding acquistion. *Journal of Educational Psychology, 79*, 3-13.

Ehri, L. C., & Wilce, L. S. (1987c). Does learning to spell help beginners learn to read words. *Reading Research Quarterly, 22*, 47-65.

Ehri, L. C., & Wilce, L. S. (1985). Movement into reading: Is the first stage of printed word learning visual or phonetic. *Reading Research Quarterly, 20*, 163-179.

Eldredge, J. L., & Baird, J. (1996). Phonemic awareness training works better than whole language instruction for teaching first graders how to write. *Reading Research and Instruction, 35*, 193-208.

Ellis, A. (1993). *Reading, writing and dyslexia: A cognitive analysis*. (2nd ed.). Hove, UK: Lawrence Erlbaum.

Ellis, A. W. (Ed.). (1992). *Spelling and writing and reading and speaking*. London: Academic Press.

Ellis, N. (1991). Spelling and sound in learning to read. In M. Snowling & M. Thomson (Eds.), *Dyslexia: Integrating theory and practice* (pp. 43-67). London: Whurr Publishers.

Ellis, N. (1994). Longitudinal studies of spelling development. In G. D. A. Brown & N. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention,* (pp. 155-177). Chichester: John Wiley & Sons Ltd.

Ellis, N., & Cataldo, S. (1992). Spelling is integral to learning to read. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 122-142). Bristol, UK: Longdunn Press.

Englemann, S., & Carine, D. (1982). *Theory of instruction: Principles and applications*. New York: Irvington.

Epstein, H. T. (1978). Growth spurts during brain development: Implications for educational policy and practice. In J. A. Chall & A. F. Mirsky (Eds.), *Education and the brain* (pp. 45-86). Chicago: University of Chicago Press.

Fawcett, A. J., & Nicolson, R. I. (1994). Naming speed in children with dyslexia. *Journal of Learning Disabilities, 26*, 583=589.

Ferreiro, E., & Teberosky, A. (1982). *Literacy before schooling.* Exeter: NH: Heinemann.

Formentin, P. J. (1992a). *Let's Decode inservice manual.* Perth, WA: Edith Cowan University Bookshop.

Formentin, P. J. (1992b). *Let's Decode videotape: Let's take a closer look.* Perth, WA: Edith Cowan University Bookshop.

Formentin, P. J., & Hammond, L. S. (1997). Prevention of reading disabilities and the role of systematic decoding instruction. *The Bulletin of the Australian Institute of Learning Disabilities, 14*, 29-41.

Formentin, P. J., Hammond, L. S., & Elderfield, J. (2000). How robust is Let's Decode in the prevention of reading disabilities in Year 1? *Unpublished research article.*

Formentin, P. J., Summers, L., & Crawford, P. (1994). Effective use of systematic decoding instruction with whole language programmes. In P. C. Long (Ed.), *Quality outcomes for learners: Selected papers from Australian Association of Special Education Inc. Conference Melbourne 1993* (pp. 112-120). Parkerville, Victoria: University of Melbourne Press.

Fox, B., & Routh, D. K. (1975). Analysing spoken language into words, syllables and phonemes: A developmental study. *Journal of Psycholinguistic Research, 4*, 331-342.

Fox, B., & Routh, D. K. (1984). Phonemic analysis and synthesis as work attack skills: Revisited. *Journal of Educational Psychology, 76*(6), 1059-1064.

Frith, U. (1978). Spelling difficulties. *Journal of Child Psychology and Psychiatry, 19*, 279-285.

Frith, U. (1980). Unexpected spelling problems. In U. Frith (Ed.), *Cognitive processes in spelling* (pp. 496-515). London: Academic Press.

Frith, U. (1981). Experimental approaches to developmental dyslexia: An introduction. *Psychological Research, 43*, 97-109.

Frith, U. (1983). The similarities and differences between reading and spelling problems. In M. Rutter (Ed.), *Developmental Neuropsychiatry* (pp. 453-452). New York: Guildford Press.

Frith, U. (1985). Beneath the surface of developmental dyslexia. In K. Patterson & M. Colheart (Eds.), *Surface Dyslexia* (pp. 301-330). London: Lawrence Erlbaum Associates.

Frith, U. (1994). Foreword. In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of Spelling: Theory, process and intervention* (pp. xi-xiv). Chichester: John Wiley & Sons Ltd.

Frith, U. (1997). Brain, mind and behaviour in dyslexia. In C. Hulme & M. Snowling (Eds.), *Dyslexia: Biology cognition and intervention* (pp. 1-19). London: Whurr.

Frith, U. (1999a, 31 December). *Research results*, Available E-mail:u.frith@ucl.ac.uk Message: Some comments on your research.

Frith, U. (1999b). Paradoxes in the definition of dyslexia. *Dyslexia, 5*, 192-214.

Frith, U., & Frith, C. (1983). Relationships between reading and spelling. In J. P. Kavanagh & R. L. Venezky (Eds.), *Orthography, reading and dyslexia* . Baltimore: University Park Press.

Galaburda, A. (1993). Neurology of developmental dyslexia. *Current Opinion in Neurobiology, 5*, 71-76.

Gentry, J. R. (1978). Early spelling strategies. *The Elementary School Journal, 79*, 88-92.

Gentry, J. R. (1981). Learning to spell developmentally. *The Reading Teacher, 34*(4), 378-381.

Gentry, J. R. (1982). Spelling genius at work: An analysis of developmental spelling in GYNS AT WORK. *The Reading Teacher, 36*(2), 192-200.

Gentry, R., & Henderson, E. H. (1980). Three steps to teaching beginning readers to spell. In E. H. Henderson & J. W. Beers (Eds.), *Developmental and cognitive aspects of learning to spell - A reflection of word knowledge* (pp. 112-119). Newark: International Reading Association.

Geschwind, N. (1974). The anatomical basis of hemispheric differentiation. In S. J. Dimond & J. G. Beaumont (Eds.), *Hemisphere function in the human brain* (pp. 7-24). London: Elek Science.

Geschwind, N. (Ed.). (1979). *Specializations of the human brain*. San Francisco: W H Freeman.

Geschwind, N., & Levitsky, W. (1968). Human brain: Left-right asymmetries in temporal speech region. *Science, 161*, 186-187.

Gilbertson, M., & Bramlett, R. K. (1998). Phonological awareness screening to identify at-risk readers: Implications for practitioners. *Language, Speech & Hearing Services in the Schools, 29*(2), 109-116.

Gillet, J. W., & Temple, C. (1990). *Understanding reading problems*. Glenview, IL: Scott Foresman.

Goodman, K. S. (1976). Reading: A psycholinguistic guessing game. In H. Singer & R. B. Ruddell (Eds.), *Theoretical models and processes of reading* (pp. 497-508). Newark: DE: International Reading Association.

Goodman, K. S. (1986). *What's whole in Whole Language?* Portsmouth: NH: Heinemann.

Goodman, K. S. (1989). Roots of the Whole-Language movement. *Elementary School Journal, 90*, 113-127.

Goodman, K. S. (1995a, 30 October). *How natural is written language?* Available E-mail: KGOODMAN@CCIT.ARIZONA.EDU Message: Teachers applying Whole Language.

Goodman, K. S. (1995b, 11 November). *Defining Whole Language.* Available E-mail: KGOODMAN@CCIT.ARIZONA.EDU Message:Teachers applying Whole Language.

Goodman, Y. M. (1990). How children construct literacy. In I. R. Association (Ed.), *Piagetian Perspectives*. Newark, DE: International Reading Association.

Goodman, Y. M., Watson, D. J., & Burke, C. I. (1987). *Reading miscue inventory: Alternative procedures*. New York: Richard C. Owen.

Goswami, U. (1988). Orthographic analogies and reading development. *Quarterly Journal of Experimental Psychology, 40A*, 239-268.

Goswami, U. (1993). Orthographic analogies and reading development. *The Psychologist, July*, 312-316.

Goswami, U. (1994a). Phonological skills, analogies and reading development. *Reading Behaviour, July*, 32-37.

Goswami, U. (1994b). Reading by analogy: Theoretical and practical perspectives. In C. Hulme & M. Snowling (Eds.), *Reading development and dyslexia* (pp. 18-30). London: Whurr.

Goswami, U. (1998). The role of analogies. In J. L. Metsala & L. Ehir (Eds.), *Word recognition in beginning literacy* (pp. 41-63). New Jersey: Lawrence Erlbaum.

Goswami, U., & Bryant, P. (1990). *Phonological skills and learning to read.* London: Lawrence Erlbaum Associates Ltd.

Goswami, U., & Bryant, P. (1992). Rhyme, analogy and children's reading. In P. Gough, L. Ehri, & R. Treiman (Eds.), *Reading Acquisition* (pp. 49-63). Hillsdale, NJ: Lawrence Erlbaum Associates.

Goswami, U., & Mead, F. (1992). Onset and rime awareness and analogies in reading. *Reading Research Quarterly, 27*(2), 153-162.

Gough, P. B., & Hillinger, M. L. (1980). Learning to read: An unnatural act. *Bulletin of the Orton Society, 30*, 179-196.

Gough, P. B., Juel, C., & Griffith, P. (1992). Reading, spelling and the orthographic cipher. In P. Gough, L. Ehri, & R. Treiman (Eds.), *Reading Acquisition* . Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Gough, P. B., & Walsh, M. A. (1991). Chinese, Phoenicians and the orthographic cipher of English. In S. Brady & D. P. Shankweiler (Eds.), *Phonological processes in literacy* (pp. 199-209). Hillsdale, NJ: Lawrence Erlbaum Associates.

