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Potential precursors to the development of phonological awareness in preschool children

by

Alison Wendy Arrow

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Abstract

Phonological awareness is one of the most important metacognitive skills needed for literacy development. However, the relationships between preschool phonological awareness and pre-literacy skills are only just beginning to be examined. An important area is the study of potential precursors to phonological awareness. The current research proposed that phonological awareness develops along a continuum of linguistic awareness beginning with syllables and moving towards the smallest level of the phoneme. In the current research, potential precursors were examined in two studies. The first study was an examination of preschool phonological awareness in a sample of 110 New Zealand four-year-old children with no formal literacy instruction but who had a range of pre-literacy skills including 12 children who could read one or more words. The second study examined how literacy instruction influenced the development of phoneme awareness by independently assessing the role of learning to read and the role of learning to spell by teaching non-readers to read 8 CVC words or to spell the same 8 CVC words, but not to read and spell. The results found that rime and phoneme awareness both contributed to a latent variable of phonological awareness and that they each had different potential precursors. Receptive vocabulary explained the most variance in rime awareness with a small association of letter-name knowledge and own-name spelling while rime awareness developed more in children who learnt new words in the intervention. Rime awareness contributed to phoneme awareness along with letter-sound knowledge. When children were taught to read using blending this led to task specific phoneme awareness gains only. Phoneme awareness did not contribute to word-learning in the experimental conditions, with the only learning occurring in the spelling conditions. Letter-name knowledge had a relationship with the acquisition of orthographic representations. Letter-sound knowledge had a relationship with phoneme and letter-level attempts at unfamiliar words. This suggests that children with good letter-name and letter-sound knowledge have both orthographic knowledge and alphabetic strategies available in early word reading and spelling. Results are discussed in terms of their theoretical and practical implications emphasising the role of alphabet knowledge in early literacy acquisition.
Dedication

This thesis is dedicated to Paige and to all children who learn how to read and write.
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Chapter 1: Introduction

Learning to read is the hallmark of success in the junior classrooms of New Zealand and across the world. Being able to read provides the ability to participate in modern society, with those who do not have minimal literacy skills marginalised (New Zealand House of Representatives, 2001). Establishing what it is that lays the foundations for reading ability has long been studied and at the heart of much of the reading research today is phonological awareness. Phonological awareness is generally understood to be the awareness of phonological units, and the ability to manipulate those phonological units. Phonological units include syllables, rimes (the part of a word that makes it rhyme with another), and phonemes.

The study of phonological awareness has a relatively short history dating back only to the 1960s. It was during the 1960s that Elkonin first mentioned the need for the awareness of language, which he saw as a glass window (Nicholson, 2000). For Elkonin the awareness of language is like a smudge on the window so that the window, or language, can be seen. At the same time Isabelle Liberman and Donald Shankweiler were convincing Alvin Liberman that speech was related to reading (Liberman, 1999). They were finding that the alphabetic structure of words was not at the surface level of print but at a level that was difficult to access – a metalinguistic level. Also during the 1960s the link between auditory perception and reading was being examined and the first tests of what we now know as phonological awareness were being developed (Chall, Roswell, & Blumenthal, 1963; Rosner & Simon, 1971).

The term phonological awareness came into use in the late 1970s and was used interchangeably with phoneme awareness (e.g., Lewkowicz, 1980). This original definition referred only to the linguistic structures of words, syllables and phonemes. Rhyme recognition tasks were used but on the basis that the rime part of the word was the same as another word and thus reflected phonological awareness at the word level. Research during the 1970s had shown that there was a developmental progression in children’s awareness of these structures, and it was these findings that highlighted the importance of linguistic awareness (Fox & Routh, 1975; Liberman, Shankweiler, Fischer, & Carter, 1974). It was also during this period that the relationship between reading and linguistic awareness was examined in more depth and it became clear that there was an important relationship between phonological awareness and reading.
Although there had been a distinction between awareness of words, syllables, and phonemes since the beginning of research on phonological awareness it was not until later that awareness of other subsyllabic units was also researched. The use of rhyme tasks in studies of reading paved the way for research on the linguistic structure of words and the psychological relevance of linguistic structures. More than anyone, it was Treiman who highlighted the relevance of the subsyllabic units of onset and rime (Treiman, 1983; 1985). The 1980s was also a time of longitudinal studies and the role of rhyming and rimes was examined in the development of reading ability (e.g., MacLean, Bryant, & Bradley, 1987). The results of such longitudinal studies led to a greater consensus on the definition of phonological awareness. Distinctions were now made between phonological awareness and phoneme awareness. Levels of difficulty between phoneme awareness tasks were also now better defined (Perfetti, Beck, Bell, & Hughes, 1987; Schatschneider, Francis, Foorman, Fletcher, & Mehta, 1999; Stahl & Murray, 1994).

More recent research on phonological awareness has been conducted on what precursors there are to phonological awareness (Burgess, 2002; Lonigan, Burgess, Anthony, & Barker, 1998; Walley, Metsala, & Garlock, 2003). Recent research has focused on the role of the different levels of phonological awareness on the acquisition and development of reading ability (Castiglioni-Spalten & Ehri, 2003; Goikoetxea, 2005; Morais, 2003). The relationship between spelling and phonological awareness has been recently examined (Castles, Holmes, Neath, & Kinoshita, 2003; Silva & Alves-Martins, 2002; Silva & Alves-Martins, 2003). In addition, the nature of the relationship between alphabet knowledge and phonemic awareness has been examined (Blaiklock, 2004; Carroll, 2004; Foorman et al., 2003). This relationship is important as both phoneme awareness and letter knowledge have been consistently found to be the main contributors to reading. This relationship is not unexpected as it is these two types of knowledge that form the alphabetic principle, the understanding that sounds in words are represented by graphemes in printed words (Moats, 2000). Phoneme awareness is thought to be required for the sounds in spoken words to be identified and letter knowledge allows the beginning reader to disconnect the simple grapheme from the print word as a whole.

**Rationale for the study**

This thesis attempts to tie together some of the threads of current research on phonological awareness. The overarching aim of the thesis is to examine the development of phonological
awareness in preschool children who are just beginning to learn about reading and writing. It examines the nature of phonological awareness in children who are in an environment in which literacy is not taught prior to formal education beginning at the age of five years. The thesis aims to provide a clearer picture of the development of phonological awareness by clarifying the nature of phonological awareness in New Zealand preschool children. It aims to demonstrate potential precursors to levels of phonological awareness, in particular the precursor of early rime awareness to phoneme awareness and the relationship between letter knowledge and phonological awareness. The thesis also examines the different effects of teaching method on the development of explicit phoneme awareness.

To achieve these aims the research was divided into two studies. The first study was an examination of the literacy skills of 110 preschool children who varied in their reading ability but were predominately non-readers. This study provided a picture of phonological awareness in New Zealand preschool children. The study examined the role of letter knowledge in the development of phonological awareness and the role of children’s own name knowledge. This is a growing area of research as it provides an opportunity to study the first words that children learn. It provides the ability to study precursors to children’s first words, and the role that own name knowledge has on both letter knowledge and phonological awareness. The study brought together several threads of research into the development of preschool phonological awareness to examine potential precursors.

The second study was developed to examine the progression of phoneme awareness after children have begun receiving formal literacy instruction. This study was conducted using the non-readers from the first study. The use of preschoolers meant that the type of instruction that the children received could be manipulated, and that the separate effects of learning to read and to spell could be teased out by teaching children only reading or only spelling. Unlike research using children already receiving formal literacy instruction in reading and spelling at the same time, the influence of learning to read could not affect children’s learning to spell, and vice versa. In addition, this study allowed for a semi-longitudinal examination of the development of phonological awareness, as well as the role of phonological awareness in word-learning. Phoneme awareness in particular was examined as formal literacy instruction in an alphabetic script is a potential trigger for phoneme awareness (e.g., Bowey, 1994; Perfetti et al., 1987; Read, Zhang, Nie, & Ding, 1986).
Overview

This thesis is separated into two parts so that the development of phonological awareness can be examined without literacy instruction, and then with the influence of literacy instruction. Part 1 is the study of the phonological awareness of preschool children in suburban New Zealand public kindergartens. Chapter 2 is the introduction to Part 1 and provides an introduction to phonological awareness. It reviews the different levels of phonological awareness, particularly those that apply to beginning readers. It also reviews the literature on the nature of phonological awareness and the issues surrounding the conception of phonological awareness. In addition, the literature on preschool literacy including letter-knowledge, speech-perception, and vocabulary is reviewed. Chapter 3 describes the methodology of the first study including the phonological awareness measures. The results are described and discussed in Chapter 4. This is followed by a discussion in Chapter 5 on the development and precursors of preschool phonological awareness, including the difference between rime awareness and phoneme awareness.

Part 2 is the study of different styles of instruction in the teaching of reading or spelling, and the influence that they have on the development of phoneme awareness. It examines the influence of letter-knowledge on the earliest stages of reading and spelling. Chapter 6 reviews different philosophies and methods in the teaching of reading and in the teaching of spelling. It also reviews literature on the influence that learning to read and learning to spell has on phoneme awareness, as well as the role of phonological awareness on learning to read and to spell. In addition, the major theories of word-learning are reviewed. Chapter 7 describes the methodology of the study including descriptions of the instruction given to the children in the study and posttest measures. This is followed by a description of the results in Chapter 8. Chapter 9 is the discussion of the findings of the study in Part 2 including implications for the proposed model of phonological awareness development, and implications for theories of reading and spelling acquisition.

The thesis concludes with Chapter 10 which is a general discussion that ties together the findings of Parts 1 and 2. It discusses how findings from both studies provide evidence for a proposed model of phonological awareness development. It also discusses the similarities and differences between the current findings and previous research as well as the limitations in the two studies.
comprising this thesis. Finally the practical implications for phonological awareness instruction in the classroom and preschool institutions are discussed.
Part 1: A study of the phonological awareness of preschool children
Chapter 2: Literature Review

Placing phonological awareness in context

Phonological awareness has its roots in the study of language and linguistics. Indeed, the base word phonology is derived from the ancient Greek words “phone” for “voice” and “logos” for “word” (Nicholson, 1997). Phonology is one of the four main aspects of language. The other three are morphology, semantics and pragmatics, and syntax. Morphology is the aspect of language that involves the internal grammar of language and how words are constructed. Words are made up of morphemes which are the smallest unit of meaning. For example ‘ski’, a single morpheme, can be combined with other morphemes such as ‘s’, ‘er’, or ‘ing’ to change the meaning, as well as the word type, of the original morpheme. This construction of spoken words is controlled by rules that humans have internalised and cannot usually verbalise, but which they use all the time. Semantics is the aspect of language that involves understanding meaning that is conveyed by words, sentences, and phrases. As an example, “hen”, “mare”, and “daughter” all have the semantic quality of being female, but only “daughter” also has the semantic quality of being human. Pragmatics is the influence of context on meaning making. Syntax is another aspect of language that involves the grammatical rules of sentence construction that ensure correct word order. Correct word order allows a listener to understand what has been said. An example of a syntactic rule is when the sentence “neighbour’s dog by me bit” does not make grammatical sense, but the sentence “I was bitten by the neighbour’s dog” does, because a sentence must be constructed of a subject noun followed by a verb phrase, not a verb phrase followed by a subject noun in English (Fromkin, Blair, & Collins, 1999).

Each of these aspects of language are required to make use of language and are usually internalised with little explicit knowledge of each area. Each aspect can however be explicitly thought about and acted on and phonological awareness is one of the metacognitive skills that people have specifically for consciously reflecting on language. The other metacognitive skills that people develop for language are morphological awareness, pragmatic awareness, semantic awareness, and syntactic awareness. Morphological awareness is the explicit knowledge people have about morphemes such as plurals and verb tense markers. Semantic and syntactic awareness are the explicit understanding and knowledge that people have about the areas of
semantics and syntax. Pragmatic awareness is the explicit knowledge that people have regarding the use of language in actual communication. With these skills people can effectively communicate and understand using language. In the transfer of spoken language to written language, it is phonological awareness that has been most commonly shown to be the most important of these four metacognitive skills (Gillon, 2004). However, an increasing body of research is investigating the role of syntactic awareness (Bryant, Nunes, & Bindman, 2000; Nation & Snowling, 2000; Tunmer, Nesdale, & Wright, 1987) in addition to phonological awareness.

Understanding of spoken language is believed to be an automatic, built in, biological function (Pinker, 1994). At one month of age, for example, children can discriminate between speech sounds, and can even discriminate foreign speech contrasts better than adults can (Eimas, Siqueland, Jusczyk, & Vigorito, 1971; Trehub, 1976). By the time children reach one year of age they understand the meanings of simple nouns, even if they are still unable to produce them. By two years of age children understand spoken language beyond nouns (Fenson et al., 1994) and also begin to communicate in meaningful speech segments (Brown, 1973). Such automatic ability gives children the ability to produce and comprehend speech but does not necessarily give children the skills they require to develop metacognition of language, especially metacognition of a complex language such as English.

**Why study phonological awareness?**

The metalinguistic skill of phonological awareness is largely believed to play an important part in learning to read through its role in linking spoken with written language. Written languages are derived from spoken language (Bertelson, 1986). In alphabetic orthographies written language represents spoken language at a phonological level (Liberman & Shankweiler, 1991). The important role that phonological awareness plays in linking spoken language and written language has been found in a number of research studies, many of which have been longitudinal in nature. Children who have been taught phonological awareness before beginning school are found to be better equipped for learning to read and spell than are children who have not (Brennan & Ireson, 1997; Hindson et al., 2005; Lundberg, Frost, & Peterson, 1988; Schneider, Kuspert, Roth, Vise, & Marx, 1997). Furthermore, children with greater phonological sensitivity and phonological awareness at kindergarten, or just before starting school, tend to be better
readers (Rohl & Pratt, 1995; Sprenger-Charolles & Casalis, 1995; Stuart & Masterson, 1992), even up to eleven years later (MacDonald & Cornwall, 1995).

The nature of the relationship between phonological awareness and reading seems to have assumed from early studies that phoneme awareness predicted reading ability. Numerous studies have reported the importance of the relationship between phonological awareness and reading. Many of these studies have been longitudinal studies in which pre-readers or beginning readers have been followed until they have reached some point further ahead in time (e.g., MacDonald & Cornwall, 1995; Sprugevica & Hoien, 2003). In other studies children are given phonological awareness interventions and then assessed, normally at an immediate posttest (e.g., Bradley & Bryant, 1985). Some studies have also included delayed posttests as well (e.g., Lundberg et al., 1988).