Goulandris, N. K. (1992). Alphabetic spelling: Predicting eventual literacy attainment. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 143-158). Bristol, UK: Longdunn Press.

Goulandris, N. K. (1994). Teaching spelling: Bridging theory and practice. In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 407-423). Chichester: John Wiley & Sons Ltd.

Graves, D. (1983). *Writing: Teachers and children at work.* Portsmouth, NH: Heinemann Educational Books.

Gray, W. S. (1925). *24th Yearbook of the NSSE Part 1- Report of the National Committee on Reading*. Bloomington, Ill: Public School Publishing Co.

Greenfield, S. (1997). *The human brain - A guided tour.* London, UK: Weidenfeld & Nicolson.

Greenfield, S. (2000). *Andrew Olle Memorial Trust Lecture*, [Broadcast Transcript]. Australian Broadcasting Commision, 10 June.

Griffith, P. (1991). Phoneme awareness help first graders invent spellings and third graders remember correct spellings. *Journal of Reading Behaviour, 23*, 215-233.

Groff, P. (1984). Resolving the letter name controversy. *The Reading Teacher, 37*(4), 384-388.

Groff, P. (1986). The implications of developmental research: A dissenting view. *The Elementary School Journal, 86*(3), 317-323.

Groff, P. (1987). *Preventing reading failure.* Portland, OR: National Book.

Groff, P. (1998). Where's the phonics? Making a case for its direct and systematic instruction. *The Reading Teacher, 52*(2), 138-141.

Hall, J., & King, R. (1992). Psycholinguistics vs phonemics: Can these approaches be reconciled. *Australasian Journal of Special Education, 16*(1), 27-35.

Hammill, D., & McNutt, G. (1981). *Correlates of reading*. Austin, Texas: PRO-ED.

Hempenstall, K. (1997a). Whole Language takes on golf. *Australian Journal of Learning Disabilities, 2*(1), 28-29.

Hempenstall, K. (1997b). The Whole Language-Phonics controversy: An historical perspective. *Educational Psychology, 17*(4), 399-418.

Henderson, E. H. (1980). Developmental concepts of word. In E. H. Henderson & J. W. Beers (Eds.), *Developmental and cognitive aspects of learning to spell - A reflection of word knowledge* (pp. 1-14). Newark: International Reading Association.

Henderson, E. H. (1985). *Teaching spelling*. Boston, MA: Houghton Mifflin.

Henry, M. (1997). The decoding/spelling curriculum: Integrated decoding and spelling instruction from pre-school to early secondary school. *Dyslexia, 3*, 178-189.

Hewitt, S. (1997, 6 August). Literacy a national disgrace. *The West Australian*, p. 4.

Hewitt, S. (2000, 19 June). Our kids fail: Literacy shock in primary schools. *The West Australian*, p. 1.

Hill, P., & Crevola, C. (1998). Characteristics of an effective literacy strategy. *Unicorn, 24*(2), 74-85.

Hoien, T., Lundberg, I., Stanovich, K. E., & Bjaalid, I. (1995). Components of phonological awareness. *Reading and Writing, 7*, 171-188.

Holdaway, D. (1979). *The foundations of literacy*. New York: Ashton Scholastic.

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing: An Interdisciplinary Journal, 2*, 127-160.

Hoover, W. A., & Tunmer, W. E. (1993). The components of reading. In G. B. Thompson, W. E. Tunmer, & T. Nicholson (Eds.), *Reading acquisition processes* (pp. 1-14). Clevedon: Multilingual Matters Ltd.

Huey, E. (1908). *Psychology and pedagogy of reading*. New York: McMillan.

Huxford, L., Terrell, C., & Bradley, L. (1992). 'Invented' spelling and learning to read. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 159-168). Bristol, UK: Longdunn Press.

Invernizzi, M., Abouzeid, M., & Gill, J. (1994). Using students' invented spellings as a guide for spelling instruction that emphasizes word study. *The Elementary School Journal, 95*(2), 155-167.

Jackson, M. (1992). The meeting place of language from experience, phonological coding, mastery learning and the task of reading. *Australian Journal of Remedial Education, 24*(1), 16-18.

Jastak, S., & Wilkinson, G. S. (1984). *The Wide Range Achievement Test - Revised*. Wilmington, Delaware: Jastak Associates.

Jorm, A. F., & Share, D. L. (1983). Phonological recoding and reading acquisition. *Applied Psycholinguistics, 4*, 103-147.

Joseph, L. M. (1999). Word boxes help children with learning disabilities identify and spell words. *The Reading Teacher, 52*(4), 348-356.

Joseph, R. (1993). *The naked neuron.* New York: Plenum.

Juel, C., Griffith, P. L., & Gough, P. B. (1986). The acquisition of literacy: a longitudinal study of children in first and second grade. *Journal of Educational Psychology, 78*, 243-255.

Kameenui, E. J., & Simmons, D. C. (1990). *Designing instructional strategies: The prevention of academic learning problems*. Columbus, Ohio: Merrill.

Kamhi, A., Catts, H., Mauer, D., Apel, K., & Gentry, B. (1988). Phonological and spatial processing abilities in language and reading impaired children. *Journal of Hearing and Speech Disorders, 53*, 316-327.

Kamhi, A. G., & Catts, H. W. (1989). Language and reading: Convergences, divergences and development. In A. G. Kamhi & H. W. Catts (Eds.), *Reading disabilities: A developmental language perspective* (pp. 1-34). Boston: Little, Brown and Company.

Katz, R. (1986). Phonological deficiencies in children with reading disability: Evidence from an object-naming task. *Cognition, 22*, 225-257.

Kemp, D. (1997a). National literacy plan adopted. *Minister Archive K9.* Canberra: The Office of the Minister for Education, Training and Youth Affairs.

Kemp, D. (1997b). Literacy. *Minister Archive K64.* Canberra: The Office of the Minister for Education, Training and Youth Affairs.

Latham, R., & Sloan, P. (1979). *A modern view of reading*. Melbourne: Nelson.

Lecours, A. R. (1975). Myelogenetic correlates of the development of speech and language. In E. H. Lenneberg & E. Lenneberg (Eds.), *Foundations of language development: A multidisciplinary approach* . London: Academic Press.

Levine, K. (1986). *The social context of literacy.* New York: Routledge and Kegan Paul Inc.

Levine, M. D. (1998). *Developmental variation and learning disorders.* Cambridge: Educators Publishing Service, Inc.

Liberman, A. M., Cooper, F. S., Shankweiler, D., & Studdert-Kennedy, M. (1967). Perception of the speech code. *Psychological Review, 74*, 731-761.

Liberman, I., Rubin, H., Duques, S., & Carlisle, J. (1985). Linguistic abilities and spelling proficiency in kindergartners and adult poor spellers. In J. Kavangh & D. Gray (Eds.), *Biobehavioural measures of dyslexia* (pp. 53-79). Parkton, MD: York Press Inc.

Liberman, I. Y. (1971). Basic research in speech and the lateralisation of language: Some implications for reading disability. *Bulletin of the Orton Society, 21*, 71-87.

Liberman, I. Y. (1973). Segmentation of the spoken word and reading acquisition. *Bulletin of the Orton Society, 23*, 65-77.

Liberman, I. Y., & Liberman, A. M. (1990). Whole language versus code emphasis: Underlying assumptions and their implications for reading instruction. *Annals of Dyslexia, 40*, 51-76.

Liberman, I. Y., Liberman, A. M., Mattingly, I., & Shankweiler, D. (1980). Orthography and the beginning reader. In J. F. Kavanagh & R. L. Venezky (Eds.), *Orthography, Reading and Dyslexia* (pp. 116-129). Baltimore: University Park Press.

Liberman, I. Y., & Shankweiler, D. (1979). Speech, the alphabet, and teaching children to read. In L. B. Resnick & P. A. Weaver (Eds.), *Theory and practice of early reading* (pp. 109-128). Hillsdale: Lawrence Erlbaum.

Liberman, I. Y., & Shankweiler, D. (1985). Phonology and the problems learning to read and write. *Remedial and Special Education*(6), 8-17.

Liberman, I. Y., Shankweiler, D., Liberman, A. M., Fowler, C., & Fisher, F. W. (1977). Phonetic segmentation and recoding in the beginning reader. In A. S. Reber & D. I. Scarborough (Eds.), *Toward a psychology of reading: The proceedings of the CUNY Conferences* (pp. 207-225). Hillsdale, NJ: Erlbaum.

Lieberman, P. (1973). On the evolution of language: A unified view. *Cognition, 2*, 59-94.

Lindamood, P. C. (1994). Issues in researching the link between phonological awareness, learning disabilities and spelling. In G. R. Lyon (Ed.), *Frames of reference for the assessment of learning disabilities: New views on measurement issues* (pp. 351-374). Baltimore, PH: Brookes Publishing Co.

Lipson, M. Y., & Wixon, K. K. (1997). *Assessment and instruction of reading and writing disability: An interactive approach.* (2nd ed.). New York: Longman.

Lombardino, L. J., Bedford, T., Fortier, C., Carter, J., & Brandi, J. (1997). Invented spelling: Developmental patterns in kindergarten children and guidelines for early literacy intervention. *Language, Speech & Hearing Services in Schools, 28*(4), 333-343.

Lundberg, I., Frost, J., & Petersen, O. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children. *Reading Research Quarterly, 23*, 263-284.

Luria, A. (1980). *Higher cortical functions in man*. New York: Basic Books.