The finding that phonological awareness predicts reading has been generally robust. Longitudinal studies have found short- and long-term effects on reading and spelling from preschool and early school age phonological awareness measures. The effect of pre-reading phonological awareness consisting of both rime and phoneme manipulation awareness has been found into the second grade (Rohl & Pratt, 1995; Roth, Speece, & Cooper, 2002; Sprugevica & Hoien, 2003). Long-term effects were reported by MacDonald and Cornwall (1995) and Stuart and Masterson (1992) where syllable and phoneme deletion predicted reading ability up to six years later. McBride-Chang and Kail (2002) found that phonological awareness, measured by syllable awareness for the Chinese children and both syllable and phoneme awareness for the English speakers, predicted reading in both English and Chinese languages. Short-term effects of phonological awareness, measured by both rime and phoneme awareness, were found by Lonigan, Burgess, and Anthony (2000) when they followed kindergartners into first grade. They found that phonological awareness predicted decoding ability, as did letter knowledge. Other studies have noted that although phonological awareness seems to be necessary for reading, it is not sufficient. Such studies are also those that primarily measure phoneme awareness and not rime awareness (e.g., McGuinness, McGuinness, & Donohue, 1995; Muter, 1994; Tunmer & Nesdale, 1985).

Training and intervention studies have confirmed that if you teach phonological awareness, such as rhyme and phoneme categorisation, to children they become better readers than those children
who do not receive phonological awareness training (e.g., Bradley & Bryant, 1983). Several meta-analyses of experimental intervention studies (e.g., Bus & van Ijzendoorn, 1999; National Reading Panel, 2000) have been published highlighting the growing interest in phonological awareness interventions and training programs in the early school curriculum. They have overwhelmingly found that interventions that include both letter training and phonological awareness training, whether it is rime or phoneme awareness training, are the most effective. The published studies range from short-term intervention studies (e.g., Fox & Routh, 1976) to long-term longitudinal studies (e.g., Lundberg et al., 1988).

One important finding is that there are differences in levels of phonological awareness with the awareness of phonemes actually occurring after reading instruction begins, and onset-rime awareness occurring before learning to read (Bachman, 2001; Christensen, 1997; Stuart, 2005). The definition of what constitutes phonological awareness, namely phoneme and onset-rime awareness has generated debate on what the role of phonological awareness is for reading. Goswami for example, argues that onset-rime awareness aids in learning to read, particularly through the use of rime analogy (Goswami, 1993b; Goswami, 1998; Goswami & Bryant, 1990; Goswami & Mead, 1992). In contrast, Hulme argues that phoneme awareness both aids and predicts learning to read independent of the awareness of rime units (Hulme, 2002; Hulme et al., 2002). At the core of this debate, particularly between Goswami and Hulme, is the nature of phonological awareness. The nature of phonological awareness is still not well understood, with the relationship between rime and phoneme awareness still requiring clarification (Stuart, 2005).

To better understand differences in levels of phonological awareness a description of the levels of speech and their corresponding awareness will be given.

**What makes up phonological awareness?**

**Phonemes**

Phonemes are part of the phonology of language. Phonology is that which deals with the systems and structures of speech (Clark & Yallop, 1990), and can be distinguished from phonetics, which is the area that focuses on acoustics and articulation. Phonology is a system of representation that provides a basis for the construction of a large and expandable database of words created by two, three, or more phonemes (Liberman & Shankweiler, 1991). Phonemes can be put together in
ways to create new words using the rules pertaining to the phonology of the particular language. Phonology makes it possible to create larger vocabularies which allows a language to be generative (Liberman & Liberman, 1990). In contrast, if each word alone was a holistic ‘signal’ the amount of words to be created would be severely limited. Words couldn’t be changed in any way to make new words, thus restricting language growth.

Phonemes themselves are speech sounds and can be distinguished from non-speech sounds. Liberman, Cooper, Shankweiler, and Studdert-Kennedy (1967) found that people perceive speech and non-speech sounds in different ways. Phonemes are the smallest units of speech sounds and are abstract non-meaningful categories of language. The smallest level of meaning is represented by a morpheme (Liberman & Shankweiler, 1991). Phonemes are what distinguishes on word from another and a phoneme can change the meaning of a word by denoting a different spoken word but does not have meaning itself. A phoneme is a contrastive and distinctive sound within its language (Clark & Yallop, 1990). The English language has between 40 and 44 phonemes, although many more phonemes are found in different languages.

![Figure 1: Example of coarticulation using the word "bag" as an example. (From Liberman, 1971).](image)

In order to understand spoken language there is no need to consciously identify what phonemes make up a word. There is a specialised speech unit in the brain that underlies both the perception and production of speech and automatically does this job for us (Liberman & Liberman, 1990).
Speech cannot easily be parsed into its phonemic units. This difficulty is due to coarticulation in word production, in which phonemes are blended or overlapped during speech so that 10 to 20 phonemes per second can be spoken (Liberman & Liberman, 1990), which is the rate at which humans can process spoken language. Coarticulation, showing the blended nature of phonemes, is illustrated in Figure 1, using the word “bag” as an example (Liberman, 1971). The phoneme /æ/ represented by the orthographic letter ‘a’ is coarticulated with both the phoneme /b/ and the final phoneme /g/ over the pronunciation of the spoken word.

There are two main types of phonemes. These are called consonants and vowels. Consonants are sounds that are restricted in some way during their production, while vowels are generally unrestricted. A combination of consonants and vowels form the syllable, which has a typical structure of sonority that peaks with the vowel (Hudson, 2000). Vowels form the peak of the word or syllable that they appear in, because of the unrestricted nature of the vowel, while consonants may or may not appear on either side of the vowel. There are more syllables in the English language than it is possible to count, due to the commutable nature of syllable structure in English. Different syllables are formed each time a phoneme within the syllable is changed, for example the syllable /bæg/ changes to the syllable /bæt/ when you change the last phoneme from a /g/ to a /t/.

When a single consonant or a consonant cluster does appear prior to the vowel in speech it is labelled the onset, while any consonant or consonant cluster appearing after the vowel is labelled the coda (see Figures 2 and 3). The second consonant in an onset consonant cluster is usually higher on the sonority scale, with the first consonant in a consonant cluster that makes up the coda also usually higher on the sonority scale. Thus the syllable has a rising and falling nature of sonority that evolves around the vowel. This makes the vowel more readily apparent to the listener of spoken English, with consonants becoming more consonantal in sound the further away they are from the vowel, while consonants near the vowel are influenced by the vowel sound, especially nasal consonants. In the example illustrated in Figure 1 the pronunciation of the coarticulated consonants /b/ and /g/ are influenced by the vowel /æ/.

**Syllables and rimes**
One of the two typical linguistic structures used to describe the syllable is a hierarchical structure (Fudge, 1987) utilising the subsyllabic constituents of the onset and rime (see Figure 2). The second typical structure is that of a flat syllable, or a linear syllable structure, in which there are no onset or rime constituents (Geudens & Sandra, 2003; Yip, 2003). In this syllable structure the phoneme units come directly from the syllable (Clements & Keyser, 1983). A flat syllable structure would mean that each phoneme in a syllable is equally relevant. Such a syllable structure can be found in spoken Japanese, in which the syllable consists of a mora. The morae are rhythmic subsyllabic units, dominated by the peak vowel sound, the psychological relevance of which increases with children’s ability to read Kana orthography which are syllabic representations (Inagaki, Hatano, & Otake, 2000). Phonemes don’t feature for Japanese morae as consonants do not occur without a vowel, although a vowel can be a mora on its own. Thus flat syllable structure may be relevant to phonological awareness and subsequent reading acquisition in some languages, but potentially, it is not relevant for the English language.

Figure 2: Simple hierarchical structure of the syllable using the word "dog" as an example.

Figure 2 shows a simple hierarchical syllable structure. The syllable “dog” sits at the top of the hierarchy, with the onset unit “d” and the rime unit “og” coming directly from the syllable. The
The onset unit consists of a single phoneme. The rime unit consists of the vowel phoneme of “o”, or the peak of the syllable, and the following consonant of “g”, called the coda. A more complex hierarchical structure, utilising all levels of the syllable structure is shown in Figure 3, using the word “stamp” as an example. At the top of the syllable hierarchy sits the syllable itself; at the next level down from the syllable is the onset “st”. The combined vowel “a” and coda “mp” make up the rime unit “amp”. The combination of the vowel and the onset, which would be represented by the combination of “sta” in this example, does not make psychological sense to English speakers, so this level is best represented by the onset and rime (Kessler & Treiman, 1997; 2001). The onset is then made up of two phonemes, which are then represented individually. The rime consists of two additional units, the vowel and the coda. The coda then consists of its own two phonemes.

Figure 3: Complex hierarchical structure of the syllable with the mono-syllabic word 'stamp' as an example.
Syllables, onsets, rimes, and phonemes are all linguistic units but it is the sensitivity towards and the ability to manipulate these units that defines phonological awareness. Research has shown the psychological relevance of all the linguistic units (Fox & Routh, 1975; Liberman et al., 1974; Treiman & Zukowski, 1996). The relevance of onsets and rimes was first examined by Treiman (1983). Adults learnt word games that involved choosing between two alternative solutions that were derived from two rules. In Experiment 1, for example, subjects were taught to separate consonant-vowel-consonant (CVC) nonwords such as /kIg/ by adding /æz/ between the first and second phonemes, thus requiring the response /kæz/ /Ig/. In the testing phase the subjects were presented with nonwords that started with consonant cluster onsets, such as /skef/. Treiman found that the subjects most often separated the word into /skæz/ /ef/ rather than /sæz/ /kef/, showing the greater relevancy of the onset rather than the individual phonemes. Furthermore, when subjects were asked to join two nonsense words together (Experiment 7), such as /flirz/ and /gruns/ they made the resulting nonsense word /fluns/, separating each of the initial nonsense words at the onset-rime and joining the onset of the first word with the rime of the second word. This was the most common result over all other possible responses such as /fruns/, /flins/, and /flirs/. Similar research on monosyllabic words (Treiman, 1985, Experiment 1) and children aged between seven and 10 years of age found that was it easier to keep the rime (VC) whole in CVC syllables rather than the CV component. In addition, the salience of onsets was also found in even younger children.

This supports the hierarchical syllable structure as having psychological relevance over flat structure, and the role of the hierarchical structure of the syllable in understanding the nature of phonological awareness. If the syllable had a flat structure, the subjects in Treiman's (1985) study would not show preferences for separating words at onset-rimes, but would separate syllables at any point, which rarely occurred in both Experiment 1 and Experiment 7. The linguistic status hypothesis (Treiman & Zukowski, 1996) suggests that the development of phonological awareness is a reflection of the hierarchical structure of the syllable. Numerous studies have shown that an awareness of syllables typically precedes onset-rime awareness and onset-rime awareness precedes phoneme awareness (Aidinis & Nunes, 2001; Fox & Routh, 1975; Liberman et al., 1974; Lonigan et al., 1998).

Treiman (1985, Experiment 2) found that four-and-five-year-old children found it easier to isolate the initial phoneme, for example /s/, if it alone is the onset, such as in the nonsense syllable /sem/
rather than when it is part of a consonant cluster, such as in the nonsense syllable /sme/. These children were introduced to a puppet and told that the puppet had a favourite sound, such as /s/. The children were presented with a phoneme and had to say whether it began with the puppet’s favourite sound or not. The stimuli that had the target phoneme followed by the vowel (/sem/), rather than a consonant (/sme/) were easier for the children, showing that children prefer the onset singleton over individual phonemes within the onset cluster. Just as for the adults in Treiman’s (1983) study, the onset and rime units had psychological relevance for children rather than phonemes.

Bertelson, de Gelder and van Zon (1997) demonstrated onset superiority over phonemes when they asked kindergarten, first-grade and second-grade children to delete the initial consonant in words. The initial consonant was either the onset or the first phoneme in a consonant cluster onset. They found that the children could more easily delete the initial consonant if it alone constituted the onset (for example, the /b/ in ‘bat’), rather than the consonant that would involve breaking up the consonant cluster onset (such as the /b/ in ‘brat’). From both the work of Treiman (1985) and Bertelson et al. (1997) it appears that young children find it difficult to detach a consonant from a consonant cluster. This lends support to the hierarchical structure of the syllable in Figure 2, rather than to a flat structure syllable in which the two consonants in a consonant cluster would be equally accessible.

More recently Tunmer and Chapman (2007) have suggested that it is not the linguistic structure of syllables that allow for the awareness of syllables, onsets, rimes, and phonemes. Their phonological processing model of phonological awareness suggests that it is children’s ability to articulate isolated segments of speech sounds that phonological awareness reflects. The first sounds they can isolate are syllables because they are focusing on the acoustic cues. The rising sonority of the vowel cannot be distinguished from any consonants for younger children. Separating syllables then requires the use of articulatory cues which allows children to articulate the vowel and anything that follows it, hence the rime, from any consonants in front of it. It is, therefore, rime awareness rather than onset awareness that children have at the next level of phonological awareness. Finally children are able to attend to abstract articulatory gestures represented by phoneme awareness. Tunmer and Chapman suggest this awareness is initially established by becoming aware of single phoneme onsets.
The nature of phonological awareness

Phonological awareness has long been considered an important meta-cognitive skill due to its relationship with later literacy and school achievement (Adams, 1990). What is less well agreed upon is the nature of phonological awareness. Hence there is more than one definition as to what constitutes phonological awareness. The problem with the definition of phonological awareness developed out of the use of the different levels of phonological units, syllables, rimes, and phonemes. One definition of phonological awareness is that it is the explicit knowledge of, and the ability to manipulate phonological units (Blachman, 1991; 1994). Such a definition of phonological units as separate units has been particularly highlighted by the early research on phonological awareness task comparability (e.g., Hoien, Lundberg, Stanovich, & Bjaalid, 1995; Stanovich, Cunningham, & Cramer, 1984; Yopp, 1988). This body of research suggests that phoneme segmentation tasks measure phonological awareness rather than the simpler rhyme awareness tasks which don’t require explicit manipulation of phonological units. Stanovich (1986) exemplified this with his definition of phonological awareness as the “conscious access to the phoneme level of the speech stream and some ability to cognitively manipulate representations at this level” (pg. 362, italics added).

This definition of phonological awareness was supported by Stanovich et al. (1984) and Yopp (1988) who both found evidence of two separate phonological variables, rhyme and phoneme. In each study this was concluded using different interpretations of factor analysis results. In the Stanovich et al. study the conclusion was based on the nonrhyming tasks loading more highly onto the first factor in their factor analysis, with the rhyming tasks having lower factor loadings. The rhyming tasks did not load onto their own factor. Yopp, in contrast, found two distinct factors in her results. This has also been found by Muter, Hulme, Snowling, and Taylor (1998) in their longitudinal study of 38 preschoolers through to second grade. Phoneme segmentation and rhyme remained two distinct variables, with both remaining stable over time. However, the interpretation of two factors was only clear for children when they were aged 4 years and 5 years of age. At the age of 6 there were not two distinct factors, with phoneme blending and deletion tasks loading onto both the rhyme factor and the phoneme segmentation factor. Hoien et al. (1995) found evidence of a third phonological variable, in addition to phoneme and rhyme awareness, which was syllable awareness in Norwegian preschoolers and first-grade children. It
was argued that the syllable factor was found because they were the first study to introduce a syllable task.