Maclean, M., Bryant, P. E., & Bradley, L. (1987). Rhymes, nursery rhymes and reading in early childhood. *Merrill Palmer Quarterly, 33*, 255-282.

Manguel, A. (1996). *A history of reading*. London: Harper Collins.

Mann, V. (1986). Phonological awareness: the role of reading experience. *Cognition, 24*, 65-92.

Mann, V., Tobin, P., & Wilson, R. (1987). Measuring phonological awareness through the invented spellings of kindergarten children. *Merrill Palmer Quarterly, 33*, 365-391.

Marsh, G., Friedman, M., Welch, V., & Desberg, P. (1980). The development of strategies in spelling. In U. Frith (Ed.), *Cognitive Processes in Spelling* (pp. 339-354). London: Academic Press.

Marsh, G., Friedman, M. P., Desberg, M. P., & Saterdhal, K. (1981a). A cognitive developmental theory of reading acquisition. In T. G. Waller & G. E. MacKinnon (Eds.), *Reading research: advances in theory and practice* (Vol. 1, pp. 145-187). New York: Academic Press.

Marsh, G., Friedman, M. P., Desberg, M. P., & Saterdhal, K. (1981b). Comparison of reading and spelling strategies in normal and reading disabled children. In M. P. Friedman, J. P. Das, & N. O'Conner (Eds.), *Intelligence and learning* (pp. 363-367). New York: Plenum.

Masonheimer, P. E., Drum, P. A., & Ehri, L. C. (1984). Does environmental print identification lead children into word reading? *Journal of Reading Behaviour, 16*, 257-271.

McBride-Chang. (1998). The development of invented spelling. *Early Education and Development, 9*(2), 147-160.

Merrill, M. D. (1992). Constructivism and instructional design. In T. M. Duffy & D. H. Jonassen (Eds.), *Constructivism and the technology of instruction* . Hillsdale, NJ: Erlbaum.

Miles, E., & Miles, T. R. (1994). The interface between research and remediation. In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 442-457). Chichester: John Wiley & Sons Ltd.

Miles, T. R., & Miles, E. (1990). *Dyslexia: A hundred years on.* Buckingham: Open University Press.

Moats, L. C. (1995). *Spelling: development, disability and instruction.* Maryland, USA: York Press.

Moffett, J., & Wagner, B. (1992). *Student-centered language arts, K-12.* Portsmouth, NH: Boynton/Cook Heinemann.

Moffett, J., & Wagner, B. J. (1993). What works is play. *Language Arts, 70*, 32-36.

Molfese, D. L. (1983). Neural mechanisms underlying the processing of speech information in infants and adults. In U. Kirk (Ed.), *The neuropsychology of language, reading and spelling*. New York: Academic Press.

Montgomery, D. (1997). *Spelling: Remedial strategies*. London: Cassell.

Morais, J., Cary, I., Algeria, J., & Bertelson, P. (1979). Does speech sequences of phones arise spontaneously? *Cognition, 7*, 323-331.

Morris, D. (1989). Editorial comment: Developmental spelling theory revisited. *Reading Psychology, 3*, 247-259.

Morris, D., & Perney, J. (1984). Developmental spelling as a predictor of first-grade reading achievement. *The Elementary School Journal, 84*(4), 441-457.

Moseley, D. (1994). From theory to practice: Errors and trials. In G. D. A. Brown & N. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 459-479). Chichester: John Wiley & Sons Ltd.

Munro, J. (1998). Phonological and phoneme awareness: Their impact on learning to read prose and to spell. *Australian Journal of Learning Disabilities, 3*(2), 15-21.

Muter, V., & Snowling, M. (1997). Grammar and phonology predict spelling in middle childhood. *Reading and Writing: An Interdisciplinary Journal, 9*, 407-425.

Nation, K., & Hulme, C. (1997). Phonemic segmentation, not onset-rime segmentation, predicts early reading and spelling skills. *Reading Research Quarterly, 32*(2), 154-167.

National Reading Panel (2000). *Teaching children to read: Reports of the subgroups.* Washington DC: National Institute of Child Health and Human Development.

Nicholson, T., & Lam, R. (1998). Whole-Language teachers and phonics. *Australian Council for Educational Research: Research Information for Teachers, 2*(6), 1-4.

Nolen, P., & McCartin, R. (1984). Spelling strategies on the Wide Range Achievement Test. *Reading Teacher, 38*(2), 148-58.

O'Connòr, R.E., Notari-Syverson, A., & Vadasy, P.E. (1996). Ladders to literacy: The effects of teacher-led phonological activities for Kindergarten children with and without disabilities. *Exceptional Children, 63*(1), 117-130.

Olson, A., & Caramazza, A. (1994). Representation and connectionist models: The NETspell experience. In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 339-363). Chichester: John Wiley & Sons Ltd.

Patterson, K. E. (1982). The relation between reading and phonological coding: Further neuropsychological observations. In A. W. Ellis (Ed.), *Normality and pathology in cognitive functions* (pp. 14-29). London: Academic Press.

Pattison, H. M., & Collier, J. (1992). Methodological Issues in the investigation of spelling and spelling development. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 100-114). Bristol, UK: Longdunn Press.

Pei, I. (1955). *The Story of English.* New York: Lippincott.

Pennington, B. F. (1991). *Diagnosing learning disorder: A neuropsychological framework.* New York: The Guildford Press.

Perfetti, C., Beck, I., Bell, L. C., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first grade children. *Merrill Palmer Quarterly, 33*(3), 283-319.

Perfetti, C. A. (1985). *Reading ability.* New York: Academic Press.

Perin, D. (1983). Phonemic segmentation and spelling. *British Journal of Psychology*(74), 129-144.

Peters, M. L. (1992). Towards spelling autonomy. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education.* Bristol: Longdunn Press.

Pinker, S. (1994). *The language instinct.* London: Penguin.

Posner, M. I., & Raichle, M. E. (1994). *Images of mind.* New York: Scientific American Library.

Pratt, C., Tunmer, W., & Bowey, J. (1984). Children's capacity to correct grammatical violations in sentences. *Journal of Child Language, 11*(2), 129-141.

Preen, B., & Barker, D. (1987). *Literacy development.* Marrickville: Harcourt Brace Jovanovich Ltd.

Preen, B., & Townsend, D. (1992). *Brain lateralisation and reading problems.* Perth, WA: Summerhill Clinic Monographs.

Rack, J. P., Snowling, M. J., & Olson, R. K. (1992). The non-word reading deficit in developmental dyslexia: A review. *Reading Research Quarterly, 27*, 29-53.

Rayner, K., & Pollatsek, A. (1989). *The psychology of reading*. Englewood Cliffs: N J: Prentice-Hall Inc.

Read, C. (1971). Pre-school children's knowledge of English phonology. *Harvard Educational Review, 41*, 1-34.

Read, C. (1975). *Children's categorisation of speech sounds in English*. Urbana, Ill: National Council of Teachers of English.

Read, C. (1980). Creative spelling by young children. In T. Shopen & J. Williams (Eds.), *Standards and dialects in English*. Cambridge, Mass: Winthrop Publishers.

Read, C. (1981). Writing is not the inverse of reading for young children. In C. H. Frederiksen & J. F. Dominic (Eds.), *Writing: The nature, development and teaching of written communication* (Vol. 2,). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Read, C. (1986). *Children's creative spelling*. London: Routledge & Kegan Paul.

Read, C., & Ruyter, L. (1985). Reading and spelling skills in adults of low literacy. *Remedial and Special Education, 6*, 43-52.

Read, C., Zhang, Y., Nie, H., & Ding, B. (1987). The ability to manipulate speech sounds depends on knowing alphabetic writing. In P. Bertelson (Ed.), *The onset of literacy: Cognitive processes in reading acquisition* (pp. 31-44). Cambridge, MA: The MIT Press.

Restak, R. M. (1979). *The brain: The last frontier*. New York: Doubleday.

Richardson, S. O. (1989). Specific developmental dyslexia: Retrospective and prospective views. *Annals of Dyslexia, 39*, 3-23.

Richgels, D. (1986). An investigation of preschool and kindergarten children's spelling and reading activities. *Journal of Research and Development in Education, 19*(4), 41-47.

Rohl, M., & Tunmer, W. (1988). Phonemic segmentation skill and spelling acquisition. *Applied Psycholinguistics, 9*, 335-350.

Rosner, J. (1974). Auditory analysis training with prereaders. *The Reading Teacher, 27*(4), 379-384.

Rubin, H., & Eberhardt, N. (1996). Facilitating invented spelling through language analysis instruction: An integrated model. *Reading & Writing: An Interdisciplinary Journal, 8*(1), 27-43.

Salvia, J., & Ysseldyke, J. E. (1998). *Assessment in special and remedial education*. (7th ed.). Boston, NY: Houghton Mifflin Company.

Samuels, S. J. (1971). Letter-name versus letter-sound knowledge in learning to read. *The Reading Teacher, 24*(7), 604-608.

Samuels, S. J. (1976). Automatic decoding and reading comprehension. *Language Arts, 53*, 323-325.

Schatschneider, C., Francis, D., Foorman, B., Fletcher, J., & Mehta, P. (1999). The dimensionality of phonological awareness: An application of item response theory. *Journal of Educational Psychology, 91*, 439-449.

Schonell, F. J. (1932). *Essentials in teaching and testing spelling*. London: Macmillan.

Seidenberg, M. S., & McClelland, J. L. (1989). Visual word recognition and pronunciation: A computational model of acquired skilled performance and dyslexia. In A. Galaburda (Ed.), *From reading to neurons* (pp. 68-99). Cambridge MA: MIT Press/Bradford Books.