However, issues of guessing (chance) and task versus linguistic complexity have confounded these tasks. Some of the scores from Yopp (1988) were influenced by the test-taker often having a one-in-two or one-in-three chance of getting an answer correct but scores were not adjusted for chance (Gough, Larson, & Yopp, 1996). Thus false positive scores are likely to have affected the results. The rhyme measures in Stanovich et al. (1984) were at ceiling, suggesting that differences in task difficulty were influencing the results since all the easier tasks had lower loadings. Muter et al., (1998) conceded that their segmentation tasks could be approached by the children as rhyming tasks, and this was possibly why six-year-olds did not show two distinct factors. The six-year-old children were showing results confounded by task and linguistic complexity at a fundamental level. The development of the Phonological Abilities Test (PAT) by the same authors (Muter, Hulme, & Snowling, 1997a) has been criticised for this reason (Godfrey & Fletcher-Flinn, 2003). Evidence that task ease and difficulty can influence the results was found by Stahl and Murray (1994). They found that although they derived three factors when entering a range of phonological awareness tasks, the first accounted for 49.7% of the variance. The other two factors, which accounted for much less variance, were the hardest and the easiest subtests respectively. The other two factors reflected restricted variance due to being easier or harder, rather than being two constructs that differed from the first factor. This reinforces the difficulty in interpreting factor analysis results and the conclusions drawn from them, especially when there are floor and ceiling effects in the tasks.

Anthony and Lonigan (2004) found floor effects on rhyme production tasks in preschoolers. This affected results for structural equation modelling. They found that ceiling effects in rhyme tasks in early-grade school children had similar consequences. This corresponds with the conclusions of Stahl and Murray (1994) that it is only those tasks that are easier or harder than others, as indicated by floor and ceiling effects, that influence their relationships with other phonological variables. This could go some way to explain why rhyme tasks do not load onto the same factor as other forms of phonological awareness, such as phoneme awareness, due to floor or ceiling effects in rhyme tasks. These problems do not seem to be specific to rhyme production tasks. In the three-factor results of Hoien (1995) there were ceiling effects in most of the measures except syllable counting, and large skews in scoring because of this. Those scores with the highest skew
loaded onto one factor, phoneme, with phoneme counting also loading onto the same factor, but with a much lower loading. The rhyme measure that was used to indicate the rhyme factor had only five items, and was also at ceiling, but with less skew than those phoneme tasks in the phoneme factor, which could explain why it was on its own factor. These results suggest that multidimensional results from factor analysis are due to measurement artefacts, primarily that resulting from task difficulty.

Anthony and Lonigan (2004) reanalysed the data of Muter et al. (1997b). They used a different method of rotation and found that only one factor accounted for the majority of the variance instead of the two factors proposed in the original study, especially when the difficult rhyme production task was removed from the analysis. Thus, when more than one factor emerges it is the result of task difficulty (Lonigan et al., 2000) or linguistic complexity (Stahl & Murray, 1994), and not because there are separate and independent types of phonological awareness. In support of the influence of task difficulty is the study of Wagner, Torgesen, Laughon, Simmons, and Rashotte (1993). They found two factors that they labelled synthesis and analysis. The synthesis factor consisted of blending tasks while the analysis tasks were those that required more manipulation. Although they found two factors, they were highly correlated and the authors suggested that the two factors occurred because of the difficulty of the analysis tasks over the synthesis tasks. The two factors were highly correlated and the one-factor model of phonological awareness had a goodness-of-fit that was just as strong as the two-factor model of phonological awareness. Thus their findings also suggest a model of phonological awareness that is unidimensional, with differences among tasks due to linguistic complexity and cognitive difficulty. Schatschneider, Francis, Foorman, Fletcher, and Mehta (1999) obtained similar results using Item Response Theory on a large sample of over 900 children ranging in age from 5.1 to 9.5 years of age, from kindergarten through to second grade.

This unidimensional concept of phonological awareness has further developed into a continuum of phonological awareness that comprises both onset-rime and phoneme awareness (Anthony et al., 2002). As a single phonological variable, phonological sensitivity (or phonological awareness) is thought of as a continuum of increasing awareness and ability to manipulate increasingly segmented subsyllabic units (Burgess, 2002; Stanovich, 1992). At the shallow end of the continuum children are able to distinguish and manipulate onset-rime units and at the deep end children are able to distinguish and manipulate phonemes (Anthony & Lonigan, 2004). The
continuum model of phonological awareness is a model of phonological sensitivity as well as awareness, as it includes the ability to identify, or distinguish and be sensitive to, phonological units but not necessarily manipulate them (Goswami & East, 2000; Stanovich, 1992). Gombert (1992) has argued for differentiation between identifying units and manipulating them. Gombert calls the first type of awareness, which is the ability to identify the units, an epiphonological skill. The identification of phonological units measures sensitivity to the units and can also be referred to as implicit awareness. An example is judging if two words rhyme or if two words start with the same sound and does not require a verbal response of the phonological segment. Gombert suggested that epiphonological skill occurs before the ability to manipulate phonological units. The ability to manipulate phonological units, such as deleting a phoneme from a spoken word, is a skill that he calls a “true metaphonological capacity” (Gombert, 1996, p. 769). This metaphonological capacity is that known as explicit phoneme awareness.

1. Can identify when words rhyme with each other
   e.g., bat hat
2. Can identify when words start with the same sound
   e.g., bed bat
3. Can segment the rime from the onset
   e.g., b - at
4. Can identify the last sound in the rime
   e.g., bat sit
5. Can segment the last sound from the rime
   e.g., ba - t
6. Can segment all phonemes in a word
   e.g., b - a - t

Figure 4: An example of the continuum model of increasing phonological awareness shown in Guttman scale form.
Gough Larsen and Yopp (1996) have suggested that the nature of phonological awareness means it can be measured by a Guttman scale. A Guttman scale is unidimensional in that it measures one finite ability (Coolican, 1994). In the case of phonological awareness you would score positively on items such as onset-rime sensitivity, but once a negative score is obtained you should not be able to score positively on any items further up the scale, such as phoneme awareness. An example of such a continuum model of phonological sensitivity in the form of a Guttman scale is illustrated in Figure 4. Sensitivity to phonological units is measured by identification and is followed by the ability to manipulate onset-rimes. The identification of phonemes develops after the manipulation of onset-rimes, and the manipulation of phonemes follows the identification of phonemes. It would be expected that if children can’t score on item 3, for example, they would not score on items 4, 5, or 6.

Evidence that onset-rime sensitivity is a precursor to the development of phoneme sensitivity forms a large part of the basis of this continuum model of phoneme sensitivity. That children develop their phonological awareness along a continuum such as this also has as evidence years of research on children’s abilities to segment words (Anthony et al., 2002; Bryant, MacLean, Bradley, & Crossland, 1990; Ellis & Cataldo, 1990; Lonigan et al., 1998; MacLean et al., 1987; Schatschneider et al., 1999; Stahl & Murray, 1994). Such research has indicated that syllable awareness occurs prior to onset-rime awareness. It is thought that children’s phonological awareness begins with large-units because young children, who have not yet begun to read, find it easier to segment large units of sounds over small units of sounds. Liberman, Shankweiler, Fischer, and Carter (1974), found that four- five- and six-year-olds had a greater awareness of syllables than phonemes. The children were shown how to segment words into either syllables or phonemes, tapping a piece of dowel to help them represent the sounds. Of the four- and five-year-olds taught to segment words into syllables just under half could do it, compared to the children who were shown to segment into phonemes, where none of the four-year-olds could do it and only 17% of the five-year-olds could do it. In comparison, among the six-year-olds first graders who were shown to segment words, 90% could segment words into syllables and 70% could segment words into phonemes.

Fox and Routh (1975) also found a developmental progression in the ability to segment the different sized sound units in children aged between three- and seven-years-old. In a test of sentence segmentation they found that four-, five-, six-, and seven-year-olds could segment at
least one word from a sentence but it was more difficult for the three-year-olds. The same pattern was found for segmenting words into syllables, although the five-year-olds were worse than the four-year-olds. A strong effect of age was found in phoneme segmentation with ability increasing with age until similar levels were found in the six- and seven-year-olds. In a more recent replication of the tapping task, five-year-old pre-readers in kindergarten could only segment into syllables, while six-year-old first-graders who were non-readers showed some onset-rime segmentation ability as well as syllable segmentation (Gombert, 1996). Six-year-old first-graders who were able to read could segment into onset-rime, and into units that did not encapsulate onset-rime only or phoneme segmentation only. As an example they could separate out an initial consonant cluster, and keep the rime intact (e.g., /s/-/k/-/Ip/), or they would segment the rime, and keep the initial consonant cluster intact (e.g., /sk/-/u/-/p/).

The tapping studies all show evidence of syllable awareness developing prior to onset-rime awareness, and both occurring prior to the ability to segment into phonemes. In addition, the only children who could complete the phoneme tapping task were those who were learning to read or who were already able to read. Awareness of larger phonological units such as the syllable and the rime have been found to develop without requiring any literacy instruction (Morais, Cary, Alegria, & Bertelson, 1979; Read et al., 1986). Phoneme awareness, in contrast, appears to require the process of learning to read and spell, along with letter knowledge. In conjunction with the requirement of alphabetic literacy knowledge phoneme awareness also appears to require the earlier developing rime awareness.

Schatzschneider et al. (1999) found evidence that sensitivity to onsets and rimes occurs prior to phoneme sensitivity and the ability to manipulate phonemes using Item Response theory to analyse performance on phonological awareness tasks. They used seven tasks: onset-rime blending, phoneme blending into words, phoneme blending into nonwords, phoneme deletion, phoneme segmentation, sound categorisation, and first sound matching. The items from these seven tasks were then combined to give 105 individual items. The items from first sound matching (which is an onset awareness measure) and onset-rime blending gave the most information about children’s phonological awareness during kindergarten. Phoneme sensitivity items, as measured by phoneme blending, phoneme elision, and phoneme segmentation, gave the most information about children’s phonological awareness just prior to beginning Grade 1, and during Grades 1 and 2.
In longitudinal studies researchers have found that rime sensitivity is a precursor for phoneme sensitivity (Bryant et al., 1990; Lonigan et al., 2000). Bryant et al. gave four-year-olds onset and rhyme odd-word-out tasks. A year later the same children were given first-sound deletion, end-sound deletion, and phoneme tapping tasks. They found that onset and rhyme awareness in four-year-olds predicted their ability on the phoneme deletion tasks a year later, suggesting that onset and rime awareness does aid in the development of phoneme awareness. Lonigan et al. found that the latent variable of phonological awareness at the age of five predicted all of the variance in the latent variable of phonological awareness at the age of six. When the children were aged five the phonological awareness variable consisted of items from tasks such as elision of words and syllable, and the blending of words and syllables. At the age of six the phonological awareness variable was more heavily loaded with phoneme items, such as the elision and blending of phonemes.

Stahl and Murray (1994) gave 113 children who attended either kindergarten or first-grade a series of phonological awareness tasks. These tasks allowed a comparison between task difficulty and levels of linguistic complexity. There were four types of task: blending, segmentation, phoneme isolation, and deletion. There were four levels of linguistic complexity: onset-rime, vowel-coda, consonant cluster onsets, and consonant cluster codas. The last three levels of linguistic complexity require phoneme awareness. They found that onset-rime tasks were the easiest for the children, followed by vowel-coda tasks, consonant cluster coda tasks, and the most difficult was the consonant cluster onset tasks. This is compatible with the finding of Treiman (1985) that breaking up the onset is very difficult for young children. By comparing children’s ability to complete the tasks at the four levels of complexity with letter knowledge and early word reading Stahl and Murray concluded that children needed a sufficient level of letter-knowledge to have onset-rime awareness but it still developed before being able to read. This knowledge of onset-rimes, they suggest can enable basic word recognition which then allows children to develop phoneme awareness.

Phonological awareness thus appears to have at least four important components as illustrated in Figure 5. The first level of awareness is rime sensitivity, followed by rime manipulation. However, these can only be distinguished if measured early enough in preschool. As identified by Burgess (2002) phonological sensitivity can be measured in very young preschool children, hence it would be rime sensitivity that can be measured at that time (Schatschneider et al., 1999).
It would be expected that around the age of four children would also show some ability to manipulate at the rime level. This is also expected by the phonological processing model of phonological awareness development because of the ability to articulate the rime. It is not onset-rime awareness as this would assume that children would be sensitive to onsets at the same time as phonemes but this is not necessarily what happens (Bradley & Bryant, 1985; Kirtley, Bryant, MacLean, & Bradley, 1989). Note that the term rime awareness will be used in the rest of this review unless referring to research that specifically calls it onset-rime awareness. Developing an explicit knowledge of rimes and being able to manipulate them would then help children become aware of phonemes, initially by becoming aware of single phoneme onsets (Tunmer & Chapman, 2007).

![Diagram of proposed progression of phonological awareness development]

**Figure 5: Proposed progression of phonological awareness development**

The conceptualisation of phonological awareness as a continuum allows for both phoneme and rime awareness to play a role in the prediction of reading. Rime awareness is necessary for phoneme awareness to develop, along with letter name knowledge. Because rime awareness develops first, phoneme awareness will account for more variance in reading skill as phoneme awareness is the level of phonological awareness that develops at the same time as learning to read. Anthony et al. (2002) and Lonigan et al. (1998) found that rime and phoneme awareness shared common variance in the prediction of early reading and early reading skills. Bowey (2002) found that although both rime and phoneme awareness predicted reading, it was phoneme awareness that predicted the most variance. Rime or syllable awareness may be predictive of reading acquisition and development if it is measured earlier than phoneme awareness. This has been found in a New Zealand sample of preschool children followed after a year of formal instruction (Fletcher-Flinn & Snelson, 1997). Preschool syllable segmentation predicted reading a year later but concurrent correlations suggested that phoneme awareness was more predictive of reading once reading had begun.
Preschool phonological awareness and literacy skills

Many studies have examined the relationship between phonological awareness and reading in school-aged children. Yet, few studies have examined what children know before they begin school, and before they are introduced to formal reading and writing instruction. The remainder of this review will examine in greater detail the influences on the different levels of phonological awareness for preschool aged children. Syllable and rime awareness both develop prior to learning to read, but awareness of such linguistic levels must have their beginnings somewhere. This and possible precursors to these levels of awareness, particularly vocabulary development and the development of letter knowledge, will be reviewed. Letter knowledge will be reviewed comprehensively given its importance as one of the requirements for learning to read along with phonological awareness (Lonigan et al., 2000; Muter & Snowling, 1998; Nicholson, 2000). Finally, types of preschool reading will be discussed along with the relationship that preschool “reading” has with different levels of phonological awareness.

One factor that may underlie all the above skills is the distal influence of the home environment. All children bring to learning their home experiences, which correlate with parental income and education (Burgess, 2002). Parental income also correlates with children’s vocabularies (Evans, Shaw, & Bell, 2000) which can, in turn, predict phonological awareness (Silven, Niemi, & Voeten, 2002). Other home environment correlates of preschool abilities include parental interest in reading, and the amount of reading at home (Evans et al., 2000; Sonnenschein & Munsterman, 2002). This suggests that home experiences influence how much children know about reading, and their phonological awareness. The present study is restricted to identifying the more direct proximal contributors to phonological awareness such as letter-knowledge.