Seymour, P. H., Bunce, F., & Evans, H. K. (1992). A framework for orthographic assessment and remediation. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 33-49). Bristol, UK: Longdunn Press.

Seymour, P. H., & Elder, L. (1986). Beginning reading without phonology. *Cognitive Neuropsychology, 3*, 1-36.

Seymour, P. H. (1992). Cognitive theories of spelling and implications for education. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 50 - 70). Bristol, UK: Longdunn Press.

Shallice, T. (1981). Phonological agraphia and lexical route in writing. *Brain, 104*, 413-429.

Shanahan, T. (1984). Nature of the reading-writing connection: An exploratory multivariate analysis. *Journal of Educational Psychology, 86*, 221-234.

Shanahan, T., & Lomax, R. G. (1986). An analysis and comparison of theoretical models of the reading-writing relationship. *Journal of Educational Psychology, 78*, 116-123.

Shankweiler, D., & Liberman, I. (1972). Misreading: A search for causes. In J. F. Kavanaugh & I. C. Mattingly (Eds.), *Language by eye and by ear* (pp. 293-317). Cambridge, MA: MIT Press.

Shankweiler, D., & Liberman, I. Y. (1976). Exploring the relations between reading and speech. In J. Knights & D. J. Bakker (Eds.), *The Neuropsychology of Learning Disorders* (pp. 42-83). Baltimore: The Uni Park Press.

Share, D. L., Jorm, A. F., Maclean, R., & Matthews, R. (1984). Sources of individual differences in reading acquisition. *Journal of Educational Psychology, 76*, 1309-1324.

Shaywitz, S. (1996). Dyslexia. *Scientific American, 275*(5), 98-104.

Shaywitz, S., & Lyon, G. R. (1998). *Unscrambling Dyslexia*, [Television interview by J. Lehrer]. Public Broadcasting System, 11 March.

Silberman, A. (1989). *Growing up writing: Teaching our children to write, think and learn.* New York: Times Books.

Sloan, P., & Latham, R. (1981). *Teaching Reading IS.* Melbourne: Thomas Nelson.

Smith, F. (1971). *Understanding Reading.* NY: Holt, Rinehart & Winston.

Smith, F. (1973a). Alphabetic writing - a language compromise? In F. Smith (Ed.), *Psycholinguisitics and reading.* New York: Holt, Rinehart and Winston.

Smith, F. (1973b). *Psycholinguistics and reading.* New York: Holt, Rinehart and Winston.

Smith, F. (1985). *Reading.* Cambridge: Cambridge University Press.

Smith, F. (1999). Why systematic phonics and phonemic awareness instruction constitute an educational hazard. *Language Arts, 77*(2), 150-155.

Smith, S. B., Simmons, D. C., & Kameenui, E. J. (1998). Phonological awareness: Research bases. In D. C. Simmons & E. J. Kameenui (Eds.), *What reading research tells us about children with diverse learning needs: bases and basics* (pp. 61-127). Mahwah, NJ: Lawrence Erlbaum Associates.

Snider, V. E. (1995). A primer on phonological awareness: What it is, why it's important, and how to teach it. *School Psychology Review, 24*, 443-455.

Snow, C., Burns, S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children: National Research Council (NRC) Committee on the Prevention of Reading Difficulties in Young Children.* Washington D.C,: National Academy Press.

Snowling, M. (1994). Toward 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: John Wiley & Sons Ltd.

Snowling, M., & Nation, K. (1997). Language, phonology and learning to read. In C. Hulme & M. Snowling (Eds.), *Dyslexia, biology, cognition and intervention* (pp. 42-59). Gateshead: Athanaeum Press.

Snowling, M. J. (1985). The assessment of reading and spelling skills. In M. J. Snowling (Ed.), *Children's written language difficulties* (pp. 80-96). Windsor: NFER: Nelson.

Snowling, M. J., Stackhouse, J., & Rack, J. (1986). Phonological dyslexia and dysgraphia: Developmental aspects. *Cogntive Neuropsychology, 3*, 309-339.

Spector, J. (1995). Phoneme awareness training: Application of principles of direct instruction. *Reading and Writing Quarterly, 11*, 37-51.

SPSS, (1994). Statistical Package for Social Sciences: 6.1 for Windows Student Version. NJ: Prentice-Hall.

Stacey, S., & Wheldall, K. (1999). Essential components of successful reading instruction for low progress readers. *Special Education Perspectives, 8*(1), 44-58.

Stage, S., & Wagner, R. (1992). Development of young children's phonological and orthographical knowledge as revealed by their spellings. *Developmental Psychology, 28*, 287-296.

Stahl, S. A., Duffy-Hester, A. M., & Stahl, K. A. (1998). Theory and research into practice: Everything you wanted to know about phonics (but were afraid to ask). *Reading Research Quarterly, 33*(3), 338-355.

Stahl, S. A., & Miller, P. D. (1989). Whole language and language experience approaches for beginning reading: A quantitative research synthesis. *Review of Educational Research, 59*, 87-116.

Stahl, S. A., & Murray, B. (1998). Issues involved in defining phonological awareness and its relation to early reading. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 65-89). Mahwah, NJ: Lawrence Erlbaum.

Stahl, S. A., & Murray, B. A. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology, 86*, 221-234.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21*, 360-406.

Stanovich, K. E. (1991a). Word recognition: Changing perspectives. In R. Barr, M. L. Kamil, P. B. Mosenthal, & P. D. Pearson (Eds.), *Handbook of reading research* (Vol. 2, pp. 418-452). New York: Longman.

Stanovich, K. E. (1991b). Discrepancy definitions of reading disability: Has intelligence lead us astray? *Reading Research Quarterly, 26*, 7-29.

Stanovich, K. E., & Cunningham, A. E. (1992). Studying the consequences of literacy within a literate society: The cognitive correlates of print exposure. *Memory and Cognition, 20*, 51-68.

Stanovich, K. E., Nathan, R. G., & Zolman, D. J. (1988). The developmental lag hypothesis in reading: Longitudinal and matched reading-level comparisons. *Child Development, 59*, 71-86.

Stanovich, K. E., & Siegel, L. S. (1994). Phenotypic performance profile of children with reading disabilties: A regression-based test of the phonological-core variable-difference model. *Journal of Educational Psychology, 86*(1), 24-53.

Sterling, C., & Seed, J. (1992). Phonological spelling in young children and some origins of phonetically plausible and implausible errors. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 268-282). Bristol, UK: Longdunn Press.

Stuart, M., & Colheart, M. (1998). Does reading develop in a sequence of stages. *Cognition, 30*, 139-181.

Sulzby, E. (1986). Children's elicitation and use of metalinguistic knowledge about 'word' during literacy interactions. In D. B. Yaden & S. Templeton (Eds.), *Metalinguistic awareness and beginning literacy* (pp. 219-234). Portsmouth, NH: Hienemann.

Tangel, D., & Blachman, B. (1992). Effect of phoneme awareness instruction on kindergarten children's invented spelling. *Journal of Reading Behaviour, 24*, 233-261.

Tangel, D., & Blachman, B. (1995). Effect of phoneme awareness instruction on the invented spelling of first-grade children: A one year follow-up. *Journal of Reading Behaviour, 27*(2), 153-177.

Tawney, J. W., & Gast, D. L. (1984). *Single subject research in special education.* Columbus: Merrill.

Taylor, E., & Martlew, M. (1992). Developmental differences in phonological spelling strategies. In C. Sterling & C. Robson (Eds.) (pp. 168-184). Bristol, UK: Longdunn Press.

Taylor, I. (1981). Writing Systems and Reading. In G. E. MacKinnon & T. G. Waller (Eds.), *Reading Research: Advances in Theory and Practice, Vol 2* (pp. 1-47). New York: Academic Press.

Temple, C., Nathan, R., & Burris, N. (1982). *The beginnings of writing.* Boston: Allyn & Bacon.

Templeton, S. (1980). What is a word? In E. H. Henderson & J. W. Beers (Eds.), *Developmental and cognitive aspects of learning to spell - A reflection of word knowledge* (pp. 15-35). Newark: International Reading Association.

Templeton, S., & Morris, D. (1999). Questions teachers ask about spelling. *Reading Research Quarterly, 34*(1), 102-112.

Thomson, M. E. (1999). Phonological skills: Comments from the chalk face. *Australian Journal of Learning Disabilities, 3*(2), 27-37.

Torgesen, J. K., & Bryant, B. (1994). *Test of phonological awareness.* Austin, Texas: Pro-Ed.

Torgesen, J. K., & Davis, C. (1996). Individual difference variables that predict response to training in phonological awareness. *Journal of Experimental Child Psychology, 63*, 1-2.

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1994). Longitudinal studies of phonological processing and reading. *Journal of Learning Disabilities, 27*, 276-286.

Torgeson, J. K. (1998). Catch them before they fall: Identification and assessment to prevent reading failure in young children. *Amercian Educator, 22*(Spring/Summer), 32-39.

Treiman, R. (1985a). Onsets and rimes as units of spoken syllables: Evidence from children. *Journal of Experimental Child Psychology, 39*, 161-181.

Treiman, R. (1985b). Phonemic awareness and spelling: Children's judgements do not always agree with adults. *Journal of Experimental Child Psychology, 39*(1), 182-201.

Treiman, R. (1986). The division between onsets and rimes in English syllables. *Journal of Memory and Language, 25*, 476-491.

Treiman, R. (1992). The role of intrasyllabic units in learning to read and spell. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 65-106). Hillsdale, NJ: Erlbaum.

Treiman, R. (1993). *Beginning to Spell: A study of first-grade children.* New York: Oxford.

Treiman, R. (1994). Sources of information used by beginning spellers. In G. D. A. Brown & N. C. Ellis (Eds.), *Handbook of spelling: Theory, process and intervention* (pp. 75-91). Chichester: Wiley.

Treiman, R. (1995). What happened to the "n" of sink? Children's spellings of final consonant clusters. *Cognition, 55*(1), 1-38.

Treiman, R. (1998). Why spelling? In J. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 289-313). Mahwah, NJ: Lawrence Erlbaum Associates.

Trevarthen, C. (Ed.). (1983). *Development of the cerebral mechanisms for language*. London: Academic Press.

Tunmer, W., Pratt, C., & Herriman, M. (1984). *Metalinguistic awareness in children: Theory, research and implications*. New York: Springer-Verlag.

Tunmer, W. E., Chapman, J. W., Ryan, H., & Prochnow, J. E. (1998). The importance of providing beginning readers with explicit training in phonological processing skills. *Australian Journal of Learning Disabilities, 3*(2), 4-14.

Tunmer, W. E., Herriman, M. L., & Nesdale, A. R. (1988). Metalinguistic abilities and beginning reading. *Reading Research Quarterly, 23*, 134-158.

Tunmer, W. E., & Nesdale, A. R. (1985). Phoneme segmentation and beginning reading. *Journal of Educational Psychology, 77*(4), 417-427.

Turbill, J. (1982). *No better way to teach writing!* Rozelle, NSW: Primary English Teaching Association.

Uhry, J., & Shepherd, M. J. (1993). Segmentation/spelling instruction as a part of first-grade reading program: Effects on several measures of reading. *Reading Research Quarterly, 28*, 219-233.

Upward, C. (1992). Is traditionl english spelng mor dificlt than jermn? *Journal of Research in Reading, 15*, 82-94.

Valtin, R. (1984). The development of metalinguistic abilities in children learning to read and write. In J. Downing & R. Valtin (Eds.), *Language awareness and learning to read*. New York: Springer-Verlag.

van Bon, W. H., & de Haag, I. J. (1997). Difficulties with consonants in the spelling and segmentation of CCVCC pseudowords: Differences amongst Dutch first graders. *Reading and Writing: An Interdisciplinary Journal, 9*, 363-386.

Vandervelden, M. C., & Siegel, L. S. (1995). Phonological recoding and phoneme awareness in early literacy: A developmental approach. *Reading Research Quarterly, 30*, 854-873.

Varnhagen, C. K., Mc Callum, M., & Burstow, M. (1997). Is children's spelling naturally stage-like? *Reading and Writing: An Interdisciplinary Journal, 9*, 451-481.

Vellutino, F. R. (1979). *Dyslexia: Theory and research.* London: MIT Press.

Vellutino, F. R., & Scanlon, D. M. (1987). Phonological coding, phonological awareness and reading ability: Evidence from a longitudinal and experimental study. *Merrill-Palmer Quarterly, 33*, 321-363.

Veltman, R. (1992). An orthography as a theory of a language. In C. Sterling & C. Robson (Eds.), *Psychology, spelling and education* (pp. 30-42). Bristol, UK: Longdunn Press.

Wade-Woolley, L., & Siegel, L. S. (1997). The spelling performance of ESL and native speakers of English as a function of reading skill. *Reading and Writing: An Interdisciplinary Journal, 9*, 387-406.

Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquistion of reading skill. *Psychological Bulletin, 101*, 192-212.

Wagner, R. K., Torgesen, J. K., Laughon, R., Simmons, K., & Rashotte, C. A. (1993). Development of young readers' phonological processing abilities. *Journal of Educational Psychology, 85*, 83-103.

Walshe, R. D. (1981). *Every child can write! Learning and teaching written expression in the 1980s*. Rozelle, NSW: Primary English Teaching Association.

Waters, G. S., Bruck, M., & Seidenberg, M. (1985). Do children use similar processes to read and spell words? *Journal of Experimental Psychology, 39*, 511-530.

Weaver, C. (1988). *Reading process and practice: From socio-psycholinguistics to whole language*. Portsmouth, New Hampshire, USA: Heinemann Books.

Weinfurt, K. P. (1995). Multivariate analysis of variance. In L. G. Grim & P. G. Yarnold (Eds.), *Reading and understanding multivariate statistics* (pp. 245 -276). London: American Psychological Association.

Weir, R. (1990). Philosophy, cultural beliefs and literacy. *Interchange, 21*(4), 24-33.

Western Australian Ministry of Education. (1992a). *First Steps: Reading developmental continuum.* Perth, Western Australia: Western Australian Ministry of Education.

Western Australian Ministry of Education. (1992b). *First Steps: Using a spelling journal in the language program.* Perth: Western Australia: Western Australian Ministry of Education.

Western Australian Ministry of Education. (1995). *First Steps notes for presenters: Spelling developmental continuum.* Perth: Western Australian Ministry of Education.

Westwood, P. (1994). Issues in spelling instruction. *Special Education Perspectives, 3*(1), 1-8.

Willows, D. M., & Scott, R. (1994). Spelling processes of the reading disabled. In G. D. A. Brown & N. C. Ellis (Eds.), *Spelling: Theory, process and intervention* (pp. 194-210). Chichester: John Wiley & Sons Ltd.

Woodcock, R. W. (1998). *Woodcock Reading Mastery Tests - Revised: Examiner's manual.* Minnesota: AGS.

Yaden, D. B., & Templeton, S. (1986). *Metalinguistic awareness and beginning literacy.* Portsmouth: Heinemann.

Yatvin, J. (1991). *Developing a whole language program for a whole school.* Richmond, VA: Virginia State Reading Association.

Yopp, H. (1988). The validity and reliability of phonemic awareness tests. *Reading Research Quarterly, 23*, 159-177.

Yopp, H. K. (1995). A test for assessing phonemic awareness in young children. *The Reading Teacher, 49*, 20-29.

Zutell, J. (1980). Children's spelling strategies and their cognitive development. In E. H. Henderson & J. W. Beers (Eds.), *Spelling strategies and cognitive development* (pp. 14-39). Newark: International Reading Association.

APPENDICES

APPENDIX A

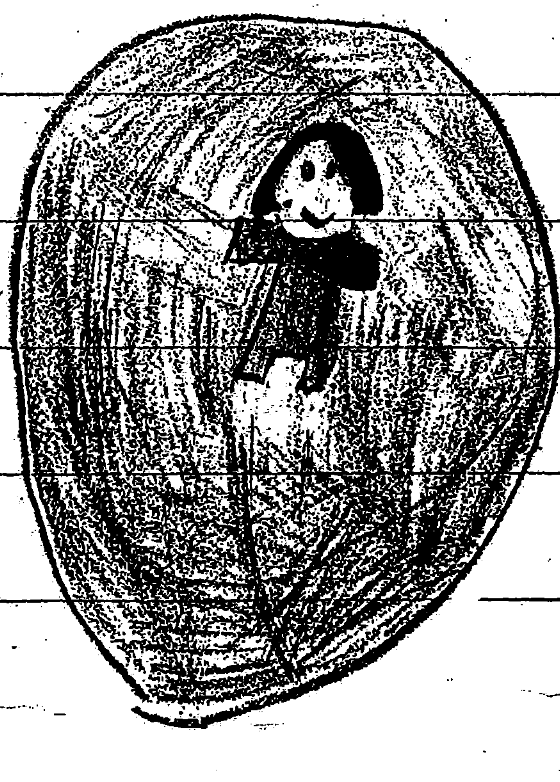
CASE STUDY 'ROSIE'

WRITING SAMPLES

'Rosie'
Writing sample

27-8-98

Today I'm going
to Swimming lessons.