Speech perception and vocabulary

One variable that is thought to underlie phonological awareness is speech perception (Elbro, 1996; Fowler, 1991; McBride-Chang, 1995b; Walley et al., 2003). Speech perception in this case means the way we perceive how words are structured and how they are stored in our lexicons. Speech perception is considered important for phonological awareness as children need to be able to perceive phonemes in words to be able to differentiate between words that differ by only one
phoneme, something that phoneme awareness also requires. This initial perception of phonemes, which is required for the basic, automatic use of language and speech representation, is an implicit, unconscious, perception (Valtin, 1984). It is believed that this perception of phonemes becomes more explicit during the preschool period (Walley et al., 2003) in a similar manner to the phonological awareness continuum. The development of phonological awareness is thus based on the nature of the representations of speech units that are stored in the lexicon, or the level of phonological representation of words stored in the vocabulary (Walley et al., 2003; Wesseling & Reitsma, 2001). Phonological awareness abilities become more explicit as phonological representations become explicit and distinct. Phonological sensitivity may reflect the development of phonological representations, and thus has the same pattern of development (McBride-Chang, 1995a).

There are at least two theoretical positions that have been proposed to explain the development of phonological representations and their relationship with phonological sensitivity. Awareness of phonemes or onset-rimes, and the manipulation of these units, requires access to phonological representations stored in the mental lexicon (Foy & Mann, 2001). The first position is that phonological representations are not easily accessible in young children (Liberman, 1998), or that they are indistinct (Elbro, 1996). This lack of distinction is proposed to characterise children who become dyslexic (Elbro, 1998; Elbro, Borstrom, & Petersen, 1998). The second position is that phonological representations become increasingly segmented. Early phonological representations of words are holistic, and become increasingly segmented between one and eight years of age (Fowler, 1991).

Liberman (1998; 1999) theorised that language is inherently phonological, which is why the alphabetic script was developed. Within spoke language there are two key components, phonological structures and phonetic gestures. Phonetic gestures are the motor-controlled articulatory gestures that produce and perceive speech. Phonological structures are made up of phonemes which are the abstract representations of those gestures. Learning to read an alphabetic script, unlike speaking a language, is not biologically inherent. In order for the phonological structure to be used Liberman suggested that there is a phonetic module which automatically produces and perceives speech at the most specific level. The phonological representations of words are produced for the listener of speech, thus there is no need to segment the different phonetic components. When children are first asked to perform tasks that require
phonological manipulation, particularly of the phonemic kind, they are often unable to do this because they have never had to use any conscious cognitive effort to access the phonological representations before. As they do become aware of the nature of phonetic structures the phonemic level remains difficult to access due to the coarticulation of phonetic segments within words, and even between words. It was suggested by Liberman that weaker phonetic modules would impair the ability to begin accessing the phonological representations and the development of phonological awareness is impaired. Thus children’s phonological awareness is biologically determined by their phonetic structures and phonetic module.

A similar theory to that of Liberman’s (1998; 1999) theory of speech is the indistinct accessibility position of Elbro (1996) who suggests that indistinct phonological representations will influence the measurement of phonological sensitivity and phonological manipulation. Distinctness as used by Elbro refers to the difference between a representation and its lexical or phonemic neighbours. There is a low distinctness, for example between the words *eyes* and *ice*, /aiz/ and /ais/ respectively. These two words are distinguished by the length of the initial vowel, but could also be distinguished by a difference in voice of the consonant which would increase the distinctness. It is argued that children can tell the difference between words such as *glade* and *grade*, /gled/ and /gred/ respectively, because they do have access to phoneme-size segments. For children with indistinct representations, and thus poor access, they are unable to identify the distinguishing phonemes of /l/ and /r/. Such children might have rime awareness but they would be unable to manipulate phonological items because they are not represented distinctly. Even rhyme sensitivity requires that children have access to phonological representations that are sufficiently distinct to be able to discriminate between rhyme neighbours in the lexicon. Elbro does not, however, specify if larger phonological representations become distinct earlier than phoneme-sized phonological representations.

In one study Elbro et al. (1998) tested six-year-old dyslexic and normal children of dyslexic and normal parents on measures of vocabulary, reading, and phonological awareness utilising deletion tasks at the morpheme, syllable, and phoneme level. They also used identification tasks at the syllable and phoneme level and a distinctness measure based on the child’s ability to correctly pronounce words that were presented to them inaccurately. A lack of phonological distinctness was related to both reading difficulties and to lower phonological awareness scores. Phonological distinctness did not explain all the variance in their measures of phonological
awareness making it possible that the size of phonological representations could influence phonological awareness levels. However, the study did not separate out linguistic unit size in phonological representations so no conclusions could be made about the influence of increasing segmentation of representations. The authors also agreed that vocabulary could play a role in the development of phonological representations but did not appear to do so in their study, possibly because the subjects already had well developed vocabularies.

Another theoretical position is one in which children's phonological representations become more segmented as they get older, as a result of increasing vocabulary (Fowler, 1991; Walley et al., 2003). Early speech perception research shows some discrimination at the phonemic level (Eimas et al., 1971), but more recent research has found that this early perception of speech is more holistic and of a syllabic nature (Houston, Santelmann, & Jusczyk, 2004; Johnson, Jusczyk, Cutler, & Norris, 2003; Jusczyk, Luce, & Charles-Luce, 1994). As children begin to have a greater understanding of language and begin to extract words out of the speech stream they develop their mental lexicon. This is initially based on the strength of syllable stress in the initial position of a word (Houston et al., 2004). Children find it easier to extract words that are monosyllabic and multi-syllabic words that begin with a stressed, strong syllable such as parachute (’pʰærəʃuːt). In the earliest stages of lexical development the number of words is relatively small, and thus words can be represented as wholes (Walley et al., 2003). As children’s word knowledge increases their lexicons increase in size and phonological representations are divided into subsyllabic units such as onsets and rimes. Finally words are segmented into phonemic representations that allow for the fine-grained distinction required to distinguish between all words in the English language. Phonological representations may not become segmented at the phonemic level if the native language is syllabic or moraic at its most fine-grained level. In such a language speech segmentation is either a combination of mora and syllabic segmentation for young children, and moraic segmentation for older children and adults (Inagaki et al., 2000; McQueen, Otake, & Cutler, 2001). The mora in Japanese is essentially syllabic in nature and generally only phonemic for the special case of the moraic nasal.

This theory of phonological representation segmentation helps to explain why onset-rime and syllable sensitivity is easier for younger children and why more segmented phoneme sensitivity increases over time (Walley, 1993; Walley et al., 2003). The change in phonological sensitivity is due to the increase in vocabulary during early childhood. A smaller sized lexicon at younger
ages means that words can be discriminated as wholes. The young infant or toddler will
generally only know a small number of nouns which are not similar, such as “Mummy” and
“cat”, which can be represented as wholes. As vocabulary and the child’s mental lexicon
increases in size, words become more similar and need to be discriminated by smaller sized units.
This begins with onset-rime (e.g., bat-cat and bat-bed), because many first words are initially
monosyllabic anyway, and ends with phoneme discrimination (e.g., bat-bad-bed). Silven, Niemi,
and Voeten (2002) showed that learning to map word meanings to parts of extracted speech at the
age of one year leads to phonological awareness at the age of four years. This may indicate that
very early holistic vocabulary development plays a role in phonological awareness development.
The inaccessibility and indistinct theories of Liberman (1998; 1999) and Elbro (1996; 1998;
Elbro et al., 1998) explain changes in phonological awareness by the increasing ability to
articulate phonological units rather than vocabulary development alone (see also Tunmer &
Chapman, 2007).

The relationship between vocabulary development and phonological representations has been
found in several studies examining the neighbourhood density of words. Many words share
phonological properties, for example, the word ‘rat’ has ‘brat’, ‘rot’, and ‘at’ included as its
neighbours (De Cara & Goswami, 2003). The larger the child’s vocabulary the more affected
they will be by neighbourhood density, as they have more words to choose from in their lexicons.
De Cara and Goswami found this in five-year-old children’s performance on an oddity task using
words that children acquire by the age of five. The oddity task had three conditions, odd word
out by vowel change, odd word out by coda change, and odd word out by rime change. Items
were chosen from dense neighbourhoods (e.g., pit, wait) and sparse neighbourhoods (e.g., bike,
bird). The children in their study who had higher receptive vocabularies performed better on
oddball task items that came from dense neighbourhoods than those items from sparse
neighbourhoods, particularly on rhyme oddity. These children were more familiar with the
rhymes in the task and so were better able to tell when a word did not rhyme than children who
had lower receptive vocabularies. For the children who had lower vocabularies words with both
dense and sparse neighbourhoods were comparable as they did not have enough words in their
lexicons to make up dense neighbourhoods. For these children all words were from sparse
neighbourhoods in their lexicon.
Carroll and Snowling (2001) found that the more phonologically similar words are, the greater their effect on children’s ability to distinguish between them and to reject them in phonological tasks such as onset and rime matching. The phonological similarity of words was calculated using phonological similarity ratings devised by Singh and colleagues (Singh & Woods, 1971; Singh, Woods, & Becker, 1972). Words are rated as phonologically similar based on phonetic properties. The two words ‘dish’ and ‘beach’ are rated as being similar because the vowels /i/ and /i/ are both high front vowels. The onsets of /d/ and /b/ are both voiced oral stops and the codas of /∫/ and /t∫/ are both voiceless palatals. In contrast the two words ‘dish’ and ‘duck’ are less similar, even though they share the same onset. In these two words the vowels do not share phonetic qualities, and neither do the final consonants.

In Carroll and Snowling’s (2001) study children were tested on onset and rime matching three times over a year, beginning when their average age was 3 years 8 months. The distractor items used in the matching tasks were chosen for their global phonological similarity to the cue word or for their semantic relationship to the cue word. In an analysis of the correct responses children had the most difficulty when the distractor word was phonologically similar to the cue word. Their difficulty with these tasks remained over the time period, suggesting that children were using phonological strategies and the global similarity of words. Children did not have segmented representations of words to be able to distinguish between the similar phonemes. The children found the rhyme matching task easier which suggests that neighbourhood density was having an effect because rhyme neighbourhoods are denser at young ages than neighbourhoods based only on vowels or codas. When vowels and codas are combined to form rimes the words are easier to distinguish from each other. The same effect was found in slightly older five-year-old children (Byrne & Fielding-Barnsley, 1993). In this study children performed better on matching tasks that didn’t control for global similarity than on phoneme tasks in which similarity was controlled. These older children also did not have phonological representations that were segmented enough to easily distinguish between words with phonemes that shared phonetic qualities.

It could be that the more words children have in their mental lexicon, the more they need to be able to segment them to be able to store and use their representations accurately in phonological awareness tasks. Research using the gating paradigm has found that vocabulary does have a relationship with phonological representations and speech perception (Metsala, 1993).
gating paradigm presents words slowly and the point at which the subject recognises the word is measured. Adults need only a small part of the word presented before they recognise it, but children need more of the word presented, especially if the word is from a sparse neighbourhood and is a low frequency word (Walley, 1988). Children need larger chunks of words presented to them before they can identify what word it is because they have more holistic representations of words stored in their lexicons. They need the larger chunks presented before they can match them up with their phonological representations.

Children with better vocabularies tend to have better phonological awareness. This is because vocabulary influences the increasing segmentation of phonological representations and phonological representations underlie phonological awareness. Many researchers investigating preliteracy development, but not phonological representations, have found strong correlations between vocabulary development and phonological awareness. Frijters, Barron, and Brunello (2000) found a correlation as high as \( r = .67 \) between receptive vocabulary and phonological awareness using a composite score of phoneme matching and deletion tasks in children aged five years who had some reading ability. In addition Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, and Poe (2003) also reported a high correlation between phonological awareness and vocabulary in 4-year-old children considered to be non-readers, using similar tasks to Frijters et al., although it was slightly lower at \( r = .49 \). These findings further bolster the segmentation theory of Fowler (1991) and Walley et al. (2003).

Foy and Mann (2001) examined the relationships between expressive vocabulary and speech discrimination with rhyme and phoneme awareness in children between four and six years of age. It was found that speech discrimination was a significant predictor of rhyme awareness, but this relationship was independent of vocabulary. One explanation for this may be that the measure of vocabulary used was an expressive measure rather than a receptive measure. Children’s expressive vocabularies often lag behind their receptive vocabularies (Bates, 1992). In the study of Foy and Mann this could mean that children’s vocabulary levels are underestimated. The relationship between speech discrimination and rhyme awareness is still one that is expected by the segmentation theory of Fowler (1991) and Walley et al. (2003). Foy and Mann also found that phoneme awareness was predicted by letter knowledge, vocabulary, and to a lesser extent age. These three variables mediated the relationship between phoneme awareness and speech discrimination.
The research on vocabulary, speech representations, and phonological awareness would seem to suggest that phoneme awareness is the result of an increase in segmented phonological representations. But the increasingly segmented representations are the result of explicit knowledge about letters and words. This segmentation theory of phonological representations may underlie the continuum model of increasing phonological sensitivity and manipulation. It also lends support to phonological awareness being a homogenous concept, in which syllable, onset-rime and phoneme awareness are all one construct. In addition, the difficulty experienced by children on the speech tasks that required sensitivity at the onset level is compatible with the proposed development of phonological awareness, in which sensitivity to onsets develops after sensitivity to rimes.

**Letter knowledge**

Knowledge of the letters of the alphabet is another important skill that preschoolers develop. Preschoolers usually know the names of letters better than they know the sounds of letters (Treiman & Broderick, 1998; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998). The discrepancy between letter-name and letter-sound knowledge is consistently found across studies but the level of letter knowledge found in preschoolers and children beginning school is not. North American preschoolers (e.g., Lonigan et al., 2000; Treiman & Broderick, 1998) have higher levels of letter-name knowledge on school entry than do Scottish children (e.g., Johnston, Anderson, & Holligan, 1996), New Zealand children (e.g., Blaiklock, 2000), and German children (Naslund & Schneider, 1996). Such differences can influence the relationships between phonological awareness, letter knowledge, and literacy skills. Theories based only on research with American children may not allow for the range of variability found in children’s preschool knowledge even within other English speaking countries.

It is unclear where letter-name knowledge initially derives from, and few studies have investigated the development of letter-name knowledge. Johnston et al. (1996), in a study of environmental logo reading found that product name reading ability was the key driver for letter-name knowledge. However, when Reutzel, Fawson, Young, Morrison, and Wilcox (2003) asked children aged from four-years to seven-years of age to read product names that were changed systematically by colour, logo removal, font, and spelling they found that the children did not use their letter or phonological knowledge to read. De Jong and Olson (2004) found that initial letter
knowledge in preschool children was best predicted by phonological memory with a small influence from rapid automatic naming (RAN). Letter names may, therefore, be learned initially as a new wordlike form in phonological memory and the association with the grapheme stored in long-term memory. The association between the phonological form of the letter and its grapheme is related to RAN as RAN is thought to reflect the ability to learn arbitrary relationships (de Jong & Olson, 2004). This would be necessary as the shapes of letter graphemes are arbitrary and the relationship between a grapheme and a letter name must be learned as paired-associates (Treiman & Kessler, 2003).

Treiman and Broderick (1998) found that children’s initial letter-name knowledge was primarily derived from the letters in their own names. Molfese, Beswick, Molnar, and Jacobi-Vessels (2006) found that four and five-year-old preschool children were better able to write their name than identify or write individual letters that may or may not have been in their names. Arrow, Fletcher-Flinn, and Nicholson (2003) found that four-year-olds who could identify their own name knew the letter-names from the letters in their own names better than other letters. These children also knew more letter-names overall compared to children who could not identify their own name. Evidence that own names are salient and thus familiar enough for children to begin to derive letter-name knowledge from them comes from studies of adults and children alike. Adults show a preference for their own name by being able to recognise their own name with rapid repetition, but not other words or names (Arnell, Shapiro, & Sorensen, 1999). Children also show a preference for their own name and the letters in their own name over other children’s names and other letters from the alphabet (Treiman & Broderick, 1998). Children and adults are also more possessive of their first name through perceived ownership of that name (Hoorens & Nuttin, 1993; Hoorens & Todorova, 1988; Jones, Pelham, Mirenberg, & Hetts, 2002; Lipsitz & Gifford, 2003; Nuttin, 1987).

Treiman and Broderick (1998) also found that children learn the first letter of their own name before the other letters in their first and last names. This relates to the importance of learning the initial phonemes in words suggested by Byrne and Fielding-Barnsley (1990) from their training study. They found that training children in word initial phonemes, as representations of letter-sounds gave pre-readers some alphabetic insight, and that this insight could be generalised to other letters. However, they did find that stops were more difficult than continuants. This effect of letter type may be misleading however, and could be an effect of where the sound of the letter
lies within the letter name (Treiman, Tincoff, & Richmond-Welty, 1996). This could mean that for some children the introduction to letter sounds is easier because the first letter of their name starts with the sound of that letter.

There is some evidence that letter name knowledge is predictive of onset-rime awareness. Stahl and Murray (1994) found that onset-rime awareness was almost non-existent in children with little to no alphabet knowledge. In addition, Murray, Stahl, and Ivey (1996) found that building four-year-old preschoolers’ alphabet knowledge by reading them conventional alphabet books in the ordinary nursery school setting increased their onset-rime awareness. The conventional alphabet books had the letter of the alphabet with pictures that began with the correct sound of the letter. This allowed children to hear the letter and the sound it makes at the beginning of the word and begin to work out that relationship between the name of the letter and the sound that it makes. To work out the relationship between the name of the letter and the sound that it makes the children had to be able to segment the example word at the onset-rime level, such as segmenting the /k/ sound from the example word ‘cat’. The posttest in this study included segmentation at the onset-rime level. The children who were learning to do this when they were being read the alphabet books were better at the posttest onset-rime awareness tasks. Children who were simply read books with just the letter name and no corresponding words starting with that letter made significantly less gains in letter-names and onset-rime awareness.

Letter-sound knowledge is derived from letter-name knowledge (Treiman et al., 1998). Letter-sound relationships are not learned as arbitrary triads of graphemes, letter-names and letter-sounds. Familiarity with letter-names allows children to begin to induce letter-sounds from the names using the acrophonic principle (Thompson, Fletcher-Flinn, & Cottrell, 1999). It is especially the case when the letter-sound is found at the beginning of the letter-name, for example, the letter ‘k’ is pronounced /ke/ with the sound /k/ at the beginning of the letter-name. Evans, Bell, Shaw, Moretti, and Page (in press) provide evidence that the letters with sounds at the beginning of the letter name are those letter sounds learnt first by kindergarten children.

Evidence of this induction process comes from the errors that children make when asked to give the sounds of letters. The letter sound response of /d/ to the letter ‘w’ is an example of such an error. The letter ‘w’ is pronounced /dæblju/, with the sound /d/ at the beginning of the letter name, hence the error in the response /d/. Similar errors occur in the letter sound responses to the
letters ‘u’ and ‘y’ for example. All the consonant stops, except for /g/ have corresponding letter names that start with the sound. Two fricatives, /v/ and /z/ also have corresponding letter names that start with the letter sound, as well as the vowels ‘e’ and ‘o’. All other consonant and vowel graphemes have sounds that are different to the initial sound in the name of the letter. Nine letters out of the twenty six in the alphabet can adequately have the sound induced using the acrophonic principle, while the remaining 17 cannot.

Once letter-sound knowledge has developed out of letter-name knowledge there is a stronger relationship between letter knowledge and phonological awareness. Barron (1991) has put forward the proto-literacy hypothesis in which children’s developing knowledge of letter-sounds influences the development of phonemic awareness. Proto-literacy refers to literacy related skills that develop prior to reading ability. The proto-literacy skill of letter-sound knowledge provides symbols for sounds which aids in accessing phonemes. Evidence of this relationship comes from Johnston et al. (1996) who found that preschool children did not display phoneme awareness unless they had some letter-sound knowledge. In addition, Byrne and Fielding-Barnsley (1989; 1990) showed that children aged from three to five years of age needed to have knowledge of the relevant letter-sound before they could correctly choose between the written words mow and sow for the spoken word “mow” after being taught to read the words mat and sat.

Correlational support for this hypothesis comes from the relationships found between letter-sound knowledge and performance on phonological awareness measures incorporating both rime and phoneme awareness in five-year-old nursery school children (Stuart & Coltheart, 1988). Letter-name knowledge also had correlations of the same strength with phonological awareness although it was not measured at the later times in the study. McBride-Chang (1999) found strong correlations between letter-sound knowledge and performance on phonological awareness, measured with syllable and phoneme deletion as well as phoneme isolation, at four different times in five-year-old kindergartners. The concurrent correlations for letter-sound knowledge and phonological awareness stayed strong over time while the concurrent correlations between letter-name knowledge and phonological awareness became weaker.

Invented spelling is often used as a measure of phonological awareness as it requires children to be able to segment phonemes in a spoken word and represent the phonemes with letters. When attempting to spell children tend to represent sounds in words with letter names. An example of
this would be the word car being spelt KR, with the rime /ər/ represented by the letter whose name this sound makes, r (Reece & Treiman, 2001). This spelling of the word ‘car’ also shows another mechanism used by beginning spellers, with the use of the letter K to represent the phoneme /k/. The child who has spelt the word ‘car’ with KR is using their knowledge of letter names to induce the letter sounds, as previously discussed. Treiman, Sotak, and Bowman (2001b) showed that children use these strategies in spelling more than they do for reading. Thus, letter name knowledge can be predictive of spelling ability. This predictive relationship also suggests that children begin to use alphabetic strategies in spelling earlier than was previously thought.

Because of the relationship between letter-sound knowledge and phonological awareness it is possible that the relationship between phonological awareness and reading is mediated by letter knowledge. Evidence of the importance of letter knowledge at the beginning of learning to read was found by Ehri and Wilce (1985). They found that children who could read a few words learnt to read simplified spellings, such as JRF for ‘giraffe’ easier than spellings that were visually distinct, such as WcT. These beginning readers were making use of their early letter-name and letter-sound knowledge to remember how to read the words that matched letter and sound.

The importance of letter-sound knowledge has been shown in meta-analyses of phonological awareness intervention studies (Bus & van Ijzendoorn, 1999; Ehri et al., 2001b; National Reading Panel, 2000). The studies show that when letter exposure is controlled phonological awareness training does not contribute much to reading; it only increases the phonological awareness of those given the intervention as compared to a control group. The National Reading Panel found the effects of phonological awareness training were strongest when the training included letters. Although phonological awareness is important for learning to read, it is not sufficient on its own, letter knowledge is also required. However, it may also be that some level of phonological awareness of at least rime manipulation is first required to even be able to access letter-sound knowledge and thus phoneme awareness.

Vocabulary can mediate the relationship between letter knowledge and phoneme or rime awareness, as Bowey (1994) found in a sample of reading and non-reading preschoolers. Differences in phoneme awareness between readers and non-readers disappeared after controlling
for vocabulary, as the two groups were significantly different on vocabulary measures. Increased vocabulary may result in more opportunities to allow children to induce letter sounds from more spoken words. By controlling for this variable, it was then possible to control for the increased induction of letter sounds. This finding is in contrast to de Jong and Olson (2004) who found that vocabulary did not play a part in early letter knowledge. However, de Jong and Olson did not distinguish between letter names and letter sounds. Higher levels of letter-name knowledge would mask any potential relationship between letter-sound knowledge and vocabulary.

To summarise, letter knowledge begins with children learning letter names. Children begin to learn letters once they begin to understand what their own name is and how it can be represented in written language. Once they have letter-name knowledge they also begin to develop onset-rime awareness. It is this increasing onset-rime awareness that may allow children to deduce the sounds of letters out of the letter-names. Knowledge of letter names must be sufficiently secure for children to begin inducing the sounds. After children have begun to deduce the sounds of letters this knowledge along with rime awareness may help children develop phoneme sensitivity. Explicitly taught letter-sound knowledge may lead to phoneme awareness without requiring letter-name knowledge first (e.g., Caravolas, Hulme, & Snowling, 2001).

**Reading and spelling ability**

Finally, we ask what reading and spelling abilities preschoolers have and what the relationship is between any early reading and spelling abilities and phonological awareness. Most preschoolers have no conventional reading ability when they begin school (Blaiklock, 2000; Seymour & Elder, 1986). A small number of precocious readers do exist (e.g., Fletcher-Flinn & Thompson, 2000; Stainthorp & Hughes, 1999), but before attending school most children have very little reading ability (Adams, 1990). Jackson and Coltheart (2001) estimate that between 1 and 3% of children can read at school entry. This seems to be regardless of the age of the child at entry to school. Even in a sample to 235 Danish children who started school at the age of seven only one child was able to read at the age of six (Lundberg et al., 1988).
Preschoolers do have some forms of functional reading ability that they make use of prior to formal instruction. One common preschool reading ability task measures children’s ability to ‘read’ environmental print (Adams, 1990; Cronin, Farrell, & Delaney, 1999; Kuby, Goodstadt-Killoran, Aldridge, & Kirkland, 1999). Environmental print is usually considered to be the marketing and commercial print that children encounter in their environment, such as the McDonalds logo, the Coca-Cola logo, and more recently the X-Box logo. The ability to read environmental print has been found to be related to the development of letter-name knowledge (Johnston et al., 1996) and to emerging phonological sensitivity in preschoolers (Burgess, 2002). Environmental print does not predict later reading ability well when controlling for concurrent letter-name knowledge and phonological sensitivity (Lonigan et al., 2000). Reutzel, Fawson, Young, Morrison, and Wilcox (2003) found that children who could read were better at reading environmental print in and out of context but they did not use their letter knowledge or phonological sensitivity in the reading of them. This can explain why children are usually unable to read environmental print when it is out of context (Sonnenschein & Munsterman, 2002). When non-readers and beginning readers are reading environmental print it appears that they are using a logographic facility and not alphabetic strategies.

Research has provided evidence that logographic reading has more to do with the accompanying graphics than the form of the word itself. Gough (1993) taught four- and five-year-old children to read four four-letter words printed on individual cards. One of the words had a thumbprint on the corner of the card. The children learnt this word to criterion the fastest. In posttesting the children were shown a card with just the thumbprint and a card with a novel word that had the thumbprint on the corner. In both conditions the children replied with the same word that they had learnt originally paired with the thumbprint. In contrast, when shown the word that was originally paired with the thumbprint they could not recognise it without the thumbprint. This indicates that these children are learning words by rote paired-associate learning using visual stimuli which has nothing to do with the words themselves (Ehri, 1995; Gough & Hillinger, 1980).

Environmental print reading may not just be using logographic strategies but could be evidence of reading with context and without decoding (Cronin et al., 1999). Cronin et al. for example,
found that children could learn to read environmental print words out of context, but that learning was reduced as the similarity decreased. The learning of the word ‘McDonald’s’ for example, was reduced when the apostrophe was missing from the training word card. However, Cronin et al. (1999) found that children learnt environmental print words out of context faster than they learnt control words matched on initial letter and word length. Their findings suggest that the visual graphics play some role in learning environmental print but that there may have been some recognition of the order of the letters which helped in the leaning out of context, a type of visuographic reading (Share & Gur, 1999).

Nicholson (1993b) suggests that contextual reading allows for correct reading at the time, but does not necessarily reflect decoding skill. When children read correctly in context it can aid in children’s developing understanding that you read for meaning, especially if the words read in context are familiar environmental print words (Kuby et al., 1999). It may also be that the frequency with which children are read to in the home also contributes to their understanding of reading for meaning, and then to reading environmental print for meaning. Sonnenschein and Munsterman (2002) found there is a strong correlation between the ability to read environmental print in context and reading frequency in the home for five-year-old children who had not yet started formal education.

It has been suggested that environmental print is an initial catalyst for letter-name knowledge, which in turn leads to phoneme awareness and manipulation (Johnston et al., 1996). But there is also a wealth of studies that indicate that environmental print reading does not have a relationship with letter knowledge (Blair & Savage, in press; Cardoso-Martins, Rodrigues, & Ehri, 2003; Lonigan et al., 2000; Masonheimer, Drum, & Ehri, 1984). In asking Brazilian illiterate adults who knew an average 64% of letter names to read environmental print out of context (e.g., the Coca-Cola label when it wasn’t on a bottle) Cardoso-Martins et al. found they averaged only 23% accuracy, compared to 87.5% accuracy when in context. In addition, these same adults could not tell when letters had been altered on the environmental print logos, even when they saw an altered logo next to the original. The inability to identify altered letters even when they knew more than half the names of letters indicates that they are not using any letter knowledge when reading environmental print.
The findings of Cardoso-Martins et al. (2003) expanded on previous research by Masonheimer et al. (1984) with children aged between three and five years. Masonheimer et al. selected children for their study who were ‘experts’ at environmental print reading and could identify 8 out of ten environmental print logos when in context. Of the 102 expert environmental print readers only six could be identified as readers of print, indicating that environmental print reading does not necessarily lead into word recognition or decoding. What distinguished the readers from the non-readers in this study was letter-name knowledge. It also appeared to be this skill that allowed the readers to distinguish between altered and unaltered environmental print logos as well as identifying the logos out of context and when in black in white. This suggests that there is a relationship between letter-name knowledge and reading ability, but that environmental print is not the catalyst for this. The relationship between environmental print and letter knowledge occurs if word reading ability is already present (e.g., Reutzel et al., 2003).

A second type of functional reading ability evident in preschool children is the identification and reading of their own name. Recent research on this second type of functional reading ability that preschoolers have suggests that reading your own and other children’s names provides a better indicator of early reading ability. Share and Gur (1999) found that children with low letter knowledge and low phonological abilities were less able to identify the names of other children in their kindergarten and based their identification on accompanying information such as a sticker next to the name when shown their labelled lockers. Older kindergarten children were able to recognise more names in and out of context, as well as when normally salient initial or final letters in the name were covered. This was interpreted as showing that pre-readers with no formal reading ability are able to use alphabetic information in the identification of words. Treiman and Broderick (1998) found a similar use of alphabetic knowledge with children’s own names. Preschoolers, whose ages ranged from 4 years 10 months to 5 years 8 months, knew the first letter of their own name more than they knew other letters, with a trend towards knowing the other letters in their name better than other letters. This preference in the knowledge of the first initial of the first name fits with research on adult name letter preference, in that we associate and prefer the first letter of our first name more than we do other letters (Jones et al., 2002).