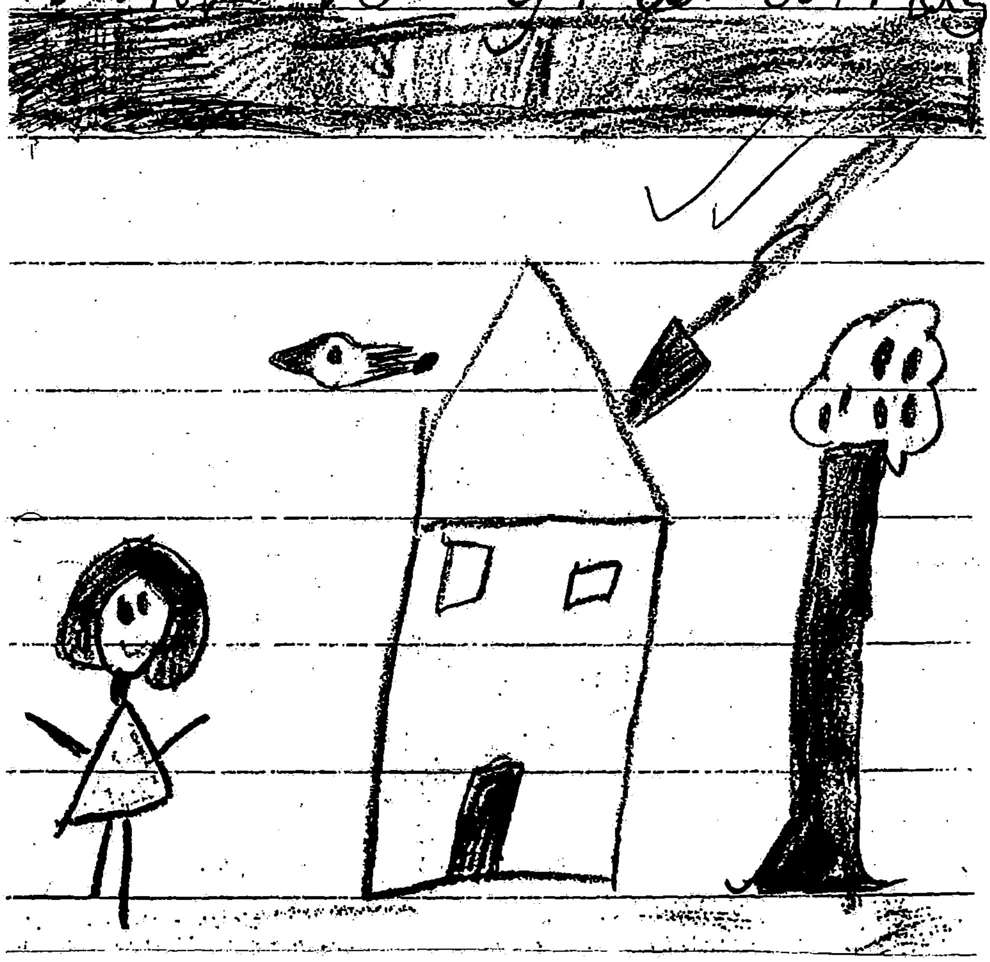


'Rosie'
Writing sample

29-6-98

On the Weekend

Iwent to grandma's



APPENDIX B

CASE STUDY 'ROSIE'

HAVE-A-GO-PAD

HAVE-A-GO

Me	Check
conuon	fly
lenoS	legs
heonu	hairy
lenum	love
	hearts
napo	butterfly
StONt	swimming

HAVE-A-GO

Me	Check
ljotheY	jumped
ciehce	castle
lenscn	Land
lsntf	soft
heUtee	has
run	
ist	in

APPENDIX C

CASE STUDY 'ROSIE'

SPELLING TEST AND

WRITING SAMPLE UNDER

TEST CONDITIONS

‘Rosie’
Spelling test and writing sample

ABcDEFgHIjKLNMoqaRSTuvWxYz

can rag
net caen fun top rög

man land
hit yes nes len

Soni

Weekend Sleep. grandma
the Wneeto gomenot

Sotmmeigin

APPENDIX D

POST HOC DATA POST HOC ANALYSIS - END OF YEAR 1 CONVENTIONAL SPELLING AND WORD ATTACK

CLASS A	WRAT ST. SC.	WOODCOCK WORD ATT ST. SC.
PHAM1	128	118
PHAM2	108	84
PHAM3	117	106
PHAM4	133	123
PHAM5	114	101
PHAM6	98	103
PHAM7	142	113
PHAF1	120	97
PHAF2	121	90
PHAF3	106	93
PHAF4	124	103
PHAF5	92	101
PHAF6	117	105
PHAF7	127	90

CLASS B	WRAT ST. SC.	WOODCOCK WORD ATT ST. SC.
PHBM1	123	115
PHBM2	127	114
PHBM3	121	106
PHBM4	114	99
PHBM5	114	99
PHBM6	112	97
PHBM7	128	120
PHBM8	101	105
PHBM9	105	90
PHBM1	117	102
PHBF1	123	103
PHBF2	118	97
PHBF3	139	120
PHBF4	112	102
PHBF5	118	102

CLASS C	WRAT ST. SC.	WOODCOCK WORD ATT ST. SC.
PHCM1	149	124
PHCM2	127	106
PHCM3	121	98
PHCM4	103	99
PHCM5	106	97
PHCM6	103	94
PHCF1	98	92
PHCF2	117	98
PHCF3	114	97
PHCF4	124	107
PHCF5	124	102
PHCF6	114	90
PHCF7	121	105
PHCF8	128	118
PHCF9	114	99

APPENDIX E

PRE AND POST TEST

PHONEME AWARENESS,

SPELLING AND

READING RESULTS

CONTROL CLASS A

	PRE TEST		POST TEST					
	TOPA ST SC	INVENTED SPELLING /60	TOPA ST SC	INVENTED SPELLING /60	SPELLING ST. SC.	WOODCOCK WORD ID. ST SC	WOODCOCK WORD ATT. ST SC	WOODCOCK PASS COMP. ST SC
CAM1	83	14	87	45	114	106	100	90
CAM2	72	6	111	30	105	81	95	82
CAM3	105	15	107	38	111	87	90	78
CAM4	98	17	121	55	121	111	118	109
CAM5	85	3	98	24	93	68	66	63
CAM6	82	14	113	24	120	72	90	74
CAM7	72	0	102	0	99	70	66	70
CAM8	86	0	102	35	111	80	97	70
CAM9	77	10	91	28	95	76	66	80
CAM10	79	8	94	5	89	68	66	78
CAM11	92	14	116	33	101	98	100	93
CAM12	69	15	97	32	106	102	103	89
CAM13	92	17	87	39	112	89	97	86
CAM14	73	3	80	16	89	50	66	54
CAM15	96	0	60	18	99	75	75	54
CAM16	79	20	104	18	108	98	97	91
CAM17	85	0	97	10	106	50	66	54
CAF1	107	22	87	30	101	90	95	82
CAF2	107	18	105	50	123	105	105	89
CAF3	94	20	95	31	103	100	95	90
CAF4	92	18	111	36	118	100	99	93
CAF5	116	30	121	39	127	110	103	93
CAF6	104	18	116	42	130	87	90	86
CAF7	98	16	93	39	117	89	75	74
CAF8	92	11	91	31	101	89	92	86
CAF9	92	16	107	34	114	78	66	74
CAF10	105	0	95	46	101	98	99	87
CAF11	99	8	116	38	106	99	90	87
CAF12	102	16	102	33	118	95	86	82

CONTROL CLASS B

	PRE TEST		POST TEST					
	TOPA ST SC	INVENTED SPELLING /60	TOPA ST SC	INVENTED SPELLING /60	SPELLING ST. SC.	WOODCOCK WORD ID. ST SC	WOODCOCK WORD ATT. ST SC	WOODCOCK PASS COMP. ST SC
CBM1	102	0	101	19	105	89	86	80
CBM2	92	9	121	26	102	94	99	96
CBM3	69	0	107	45	108	89	90	74
CBM4	123	20	104	43	111	104	106	96
CBM5	101	10	93	32	112	83	92	80
CBM6	79	12	104	27	111	75	92	82
CBM7	107	18	111	44	118	85	82	74
CBM8	92	9	111	41	102	79	90	74
CBM9	105	20	102	38	109	88	82	70
CBM10	95	2	83	12	99	62	66	54
CBM11	120	18	121	39	114	88	82	74
CBM12	100	8	107	38	134	85	82	78
CBM13	116	20	121	43	108	88	97	82
CBM14	95	21	101	43	118	104	115	98
CBM15	106	18	111	33	108	88	102	96
CBM16	77	6	82	32	101	79	86	78
CBM17	92	6	101	20	111	90	95	86
CBF1	113	21	97	52	120	98	97	84
CBF2	117	28	111	41	117	98	114	94
CBF3	101	16	121	42	121	98	82	87
CBF4	101	22	116	47	112	94	86	90
CBF5	110	24	121	39	114	95	106	90
CBF6	123	29	107	58	142	106	112	93
CBF7	94	20	91	42	114	98	100	84
CBF8	83	0	82	1	84	62	66	70
CBF9	110	29	107	45	108	98	99	93
CBF10	98	0	123	35	137	90	92	84
CBF11	112	4	123	44	140	92	97	87
CBF12	99	8	100	39	106	92	97	74
CBF13	101	16	105	44	117	102	99	96

INTERVENTION CLASS A

	PRE TEST		POST TEST					
	TOPA ST SC	INVENTED SPELLING /60	TOPA ST SC	INVENTED SPELLING /60	SPELLING ST. SC.	WOODCOCK WORD ID. ST SC	WOODCOCK WORD ATT. ST SC	WOODCOCK PASS COMP. ST SC
IAM1	89	10	105	57	120	107	115	104
IAM2	113	25	116	60	131	117	131	122
IAM3	83	16	121	57	136	106	112	103
IAM4	111	0	116	48	109	90	104	84
IAM5	111	19	116	56	128	108	125	104
IAM6	83	16	105	59	128	114	120	118
IAM7	120	14	121	58	139	113	122	106
IAM8	106	11	121	58	139	113	128	102
IAM9	92	10	116	55	123	103	120	96
IAM10	123	49	121	60	152	130	148	133
IAM11	76	20	101	59	149	126	125	124
IAM12	113	25	111	54	130	104	137	111
IAM13	123	22	116	58	123	113	121	111
IAM14	79	4	96	52	127	90	108	96
IAM15	69	2	111	53	127	90	103	90
IAM16	98	5	121	56	139	118	127	117
IAM17	110	16	121	57	133	101	115	104
IAF1	96	9	116	56	128	102	112	110
IAF2	85	12	121	56	130	105	121	110
IAF3	117	19	123	55	154	107	121	100
IAF4	116	28	116	60	128	120	128	109
IAF5	113	16	116	58	126	102	114	103
IAF6	76	9	121	58	130	105	122	96
IAF7	96	4	123	49	144	89	105	87
IAF8	100	4	123	59	147	104	114	100
IAF9	75	0	93	54	120	95	108	100