Thus, if environmental print is not the trigger for letter name knowledge or for understanding that words consist of letters, then it is possible that children’s own names allow children to begin to attend to print, and not just to the context (Share & Gur, 1999). Once children can identify their
own name they have more skills than children who cannot identify their own name (Riley, 1996). In particular, letter-sound knowledge and phonological awareness of both rimes and phonemes were associated with own-name writing more than own-name identification (Blair & Savage, in press). Using their own name as a springboard into alphabetic strategies was shown in kindergarten aged children who used the letters in their names when attempting to spell words they didn’t know (Treiman, Kessler, & Bourassa, 2001a). Thus, your own name is a word that you are very familiar with, and relate to, more than any other word in the beginning readers vocabulary. This increased familiarity could mean that the child can act upon and manipulate the printed form of their name, including the letters, with reduced cognitive load which allows the child to concentrate on what letters are used to make this word and the relationships with other letters and words.

It is accepted that phonological awareness is important for learning to read but there is some debate as to the nature of the relationship between phonological awareness and reading (Bryant, 2002; Bryant et al., 1990; Hatcher, Hulme, & Snowling, 2001; Hulme, 2002; Hulme et al., 2002; Hulme et al., 2001; MacLean et al., 1987; Muter et al., 1997b). Hulme and colleagues argue that phoneme awareness is required for learning to read. Evidence for this relationship comes from training studies such as that by Lundberg et al. (1988). In the Lundberg et al. study training children in phonological awareness aided in their reading acquisition compared to a similar control group who received no phonological awareness training. In addition, longitudinal studies also indicated that phoneme awareness, as measured by segmentation, predicted how well children would learn to read once at school (Hulme et al., 2002; Muter et al., 1997b; 1998).

In contrast, Bryant and colleagues (Bryant, 2002; Bryant & Cavendish, 2001) suggest that rhyme awareness plays a role in reading acquisition, and they also provide evidence with longitudinal studies (e.g., Bryant et al., 1990; MacLean et al., 1987). Bryant et al. (1990) for example, found that there was a role for rhyme awareness in reading, and that it fed into the development of phoneme awareness. Phoneme awareness is aided by the process of learning to read, but prior phonological awareness at the rime level is the type of phonological awareness that would initially aid in early reading acquisition. The continuum model of phonological awareness would expect that rime awareness would initially predict reading, and that phoneme awareness would develop out of rime awareness, but is triggered by children’s increased knowledge of letter sounds and formal reading instruction. Bryant’s (2002) hypothesis of the direct influence of rime
awareness to reading, and the indirect route in which rime awareness helps children develop phoneme awareness which also aids in reading acquisition.

The role that rime awareness can have in early reading acquisition and development is suggested by Goswami (1998). Goswami found that children can begin to make use of rime analogies when attempting to read words. In the interactive analogy model of Goswami (1993b), novel words are read by analogy using existing knowledge of words with the same spelling patterns in the rime. As an example, the word *plum* may be known to a reader, and is held in the orthographic lexicon as *pl-um*, with the segment of *um* used as an analogy in order to attempt to read the word *sum*.

Goswami (1993a; 1993b) claims that as reading develops finer-grained comparisons can be made between spelling patterns and the sounds of words, developing alongside phonemic awareness. The interactive relationship between phonological and orthographic knowledge begins with rime knowledge. The interaction between phonemic knowledge and orthographic knowledge develops during the process of learning to read and spell. Thus, children begin to learn to read using their knowledge of spoken words at the rime level to recognise word units of the same size, followed by the recognition of words as a collection of phonemes, and their representational graphemes.

Furthermore, Bowey (1994) found that novice readers were better on measures of rime awareness, but there were little to no differences between readers and non-readers with equivalent letter knowledge in phonemic awareness measured by identity tasks. This would suggest that the novice readers did not yet have stable enough reading skills to be differentiated from non-readers on the phoneme task, but that their increased rime awareness was sufficient to give them the ability to begin reading. In addition, phoneme awareness occurs in populations that have been taught alphabetic literacy, but not in adult illiterates (Morais et al., 1979) or in samples that learnt to read in non-alphabetic scripts such as Chinese (Read et al., 1986). This focus on phoneme awareness and not on both phoneme and rime awareness means that any lower level phonological awareness, such as rime awareness, is not measured. As a result, rime awareness doesn’t appear to be related to reading.

While phonological awareness is strongly related to reading ability it is important to note that training children in phonological awareness does not necessarily have long-term effects. It seems that the effects of phonological awareness training can be lost at around the Grade 2 level. At this time children who received phonological awareness training are now even with the control
groups that were used during the intervention (Krashen, 1999a). This is supported by a meta-
analysis of experimental studies that found effect sizes of phonological awareness training
dropped over the length of time between intervention and posttest follow-up (National Reading
Panel, 2000). It may be that although phonological awareness intervention does improve
phonological awareness it has little effect on reading itself (Krashen, 1999b). Again, this is also
shown by the National Reading Panel’s (2000) results that indicate higher effect sizes for
phonological awareness outcomes than for both reading and spelling outcomes when
phonological awareness training was provided. In addition, in his critical meta-analysis of
phonological awareness intervention Troia (1999) found that few studies show long-term benefits
of phonological awareness training, and that some studies also acknowledge that not all children
respond well to such training (e.g., Byrne & Fielding-Barnsley, 1991; Byrne & Fielding-

**Spelling**

Conventional spelling is also not usual in preschoolers, and the spelling ability of even
precocious readers tends to lag well behind their reading ability (Fletcher-Flinn & Thompson,
2000; Stainthorp & Hughes, 1999). Spelling development is best described as a series of stages
from scribbling to the use of spelling rules. The lowest spelling level that is often described is
that of the pre-phonemic speller, in which children are scribbling or writing random combinations
of letters (Bear & Templeton, 1998; Frost, 2001). Frost (2001) describes a next stage in which
children are able to write familiar words such as their own names or the names of family. Either
of these first two stages would accurately describe many preschool children. Treiman et al.
(2001a) provided evidence that kindergarten children’s familiarity with their own name also
allows them to use the letters from their own name when trying to spell new words. Once
preschool children have knowledge of their own names they use that knowledge to attempt to
spell new words, even if it is not phonetically appropriate.

The next stage of spelling ability is also found in preschool children without formal spelling
instruction. This stage has a variety of names including invented spelling (Chomsky, 1979;
Gentry, 1982; Read, 1986), and the alphabet layer (Templeton & Morris, 1999). At this stage
children are beginning to use more appropriate phonetic representations when spelling words.
The phonetic representations at this level come from the use of letter names for long vowels and
representing short vowels by the letter name with the closest phonetic representation (Beers & Beers, 1980). In addition children at this stage tend to omit vowels altogether when they are prior to the consonants ‘r’ and ‘l’ and they also tend to omit the nasal consonants ‘n’ and ‘m’ when they occur before other consonants (Chomsky, 1979; Read, 1986). Children all show this pattern of spelling whether they have not yet been taught to spell (Read, 1971) or are being taught to spell (Silva & Alves-Martins, 2003; Treiman et al., 2001b).

Children’s spelling patterns may follow the hierarchical structure of the syllable, in which children begin to represent sounds by syllable, then onset-rime, then by phoneme. Evidence for the initial use of syllabic writing, which is also influenced by letter name knowledge, is given by Treiman and Bourassa (2000). They show one child’s writing in which he spells the monosyllabic word be with a B, and the bisyllabic word enough is represented by NF, one letter for each syllable. Evidence of syllabic spelling was also illustrated by Gentry (1982) with RUDF for the sentence ‘are you deaf’.

The next spellings that children use are those in which one letter represents the onset and one letter represents the rime. Examples of onset-rime spellings are evident in Gentry (1982) with KR for car and BRDE for birdie. This is the type of spelling usually considered to be invented spelling. Letter-name knowledge is combining with onset-rime awareness to help children begin to understand how to represent words using written language. Children’s use of letter names in spelling was experimentally shown by Treiman et al. (2001b). Kindergarten children found it easier to learn to spell letter-name based spellings, such as BT for beet, than they did sound based spellings, such as TR for tore, and visually distinct spellings such as PL for robe. As letter-name representation is the hallmark of the entry into invented spelling (Bear & Templeton, 1998; Frost, 2001) it would be anticipated that letter-name knowledge is strongly correlated with preschool or early spelling ability.

Once children are able to represent sounds in words using letters they then can begin to use their developing letter-sound knowledge and phoneme awareness to help them learn to spell more phonetically where one sound is represented by one grapheme. This more phonetic spelling requires more sophisticated phonological awareness in which the speller needs to be able to segment the sounds in a spoken word so they can represent them with a letter. This relationship between phoneme awareness and spelling has been found in phonological awareness intervention
studies but the nature of the relationship is unclear. Many studies in this area have found that phoneme awareness helps with learning to spell (e.g., Schneider et al., 1997; Torneus, 1984). In turn, others such as Torgesen and Davis (1996) have found that children with already existing spelling ability learn phoneme segmentations and phoneme blending more easily than children with little to no spelling ability. Studies that have taught kindergarten children to spell have found that their segmentation skills have improved in contrast to the segmentation skills of controls (Ehri & Wilce, 1987).

Early spellers also seem to follow a pattern in the way they become able to accurately represent the sounds in a word when spelling. The initial phoneme is the first to be represented in a phonologically accurate way, followed by the final letter, with the medial letter trailing behind (Bear & Templeton, 1998; Frost, 2001), for both preschool readers and non-readers (Uhry, 1999). Holligan and Johnston (1991) found that poor spellers are no different to age-matched spelling controls on an initial phoneme odd-word-out task, but had more difficulty with medial and final phoneme odd-word-out tasks.

To summarise; reading, spelling, letter-name knowledge, letter-sound knowledge and phonological awareness are all closely tied to each other. When it comes to reading, preschoolers do not necessarily go through a series of stages. Rather, they initially learn to process different types of functional print using different strategies. Environmental print is learnt using a logographic strategy but learning their own name and other children’s names utilises children’s knowledge of letters. In addition, as children initially begin to read words rime awareness predicts their reading acquisition and development. This rime awareness, along with learning to read and increasing letter-sound knowledge increases children’s phoneme manipulation skills. These phoneme manipulation skills may then aid children in beginning to spell phonetically, representing each phoneme in a word with a grapheme. Prior to this they are using their rime awareness and letter-name knowledge to make attempts to spell new words, the ability of which lags behind their reading ability. This could be because when reading there are less cognitive decisions to make than when spelling. Or, it could be because phonological or phoneme awareness is needed for spelling but is not necessary for beginning to read.
Hypotheses

This review of the literature on preschool literacy skills and phonological awareness has shown that there is a relationship between phonological awareness and reading. Phoneme awareness in particular is related to formal alphabetic literacy instruction while rime and syllable awareness appears to develop without requiring literacy instruction. There is less research on what skills or knowledge precede the development of phonological awareness. This is an important area of knowledge as the teaching of phonological awareness has frequently been recommended for beginning readers (Adams, Foorman, Lundberg, & Beeler, 1998; National Reading Panel, 2000; New Zealand House of Representatives, 2001). However, before they are able to make use of such instruction beginning readers will need to have a sufficient knowledge base in any precursors of phonological awareness. It then ensures that children learn the right skills, in the right order, to facilitate efficient literacy learning.

The current study adds to the body of literature on the development of phonological awareness by examining the development of phonological awareness and the precursors to the different levels of phonological awareness, namely rime and phoneme awareness. A hypothesised model of phonological awareness development was developed based on the literature review and is illustrated in Figure 6. The study will initially test the definition of phonological awareness in which rime and phoneme awareness are both contributors to the latent variable of phonological awareness (see Figure 6). The current study examines the development of phonological awareness in a sample of four-and-a-half-year-old preschool children who have not received any formal literacy instruction. Because of the range of literacy skills and phonological awareness in preschool children the division of rime sensitivity and manipulation and phoneme sensitivity and manipulation will be collapsed into rime and phoneme awareness when examining the development and precursors of phonological awareness. This is to control for potential floor and ceiling effects.

The study will then examine the development and precursors of rime and phoneme awareness as they are hypothesised (see Figure 6). Specifically it is expected that vocabulary, along with own-name knowledge and letter-name knowledge, will predict rime awareness. In turn it is expected that rime awareness will predict phoneme awareness, along with letter-sound knowledge and conventional reading ability. In addition, the current study tests whether individual differences in
the hypothesised precursors differentiate children who are at different points along the continuum in terms of their phonological awareness at the rime and phoneme levels. In summary, the following explicit hypotheses were derived to examine the phonological awareness and early literacy skills of these preschoolers prior to beginning formal literacy instruction.

1. Rime sensitivity, rime manipulation, phoneme sensitivity, and phoneme manipulation are one factor.

2. Preschool children develop rime awareness before they develop phoneme awareness.


Figure 6: Possible model of phonological awareness development based on the continuum model of phonological sensitivity and the drivers hypothesised
Chapter 3: Methodology

Participants

New Zealand is unique in its school entry in that children generally start on their fifth birthday and not at one intake. This allows the researcher to examine children’s preschool knowledge and hold age constant. Public kindergartens in New Zealand are sessional with junior kindergarten sessions held three afternoons a week and senior kindergarten sessions run weekday mornings for approximately four hours. Children are eligible to begin junior kindergarten after their third birthday and usually move to senior kindergarten when they turn four. Often there are more children enrolled than there are places so entry to senior kindergarten can be at anytime between the child’s fourth and fifth birthdays. There is no explicit teaching of letter names or sounds to children while attending these kindergartens and play is an important part of the public kindergarten philosophy (Auckland Kindergarten Association, 2006). Informal observations found that children were sometimes encouraged to think about the first letter of names as children’s written names are shown at mat times for different reasons, e.g., when it is their turn for buzz news or if they forgot to put their name on the attendance board. This was an inconsistent practice and was only observed in two of the seven kindergartens that participants were drawn from.