INTERVENTION CLASS B

	PRE TEST		POST TEST					
	TOPA ST SC	INVENTED SPELLING /60	TOPA ST SC	INVENTED SPELLING /60	SPELLING ST. SC.	WOODCOCK WORD ID. ST SC	WOODCOCK WORD ATT. ST SC	WOODCOCK PASS COMP. ST SC
IBM1	98	12	107	48	130	99	112	96
IBM2	83	11	101	46	118	88	108	94
1BM3	60	0	92	47	103	80	97	87
IBM4	83	4	121	41	127	94	111	110
IBM5	116	39	111	57	124	113	121	111
IBM6	72	11	102	55	139	103	108	96
IBM7	89	16	89	47	130	88	104	93
IBM8	82	4	91	37	99	78	95	87
IBM9	94	8	91	45	114	97	108	94
IBM10	76	12	111	53	130	81	99	82
1BM12	96	19	111	50	118	94	105	89
IBM13	72	4	97	47	112	93	108	91
IBM14	111	32	116	51	117	98	118	102
1BF1	98	26	121	56	139	119	137	124
IBF2	86	10	104	45	118	93	112	94
IBF3	79	8	116	53	120	98	104	93
IBF4	116	32	121	58	139	113	121	111
IBF5	107	33	105	57	131	114	128	115
IBF6	127	34	123	51	137	94	103	96
IBF7	113	26	102	49	124	97	112	104
IBF8	104	19	92	54	127	88	108	93
IBF9	92	10	100	52	114	95	111	100
IBF10	89	10	121	44	127	95	112	96
IBF11	101	30	102	51	133	105	118	111
IBF12	101	18	105	54	112	103	112	99
IBF13	107	23	116	54	120	105	125	107
IBF14	116	34	105	51	117	98	108	98

APPENDIX F

EXAMPLE OF

DEVELOPMENTAL

SPELLING TEST RATING

SCALE

Developmental Spelling Test Rating Scale for *lap* and *elephant*

Lap

A random string of letters, numerals and/or drawings	0
The initial phoneme represented with a phonetically related letter. May be followed by a random string e.g. *r, lnmnnn, rjn* **Or** A single letter response that represents some *salient* part of the word other than the initial phoneme. May be followed by a random string e.g. *p, pkn*	1
The correct initial phoneme of the word. May be followed by a random string or an alphabet string e.g. *lmnop*	2
More than one phoneme but not all. Must be represented with phonetically related or conventional letters. May include instrusions. When the intrusion is removed, the rest of the letters should be in proper sequence e.g. *lttp, lpa* Or Every phoneme must be represented, but not all with phonetically related letters e.g. *fab, eab*	3
Every phoneme represented with a mix of phonetically related and conventional letters. May include instrusions e.g. *labt, rap, lape*	4
All consonant phonemes with conventional letters and the correct short vowel e.g. *lapp*	5
The correct spelling of the word.	6

Elephant

A random string of letters, numerals and/or drawings	0
A single letter that represents some *salient* part of the word other than the initial phoneme. May be followed by a random string e.g. *l, f, t*	1
The initial syllable represented by *e* or *el*. May be followed by a random string. **Or** Any two phonemes from the word (must be in proper sequence) and may be followed by a random string. The middle syllable (the schwa) may be represented with any vowel e.g. *lftnos, efl, lolot, le,* or *ll, al* or *el* plus any one phomeme, e.g. *alf, elf.*	2
One or two letters from initial syllable (*e, l, el, al, ll)* plus two phonemes from the third syllable e.g. *eft, lfax, alft, llft* **Or** The initial syllable represented with *el, al, e,* or *l,* a vowel to represent the middle syllable, and one or two phonemes from the third syllable e.g. *lot, elof, elovt lyfe, eeft* **Or** The initial syllable represented by *l, al, el,* or *e,* plus three phonemes from the third syllable e.g. *efanl, elfit, alfate, elfnt*	3
The initial syllable represented with *e, l, al,* or *el,* a vowel to represent the middle syllable, and three or more phonemes from the last syllable e.g. *lefan, lifit, elufit, alafinte, elapint* **Or** The initial syllable represented with *el, al, l,* the final syllable represented with four conventional phonemes, including the preconsonantal nasal, but no vowel to represent the middle syllable e.g. *elefent, alfint, llfent*	4
The initial syllable represented, a vowel for the middle syllable, and four conventional or phonetically related phonemes from the third syllable e.g. *elufint, alufint, alefint*	5
The correct spelling of the word.	6

APPENDIX G

'TESS' PRE AND POST TEST

DEVELOPMENTAL

SPELLING TEST RESULTS

Student: CBF8 abcdefghijklmnopqrstuvwxyz 0
February 1999
'Tess'

1. a A t 0

2. l tox d ft 0

3. e e 8 l a 0

4. nntct 0

5. x tomto 0

6. tom to tra [illegible] 0

7. a o [illegible] 0

8. to [illegible] 0

9. t [illegible] 0

10. t [illegible] 0

Student: CBF8 abcdefghijklmnopqrstuvwxyz
December 1999
'Tess'

1. ttti 1 0
2. l 0
3. (0
4. mmmnt 0
5. ntmm 0
6. nutttu 1
7. fTdg 0
8. tnip 0
9. ymo eT 0
10. mn 0

APPENDIX H

'LUKE' PRE AND POST TEST DEVELOPMENTAL SPELLING TEST RESULTS

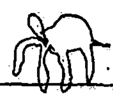
Student: IAM4 abcdefghijklmnopqrstuvwxyz
February 1999
'Luke'

0

1. ______________________ 0

2. ______________________ 0

3. ______________________ 0

4.  ______________________ 0

5. ______________________ 0

6. ______________________ 0

7. ______________________ 0

8. ______________________ 0

9. ______________________ 0

10. ______________________ 0

Student: IAM4 abcdefghijklmnopqrstuvwxyz

December 1999

'Luke'

48

1. Lap — 6
2. Sic — 5
3. prity — 5
4. elefent — 5
5. tame — 5
6. hunt — 6
7. stete — 5
8. cest — 3
9. ordr — 4
10. Strong — 4

APPENDIX I

'KELLY' PRE AND POST TEST DEVELOPMENTAL SPELLING TEST RESULTS

Student: CAF5 abcdefghijklmnopqrstuvwxyz 30
February 1999
'Kelly'

1. LAP 6
2. SK 3
3. ELRF 2
4. PEE 2
5. TRAEWN 5
6. hATO 3
7. SRET 3
8. TeENFA 0
9. ODR 3
10. SOE 3

Student: CAF5 abcdefghijklmnopqrstuvwxyz
December 1999
'Kelly'

39

1. lape 4

2. Sen 3

3. piri 3

4. elpnt 4

5. trane 5

6. hrtee 4

7. Sreke 4

8. Best 4

9. ordr 4

10. Snoong 4

APPENDIX J

'BETH' PRE AND POST TEST

DEVELOPMENTAL

SPELLING TEST RESULTS

Student: IBF11 abcdefghijklmnopqrstuvwxyz
February 1999
'Beth'

30

1. Lt 3

2. SK 3

3. Pt E 3

4. ELFf 3

5. Inu 3

6. Htri 3

7. stool 3

8. Kttanu9 2

9. older 4

10. Snw 3

Student: IBF11 abcdefghijklmnopqrstuvwxyz
December 1999
'Beth'

51

1. lap 6
2. sic 5
3. pritee 5
4. elpant 3
5. tran 4
6. hunt 6
7. street 6
8. kised 5
9. ordur 5
10. snowing 6

APPENDIX K

INSTRUCTIONS AND

WRITING TOPICS FOR

SINGLE SUBJECT DESIGN

Instructions: Today I would like you to write about *your family.* Before you start, tell me something about *your family.* (A period of five minutes discussion follows). Now start writing. I want you to do your best work. I will tell you when to stop writing. If you don't know how to spell a word just try your best. Use the alphabet chart to help you find the letters you need.

Topics

1	Your family
2	Your favourite game
3	What do you like to do after school?
4	Your favourite television show
5	Your bedroom
6	Your best friend
7	The best thing to eat for dinner
8	The best pet
9	Where you like to play
10	What did you see on the way to school?
11	The best thing about being in Year 1
12	What did you do on the weekend?
13	Your favourite sport
14	How are you feeling today?
15	What will Santa bring you for Christmas?

APPENDIX L

RATIONALE, PROCEDURE AND WORDS FOR SEGMENTATION PRACTICE DURING THE TREATMENT PERIOD FOR SINGLE SUBJECTS

Words for segmentation

Session	Words
1	am, on, sun, red, sit, sand (sister)
2	an, up, man, wet, hot, spat (play)
3	if, it, and, run, fan, wet (with)
4	at, fun, men, not, kid, jog (went)
5	up, let, mud, red, hand, tent (television)
6	lad, lot, map, frog, much, smart (family)
7	rug, pet, dad, slip, grab, shark (chocolate)
8	him, bug, tom, sick, mess, shock (sleeping)
9	bet, hug, lock, sell, drop, thick (friends)
10	bad, pup, lost, send, lump, sing (bedroom)

Rationale and procedure for segmenting words

Words range in difficulty in word types from vc, cvc, cvvc, ccvc with gradual introduction of stop sounds at the end and beginning of words. Ten words most children have attempted to spell, but are clearly beyond their ability level, are included to demonstrate the link between oral segmentation and invented spelling.

Single subjects were taught how to segment each word then demonstrated how to segment the six words orally. The final word was demonstrated by the teacher and treated as a game for the child to try and segment

APPENDIX M

SINGLE-SUBJECT 'WILL'
WRITING SAMPLES

'Will'
Writing samples

Non-Treatment 1

tee wees?
went television
I We to the te Wentt
with brothers
Wit my Luduna and
my MuM and my dad
bec

Treatment 3

the dog. My best
The Dog My best
Pet is us dog
pet is a dog
becos he~~s~~ cHas cat
because he chases cats

'Will'
Writing samples

Treatment 4

on the Wa to Scol
On the way to school
to day I saw an
today I saw an
acsdant
accident.

Treatment 5

I like Plaing in the
I like playing in the
saind Pit Becos You
sand pit because you
can mac Big cusols
can make big castles

'Will'
Writing samples

Treatment 7

I like runing becos
I like running because
it givs You nerge.
it gives you energy
I can run ~~th~~ fast
I can run fast.

Treatment 9

I hop santu Brings
I hope Santa brings
my Monstr truc.
my Monster truck.

Treatment 10

I am happe today becos
I am happy today because
we hav mewsic
we have music.

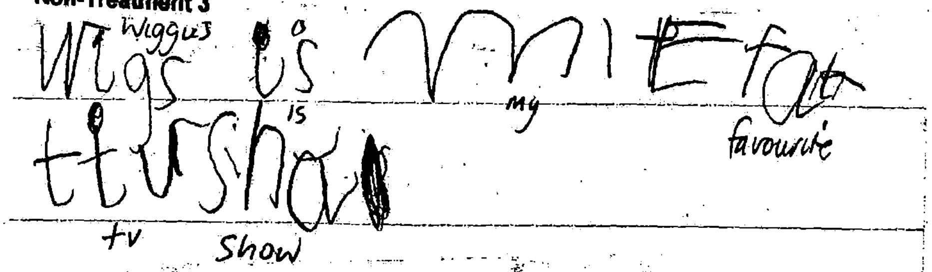
APPENDIX N

SINGLE-SUBJECT 'MAT'

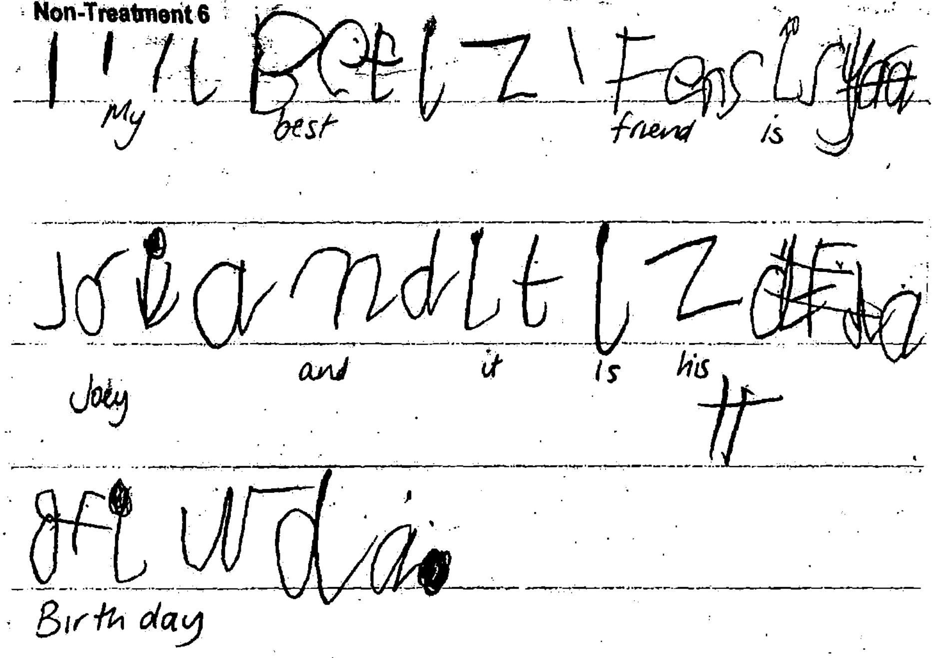
WRITING SAMPLES

‘Mat’
Writing samples

Non-Treatment 3



Non-Treatment 6



'Mat'
Writing samples

Treatment 1

WE hav a dog
We have a dog
a ndaca t the
a nd a cat The
bestpet isadog
best pet is a dog
the dog is kurd
the dog is called
tekse
Trixie.

Treatment 3

I like playing on the
I tic Plaingonthe
basket Ball
BasEtBall
courts we play
Corts. WePla
tEnnis.

'Mat'
Writing samples

Treatment 5

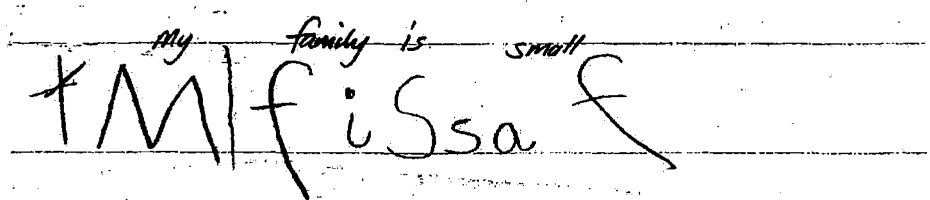
On the weekend
On thewekend
its mi frends
it is my friends
Brthda. shisshav
birthday She is having
inga Purtke
a party.

APPENDIX O

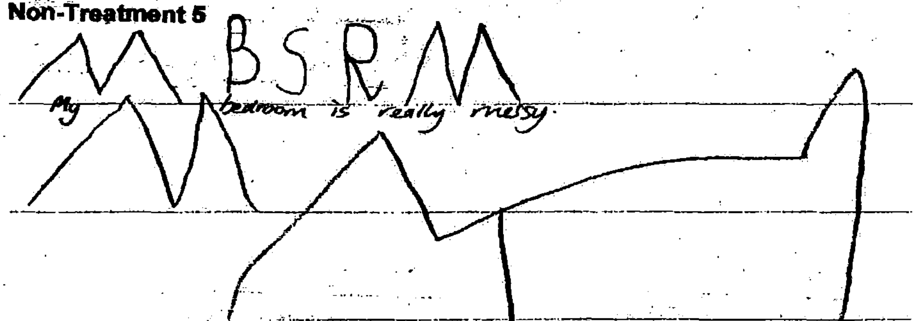
SINGLE-SUBJECT 'LES' WRITING SAMPLES

‘Les’
Writing samples

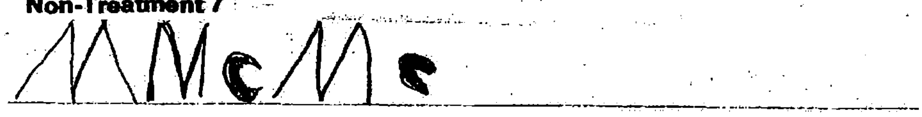
Non-Treatment 1



Non-Treatment 5



Non-Treatment 7



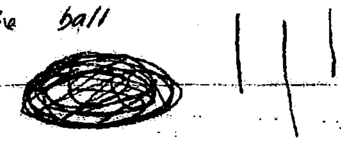
My mum cooks macaroni cheese.

'Les'
Writing samples

Treatment 1

FOSTBL S M Bt BSh
Football is my best sport

I clc Bl Mia
I kick the ball



Treatment 2

I was sick on
I Wask K so Ldn
ThWEKEWbL
the weekend

APPENDIX P

SINGLE-SUBJECT 'BEN' WRITING SAMPLES

'Ben'
Writing samples

Non-Treatment 2

I like to play cops

ICtXtqX pLaCoPSa

and robbers

Baqd ro b bre

Non-Treatment 4

I went to my

tD I wd etemesc

friends house

frenedsCHaS

to play nintendo

tb to pLa ni ntend

'Ben'
Writing samples

Treatment 1

On the weekend I went
over next door to play nintendo

Treatment 2

I am happy because
it is Miss Higgins
Birthday today

Treatment 3

Santa will bring
me a fire truck.

APPENDIX Q

PERCENT CORRECT
SCORES FOR SINGLE-
SUBJECTS

Percent Correct Scores for Single-Subjects

	Session														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Intervention Group															
IAM15 'Mat'															
Correct letters	30/41	19/30	14/21	18/33	13/26	21/36	10/18	43/53	24/29	41/45	39/46	40/48	43/50	28/31	24/27
Percent Correct Letters	73	63	67	54	50	58	55	***81***	***83***	***91***	***84***	***83***	***86***	***90***	***89***
Words attempted	10	8	5	7	6	10	4	18	7	11	13	11	13	9	8
IBM3 'Ben'															
Correct letters	4/9	17/25	13/24	25/36	17/25	12/30	19/37	19/29	12/22	20/37	19/31	13/21	37/42	34/42	22/26
Percent Correct Letters	44	68	54	69	68	40	51	65	54	54	61	62	***86***	***81***	***85***
Control Group															
CBM3 'Will'															
Correct letters	31/50	30/37	25/32	30/46	21/27	30/38	51/62	33/40	29/35	42/51	36/40	39/46	34/37	25/31	26/30
Percent Correct Letters	62	81	78	65	78	***79***	***82***	***82***	***83***	***82***	***90***	***85***	***92***	***81***	***87***
Words attempted	14	11	10	12	6	10	16	12	12	12	10	12	11	8	7
CAM14 'L es'															
Correct letters	5/15	3/15	5/22	5/22	6/28	6/18	5/24	4/18	4/23	3/14	5/30	14/33	15/20	9/12	18/28
Percent Correct Letters	33	20	23	23	21	33	21	22	17	21	17	***42***	***75***	***75***	***64***
Words attempted	4	5	5	6	8	5	5	6	8	5	8	9	6	4	6