The children were recruited from seven public kindergartens in the central-west Auckland region. This region was selected as it has a diverse population, highlighted by the decile ratings of local primary schools. Schools in New Zealand are given decile ratings as a measure of the socio-economic status of the surrounding area, with 1 being the least affluent, and 10 the most affluent. The decile ratings for the closest primary schools to the participating kindergartens ranged from decile 4 to decile 10. The mode was decile 8 which indicates that the children participating generally came from middle-class homes. This was not as representative as anticipated, but with most children coming from middle-class homes the confound of SES level is reduced. Children were recruited from public kindergartens as initial contacts with private day-care centres indicated that it would be difficult to recruit children in the desired age-range. In addition, public kindergartens are likely to be more representative of the populations entering public primary school.
A total of 177 consent forms and information letters were distributed by the kindergarten staff to all children at the participating kindergartens who were attending senior kindergarten sessions and whose ages fell between 4 years 6 months and 4 years 10 months. Due to the nature of the distribution through the kindergartens some children younger and older than this also received a consent form. The number of total consents returned was 126, with a return rate of 71.91%. Of the 126 children with consent, seven were below the age of 4 years 5 months, and considered too young to participate; five children refused to participate; three children had no English speaking skills and were unable to be tested due to their lack of understanding of what was required of them; and one child began school before he was able to participate. As a result, 110 children participated in the study, 59 girls and 51 boys. The children’s ages ranged from 4 years 5 months to 4 years 11 months on entry to the study, with a mean of 4 years 7 months. By having such a restricted age range the confound of age was reduced. The sample was predominantly Pakeha/New Zealand European (80%), followed by children who were identified in kindergarten records as either Maori or Pakeha and Maori (6.3%), children of Pacific Island descent (4.5%), children who were identified as Indian (3.6%), children who were identified as Chinese (2.7%), and others (1.8%).

Design

This study is an examination of preschool children’s phonological awareness and analysis of their abilities from a test battery of phonological awareness and early literacy skills. A pilot study was conducted initially with 12 children who were attending a public kindergarten in the same region as the children who participated in the full study. As a result the scorings of the reading and spelling tasks had phoneme analysis included and the presentation of the identity tasks were simplified. The rhyme production task was also added to the current test battery as children in the pilot study scored at ceiling on the rime tasks.

Materials

Children were tested on several different literacy measures including reading ability, spelling ability, and letter knowledge. The children were also tested on three measures of phonological awareness. Two of the phonological awareness measures tested both rime and phoneme levels of phonological awareness. Children were also administered a measure of receptive vocabulary.
**Reading measures**

*Own name.* The child’s name was typed on an A4 sheet of paper, portrait style in 24pt Arial font. The child was presented with the sheet of paper and asked if they knew “what this word is”. For example, if the child’s name was Ben they were presented with the paper with their name on it and asked “what does this word say?”. If Ben replied “that’s my name” he would be asked “what is your name?”. A response of “don’t know” was scored as 0 and a correct identification of their name was scored as 1.

*Clay reading words.* The Clay (1985) reading words used in this task were 15 words from list B. The Clay reading words are words that children encounter most often in the early reading books in New Zealand classrooms. These words were used as it gives an indication of words that children will know at the early stages of formal school education better than standardised reading tests which become difficult for beginning readers very quickly (see also Bowey, 1994). This particular list was chosen as it does not have any single letter words such as ‘I’ or ‘a’. This list did have the word ‘Mr’ but this was not included in the scoring because it was an abbreviation. The first five words that children had to attempt were *and, to, will, look,* and *he.* The words were presented in a list down an A4 page in 24pt Arial font. The words were covered by a sheet of paper and uncovered one by one as the child attempted each word. Children were told that it didn’t matter if they didn’t know any words, but that the experimenter wanted to see if they could read them. After 5 consecutive incorrect responses children were shown the remaining words and asked if they knew anymore. If they did not know any of the remaining words the test was stopped. The test was scored in two ways, the first was the number of words read correctly to a maximum score of 14, and the second was the number of phonemes correctly pronounced in the correct position to a maximum of 36. The word ‘to’ for example, would have the response of /æt/ scored as 0, the response of /du/ scored as 1, and the correct response of /tu/ as 2. As this was a measure of word reading attempts and not producing letter sounds the response of /tα/ would have the score of 1 as the vowel was not correctly pronounced for the word. Children’s “don’t know” responses and other responses such as letter naming of the letters in the word or other letters were also scored as 0. The majority of responses were “don’t know” responses.
Spelling measures

Own name. Children were given a pencil and paper, presented in landscape format, and asked to spell their name. If they could not write they were asked if they could tell the experimenter the letters in their name, however all children made an attempt to write their name. Children’s responses were scored as either able to spell or not able to spell their name so that scoring was the same as for the own name identification task.

Small common vocabulary words. The words used in this task were taken from Fletcher-Flinn and Thompson (2000) and were to, hi, me, we, at, am, so, no, go, dad. In this task the children had eight lower case plastic letters displayed in front of them (t, o, h, i, w, e, m, a) enough to spell the first six words in the test. Only these letters were presented as it was found that most children could not spell any words, and only giving them a small number of letters to choose from shortened the time it took for them to choose. The children were asked if they could show the experimenter how to spell the words, using the letters in front of them. If the children spelt four of the first six words correct then they were also provided with the remaining five letters required to spell all the words (s, n, g, d, d) and told that they might also need to use these letters. The children were stopped after five incorrect attempts, or five refusals. As for the reading task the spelling task was scored two ways, the number of words spelt correctly to a maximum of 10, and the number of phonemes spelt correctly, in the correct position, to a maximum of 21.

Letter knowledge measures

Letter-names. Children were presented with an A4 sheet with all 26 letters printed in lower case 24pt Arial font, in random order which is provided in Appendix C. Lower-case letters were used as it was thought that they are a more sensitive measure of children’s letter knowledge than upper case letters. The letters were printed in random order to ensure that the task measured children’s knowledge of letters and were not simply repeating the ‘alphabet song’. This was important as in at least one of the kindergartens participating the ‘alphabet song’ was a staple song at mat time. The children were asked to say what the name of the letter was, or what the letter was called. They were given corrective feedback only on the first letter, a. However, if the gave the sound of the letter they were told that yes, that was the sound, but were then asked what the name of the
letter was. The score was the total number of letter-names correctly given out of 26. The Spearman-Brown split-half reliability was .97.

*Letter-sounds.* This task immediately followed the letter name task using the same A4 sheet of letters. The children were then asked to provide the sound of letters and were again given corrective feedback on the first letter of a. If they gave the name of the letter they were told that it was the name of the letter and asked again what sound it made. The score was the total number of correct letter-sounds out of 26 letters. The Spearman-Brown split-half reliability was .95.

**Phonological awareness measures**

*Identity tasks.* Identity tasks test children’s sensitivity to the unit of phonological awareness that is being measured. It measures children’s understanding, for example, that the phoneme of /m/ is the same at the beginning of both *mow* and *mat* (Byrne, 1998). In phoneme identity tasks children are presented with the experimental word and its picture, and then presented with three other words and their pictures. The child has to decide which of the three words begins with the same sound, ends with the same sound, or has the same sound in the middle as the experimental word. In the rhyme identity task they have the same test format but have to say which word/picture has the same ending.

This task consisted of three conditions, onset, coda, and rime identity, given in this order. The onset and coda were both single phonemes in all items in this task. The test items are provided in Appendix C and are taken from Byrne and Fielding-Barnsley (1991). In the onset identity task the children were shown a card with four pictures. The picture at the top of the page was presented orally to the child while the experimenter pointed to it, for example *man*. The target word *mouse* was pictured underneath along with two filler items, *cow* and *pear*. These items were presented in the same way as the first word. The child was then asked which word began the same as *man*. The same procedure was followed for the coda and rime identity tasks. An example for the coda identity task is the experimental word *drum* with the answer to be selected from the words *horse*, *swim*, and *kite*. An example of an item from the rime identity task is *plane*: *goat*, *train*, *sun*. There were ten items in each condition with two practice items that were given first. The practice items were given with corrective feedback and assistance from the experimenter.
The practice items in the onset and coda tasks began with a syllable identity item, such as *football*: *footpath*, *telephone*, *wardrobe* for the initial phoneme identity task, and *snowman*: *traffic light*, *beachball*, *postman*. These easier items were administered first to help children understand that they had to find which words start or finish the same using more salient linguistic units. The practice items in the rime identity task were similar to the experimental items. One point was scored for each correct response, either through pointing or verbalisation. The task was stopped after the child made four consecutive incorrect responses. The Spearman-Brown split-half reliabilities for the identity tasks were .81 for onset, .66 for coda, and .85 for rime.

*Blending.* Blending requires the ability to combine isolated syllables or phonemes into one word. In terms of cognitive load it requires the storage of each sound unit in memory and then to put the sounds together. The blending task has three conditions, one for each level of phonological awareness, syllable (e.g., *bull-doz-er*), rime (e.g., *b-oy*), and phoneme (e.g., *t-a-p*). The items for this task can be found in Appendix C and were adapted from O’Connor, Jenkins, and Slocum (1995) and Roper (1984). Each condition had one practice item and five experimental items. When the experimental items were given corrective feedback and assistance was given by the experimenter.

Children had an index card placed in front of them. The index card had a picture of the target word on the other side of the card. They were told that they had to figure out what the picture was on the other side of the card by putting the sounds together to make the word. The sounds were further represented by counters that the experimenter placed in front of the child as they verbalised each sound segment to be blended, in 2-second intervals. Children were encouraged to repeat each sound after the experimenter while pointing to each counter. Children were corrected if they pronounced any sound incorrectly during this repetition. The children were then asked what word those sounds made, and once an attempt was made they could turn the card over to see if that was it. All items were presented to all children and each correct item was scored as 1. If a child turned a card over prematurely it was assumed that they could not give a correct answer and that item was scored as 0, as well as being reminded that they were to give the answer before they turned the card over. Spearman-Brown split-half reliabilities for the blending task are .69 for syllable blending, .85 for onset-rime blending, and .74 for phoneme blending.
Rhyme production. Rhyme production was used because rhyme awareness has been found to be a predictor of beginning reading. Rhyme production requires the child to decide on the rime unit in the orally spoken word and then to search their lexicon for words that match. It is often a difficult task for young children, harder than rhyme detection (Muter, 1994). It was used in this study as pilot testing found that some children scored at ceiling on both the rime identity task and onset-rime blending task so another task was needed to measure rime awareness that was more difficult (Anthony & Lonigan, 2004).

Children were orally presented with 5 words, one at a time and asked to give as many words as they could that rhymed with the target word. The children were shown a black and white picture of the target word as it was orally presented to them. This picture remained in front of the child while they tried to find rhyming words so that the memory load was reduced. The target words in this task were bat, cap, hen, shoe, and plum. The task was preceded by a discussion about rhyme that was adapted from Bradley and Bryant (1985) and utilised the children’s knowledge of nursery rhymes. Two practice items were also given so that the experimenter could give corrective feedback in the test format. Children were given thirty seconds to provide any responses for each word and the first five were recorded for each word. Nonwords were accepted if they rhymed with the target word. The maximum score for this task was 25, with up to five points available for each item. The Spearman-Brown split-half reliability for the rhyme production task was .94.

Vocabulary

This was measured by the British Picture Vocabulary Scale II (Dunn, Dunn, Whetton, & Burley, 1997). Children were required to point to the best picture, out of four black and white pictures, of the word verbally presented by the experimenter. The standardised instructions were given and the scores reported are standardised test scores. The published split-half reliability for preschool children aged between three-and-five-years-of-age is .89.

Procedure

After consent was obtained the experimenter attended a kindergarten session during which they were introduced to the children. Beginning the next day children were administered the tests in a
quiet corner of their kindergarten during the morning kindergarten sessions. Children were tested at kindergartens at one time, with the next kindergarten approached after collecting all the data from the previous kindergarten. As a result of this and being restricted to four hours or less a day the data collection was spread out over the space of two years. All children completed the tests in the same general order that they are described in the materials section. Two children completed the phonological awareness tests first and some children were administered the name reading task after the letter knowledge task. In addition, five children were unable to be administered the vocabulary measure.

The tests were presented as part of a game in which children had to complete a test to get a sticker which moved the child further up a game board. Once they had completed the game board they were able to get a bigger sticker. This motivated children to complete tests rather than stop halfway through. Testing took place over 2 to 4 sessions with breaks being dictated by individual children’s attention levels or their desire to have a ‘break’ from testing. The BPVS was administered on a separate day entirely. The average time to complete the literacy and phonological awareness tasks was 7.90 (SD = 4.85) days, which included weekend and public holiday days. The mode was 6 days and it ranged between one and twenty-seven days. Forty of the test sessions were timed and the average of these forty test sessions was 31 minutes and 45 seconds (SD = 5 minutes and 17 seconds). These times did not include testing on the British Picture Vocabulary Scale.
Chapter 4: Results

The purpose of this study was to examine the nature and development of phonological awareness in four-year-old preschool children. The first aim of the study was to examine what constitutes phonological awareness. The second aim was to examine possible precursors to the development of phonological awareness. This chapter presents the results of the data analysis based on the battery of tests given to the children. The battery of tests consisted of tests of literacy knowledge, tests of phonological awareness, and a test of receptive vocabulary.

A problem for the study was that deviations from normality were likely to occur for tests that these preschool children found very difficult or very easy. These floor or ceiling effects show positive or negative skew respectively (Coolican, 1994). In addition, kurtosis reflects bimodal distributions. Examination of these deviations from normality was required since it was expected that there would be some floor effects when children did not have some of the precursor skills. The measures that showed deviations from normality were transformed using a log transformation, but it did not change the significance of results. The phonological awareness tests that had an element of chance were also transformed, but it also did not change the significance of the results. As a result, it was decided that the untransformed variables could be used in all analyses. The untransformed descriptive results also give a general picture of the phonological awareness of New Zealand preschool children so that their levels of phonological awareness and literacy knowledge can be compared with similar samples of children from the United Kingdom and the United States in other studies.

The descriptive results section is followed by analyses examining the nature of phonological awareness. Factor analysis is used to examine the number of factors that the current measures of phonological awareness contribute variance towards. Data is examined using both exploratory and confirmatory factor analysis (CFA). Exploratory factor analysis was used first to provide a test of the theoretical base that both rime and phoneme awareness measures contribute variance towards a common factor of phonological awareness. The CFA was then used to examine the a priori model proposed in Chapter 2. This model specifies that there is a single latent endogenous variable with two latent exogenous factors of rime and phoneme awareness.
The factor analysis section is followed by the analyses examining the development of phonological awareness. This was examined in two ways. Firstly, hierarchical multiple regressions were used to provide evidence of potential precursors or predictors of rime awareness and of phoneme awareness. In the second analyses children in the sample were grouped by level of ability in the preliteracy skills that the regressions suggested were potential precursors to the development of phonological awareness. Differences in phonological awareness ability were examined by using ANOVA on groups based on reading ability and letter-name knowledge and on groups based on letter-sound knowledge. Differences in phonological awareness by literacy level provide further evidence of the utility of the potential precursors as indicators of difficulty in phonological awareness development. In all of the following analyses the alpha level was set at $p < .01$ to reduce the probability of Type I error due to the large sample size.

**Descriptive results of preschool literacy and phonological awareness**

*Literacy and vocabulary*

Table 1 shows the children’s literacy skills prior to beginning any formal instruction. The vocabulary measure was inadvertently not given to five children. The data from the five children are reported for all the measured variables, and the missing vocabulary scores considered as missing data in the remaining analyses. As would be expected of children without any formal instruction children knew significantly more letter names ($M = 11.04$) than letter sounds ($M = 2.59$), $t(109) = 14.23$, $p < .01$. Table 3 shows the correlation matrix for all variables measured in this study. The two letter knowledge measures significantly correlated with each other, $r = .64$. Letter sound knowledge also had problems with skew and kurtosis. Inspection of the data indicated that the kurtosis was due to the small number of children who could read more than one word.

Name spelling and identification scores are given as proportions since the children’s responses were counted as either correct or incorrect. Name spelling was easier for the preschoolers with 71% of the children able to spell their name. In the name identification task 65% were able to identify their name out of context. The difference between own name identification and name spelling was not significant, $t(109) = 1.00$, $p = n.s$. The two measures were significantly, but not highly, correlated, $r = .25$. For those children who could not write or spell their name
observations suggest that it was because they did not know which letters to use, rather than due to motor skill difficulties.

<table>
<thead>
<tr>
<th></th>
<th>Max</th>
<th>Mean</th>
<th>SD</th>
<th>Skew</th>
<th>Kurtosis</th>
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</thead>
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<td>Own name(^b)</td>
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<td></td>
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<td></td>
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<td>3.45</td>
<td>4.19</td>
<td>20.68</td>
</tr>
</tbody>
</table>

\(^aN = 105\)
\(^bMean score represents proportion of children who could spell or identify their own name\)

It was anticipated that children in the study would have no conventional reading or spelling ability. As can be seen in Table 1 the means for reading and spelling words were very low. The high skew reflects the great difficulty that most children had in reading and spelling the early vocabulary words. The kurtosis reflects the abilities of a small number of children who could read and spell and the difficulty experienced by most of the other children in the sample. Nine children could read and spell at least one word, 7 children could spell at least one word but not
read any words, and 3 children read at least one word but not spell any words. The two literacy tasks of reading and spelling words were significantly correlated, \( r = .71 \).

The number of phonemes pronounced correctly in the correct position was also calculated as a reading measure. This measure was also used as it was thought that children who could not read any words may be able to attempt reading by pronouncing at least the onset correctly and thus give a more sensitive measure of reading. Nine children who did not read any words correctly were able to score on this measure which had a mean of 1.35 phonemes read correctly. Thirty children who could not spell any words were able to score on the phoneme measure for spelling which had a mean of 1.45 phonemes spelt correctly. Even using this more sensitive measure of reading and spelling the skew and kurtosis levels were still high. The points scoring measures of phoneme reading and phoneme spelling were significantly correlated, \( r = .65 \).

**Phonological awareness**

Table 2 shows descriptive results for the total sample of children. It gives a general picture of New Zealand pre-schooler phonological awareness. Overall children had more difficulty with the phoneme awareness tasks which included the onset identity task, the coda identity task and the phoneme blending task. There were widespread floor effects in children’s ability to complete the coda identity task, with the mean of 2.90 below the chance level of 3.33. This did not affect skew or kurtosis statistics because chance allowed children to guess at least one correct answer. The phoneme blending task was difficult with a mean of just 0.57. Phoneme blending had a high skew tending towards floor effects because it was not influenced by chance. The positive skew was expected because these are mainly children who cannot yet read or write. The onset identity task was only just above chance with a mean of 3.54.

Syllable blending was expected to be the easiest task since it measured awareness of a larger phonological unit. It had a mean score of 2.45. The measures of rime awareness were the easiest within both the identity tasks and the blending tasks. The rime identity task had a mean of 4.47 which was well above the chance level of 3.33, but was not high enough to be significantly different from chance (using the binomial theorem the mean has to be above 7 to be significantly greater than chance). The onset-rime blending task had a mean of 2.68. Rhyme production, a task that requires greater manipulation of the rime unit was the more difficult of the rime tasks
with an average of 5.74 rhyming words produced. Despite this, children were able to produce, on average, one rhyming word for each item. None of the measures for the awareness of larger phonological units had skew or kurtosis problems.

**Table 2: Descriptive statistics on children's phonological awareness**

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<tr>
<th></th>
<th>Max</th>
<th>Chance level</th>
<th>Mean</th>
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<td>0.57</td>
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<td>5.74</td>
<td>6.68</td>
<td>0.91</td>
<td>-0.49</td>
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### Table 3: Intercorrelations between measures of literacy, phonological awareness measures, and control variables

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<th>C</th>
<th>D</th>
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<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
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<td>J. Coda identity</td>
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<td>.44**</td>
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</tr>
</tbody>
</table>
| O. Rhyme Production | -

<sup>a</sup>Represented by number of phonemes pronounced/spelt in the correct position.

<sup>b</sup>Either correct or incorrect

** p < .01
The nature of phonological awareness

The first hypothesis was that all measures of phonological awareness at the syllable, onset-rime, and phoneme levels could be accounted for by one latent variable. This single latent variable model of phonological awareness is illustrated in Figure 7. Correlations among the measures of phonological awareness are shown in Table 3. All phonological awareness measures except coda identity correlated significantly with each other. The coda identity measure didn’t correlate with other measures due to floor effects. This measure did not significantly correlate with any of the other phonological awareness measures, not even with the two other identity tasks, onset identity, $r = .17$, and rime identity, $r = .15$.

![Diagram of phonological awareness](image)

**Figure 7: Single latent variable model of phonological awareness**

To evaluate the single latent variable structure of phonological awareness principal component analysis was run with orthogonal rotation and Kaiser normalisation, using the data from all children who completed the tasks. Principal component analysis was run rather than exploratory
factor analysis as it was expected that the data would share common and unique variance and not just share an underlying latent variable (Fabrigar, Wegener, MacCallum, & Strahan, 1999). The measure of coda identity did not correlate with the other phonological awareness measures so it was not included in the factor analysis. Phoneme blending scores were transformed using a log transformation and run through the factor analysis with the other phonological awareness measures. The analysis was repeated using the untransformed blending scores. There was no difference between the results so the scores were left untransformed in the following analyses. Using a scree plot one unique component appeared with an eigenvalue of 2.90. The next largest eigenvalue was .92. This single factor accounted for 48.39% of the total variance shared by all the variables. The component loadings are provided in Table 4.

Table 4: Component loadings of phonological awareness measures in exploratory factor analysis

<table>
<thead>
<tr>
<th>Measure</th>
<th>Component loading</th>
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<td>Onset identity</td>
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<td>Onset-rime blending</td>
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<td>Phoneme blending</td>
<td>.730</td>
</tr>
<tr>
<td>Rhyme production</td>
<td>.641</td>
</tr>
</tbody>
</table>

Even though all measures of phonological awareness loaded onto one factor the second hypothesis was that before children could show any phoneme awareness they have to have rime awareness. The proposed model of phonological awareness distinguishes between two levels of phonological awareness, a rime level and a phoneme level. To test this theoretical construct further a CFA was run using AMOS computer software. A CFA was run as it tests theoretical
assumptions whereas exploratory factor analysis is simply an exploration of factors, not a test of
typeory. There are two types of variables in CFA, the first are exogenous variables which are
variables that are not caused by any other variable in the model, and the second are endogenous
variables which are those that are caused by other variables within the model, either exogenous or
endogenous. Latent variables are, by definition endogenous variables. Thus the latent variables
of rime awareness, phoneme awareness, and phonological awareness are all endogenous.

Figure 8: The second CFA model tested with two endogenous variables of rime awareness and phoneme
awareness contributing to phonological awareness

Two a priori models were tested, the first is the model suggested by the principal component
analysis in which phonological awareness is the single latent endogenous variable predicted by
observed exogenous variables only (see Figure 7). In the second there are two latent endogenous
variables factors representing the endogenous latent variable of phonological awareness,
illustrated in Figure 8. Because there was only one observed exogenous variable for the potential
endogenous variable of syllable awareness it was not included in the second model. Thus rime awareness and phoneme awareness are the second-order endogenous variables.

Figure 9: Single latent exogenous variable model of phonological awareness with standardised beta weights and the error for phonological awareness

The first model evaluated the single latent endogenous variable model of phonological awareness with no distinction between rime awareness and phoneme awareness. Because of the nonnormal distribution of some of the observed exogenous phoneme awareness measures, particularly the phoneme blending data, the CFA was conducted using maximum likelihood estimation and bootstrapped adjusted standard errors (Byrne, 2001). This first model provided a poor fit for the data with $\chi^2(9) = 29.21, p < .01$, and comparative fit index (CFI) = .87. The Tucker-Lewis index (TLI) = .72 and RMSEA (root square mean error) = .19 also indicated a poor fit of the data for the single factor model without distinguishing between rime and phoneme awareness. Better fit models are indicated by CFI and TLI results close to 1 and a RMSEA result less than .06 (Byrne,
However, this model does appear to explain 81% (1-error) of the variance in phonological awareness.

![Diagram of phonological awareness models]

**Figure 10:** The second model of phonological specified by the proposed model of phonological awareness development showing standardised beta weights and the error for phonological awareness.

The second model evaluated the hypothesis that phonological awareness is a single construct but within the single construct rime awareness and phoneme awareness are endogenous latent variables. In this model the residual errors of the endogenous latent variables were held constant due to the intercorrelational nature of the observed rime and phoneme measures (see Table 3). This model provided a much better fit of the data with $\chi^2 (4) = 5.62, p = \text{n.s}$, and comparative fit index (CFI) = .99. The additional fit indices of TLI = .97 and RMSEA = .06 also indicated that this was a much better fit of the data. The second model also explained 82% (1-error) of the variance in phonological awareness.
Figure 11 shows a scatter-graph of the children’s performance on rime and phoneme awareness tests which pictorially reflects the difference in performance on rime and phoneme awareness measures. The scores of rime identity and onset-rime blending were combined to give a percentage correct score for rime awareness. Rhyme production scores were not used in this analysis as the scores were too varied to use as a percentage correct. The measures that used smaller units were then combined to give a percentage correct score for phoneme awareness. This measure used onset identity and phoneme blending.

![Distribution of phonological awareness scores on rime and phoneme awareness composite measures.](image)

The correlation between these composite measures of large-unit and small-unit phonological awareness was significant, $r = .41, p < .01$. As illustrated in Figure 11, children had to have more than 60% accuracy in rime awareness measures before they showed phoneme awareness. Only two children had less than 50% accuracy in rime awareness measures and more than 50%
accuracy in phoneme awareness measures. The rime awareness scores were much more varied regardless of phoneme awareness. Taken together the results indicate that a distinction should be made between rime awareness and phoneme awareness in preschool children with no formal literacy instruction, but that they both contribute to the exogenous latent variable of phonological awareness.

**Precursors of phonological awareness**

The precursors of phonological awareness are those variables that may provide children with a cognitive base in which increasingly fine-grained phonological awareness can develop. The precursors to each level of awareness under examination in this study are vocabulary, own-name knowledge, letter knowledge, and reading and spelling ability. Examination of the correlations in Table 3 gives some initial support for these variables as precursors for the development of phonological awareness. Vocabulary correlated significantly with the rime awareness measures of rime identity, onset-rime blending, and rhyme production. It also correlated significantly with phoneme blending but this only just reached significance. Own-name knowledge measured by children’s ability to spell their name was significantly correlated with rime awareness measures. Own-name knowledge measured by identification of own names significantly correlated only with the phoneme blending measure.

Both letter-name and letter-sound knowledge were significantly correlated with rime awareness measures, as well as with onset identity and phoneme blending. Letter-sound knowledge had generally higher correlations with phonological awareness measures which would be expected if children’s letter-sound knowledge is developing out of their letter-name knowledge. Effects of letter-name knowledge were mediated by letter-sound knowledge. Reading ability was significantly correlated with the phoneme measures of onset identity and phoneme blending while spelling ability was significantly correlated with these two measures of phoneme awareness as well as with coda identity.

**Rime awareness**

Hierarchical fixed-order regressions were carried out on the phonological awareness measures to further examine the nature of the correlations as precursors to the development of phonological
awareness. Given that phoneme awareness may require some level of rime awareness to develop in children (see Figure 11), and that the CFA also suggests they are separate in this sample, it is appropriate that phoneme and rime awareness could be separated into different measures for the children in this sample. Unit-weighted composites were formed for phoneme awareness and for rime awareness.

The phoneme composite measure was made up of onset identity and phoneme blending. Coda identity was excluded due to its difficulty and because it was only correlated with spelling ability. The rime composite measure was made up of rime identity and onset-rime blending. Rhyme production was excluded as it had greater variance than the rime identity and onset-rime blending tasks and also because it had a lesser weighting in the CFA. Unlike the sample of children in the pilot test the current sample did not show ceiling effects in rime identity and onset-rime blending which was why the more difficult rhyme production measure was initially included.

Table 5: Summary of hierarchical regression analysis for variables predicting rime awareness ($n=104$)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$\Delta F$</th>
<th>Final $\beta$</th>
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<td>.03</td>
<td>4.19</td>
<td>.04</td>
</tr>
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<td>2</td>
<td>Vocabulary</td>
<td>.21</td>
<td>.18**</td>
<td>23.91</td>
<td>.36**</td>
</tr>
<tr>
<td>3</td>
<td>Own name spelling</td>
<td>.26</td>
<td>.06**</td>
<td>9.07</td>
<td>.18</td>
</tr>
<tr>
<td>4</td>
<td>Letter names</td>
<td>.29</td>
<td>.03</td>
<td>4.59</td>
<td>.21</td>
</tr>
</tbody>
</table>

| 3    | Letter names       | .27   | .07**        | 9.80       | .21           |
| 4    | Own name spelling  | .29   | .03          | 3.90       | .18           |

| 2    | Letter names       | .14   | .11**        | 13.74      | .21           |
| 3    | Own name spelling  | .17   | .04          | 5.59       | .18           |
| 4    | Vocabulary         | .29   | .12**        | 17.50      | .36**         |

| 2    | Own name spelling  | .13   | .11**        | 13.21      | .18           |
| 3    | Letter names       | .17   | .05          | 6.08       | .21           |
| 4    | Vocabulary         | .29   | .12**        | 17.50      | .36**         |

** $p < .01$
The rime composite score had age entered at the first step, vocabulary at the second step, name spelling at the third step, and letter name knowledge at the fourth step. Own-name reading was not included as it did not correlate with the rime measures. The results of the regression are shown in Table 5. Age was entered into the regression as a control variable only and did not contribute significantly to rime awareness, $F(1, 103) = 4.19, p = \text{n.s.}$ This was expected given the restricted age range of the sample. Own-name spelling ability and letter-name knowledge contributed to rime awareness only when entered before the other. Letter-name knowledge does seem to add a little more to rime awareness, especially when added before vocabulary, $R^2 = .14, F(1, 103) = 9.22, p < .01$. When entered before letter-name knowledge and vocabulary, own-name spelling ability adds a little less variance to rime awareness, $R^2 = .13, F(1, 103) = 8.95, p < .01$.

The most striking result is the amount of variance explained by vocabulary, regardless of when it was entered in the regression analysis. When entered before letter-name and own-name spelling knowledge it explained 18% of the variance in rime awareness, $F(1, 103) = 14.52, p < .01$. When entered after letter-name and own-name spelling knowledge it independently explained 12% of the variance in rime awareness, $F(1, 103) = 11.61, p < .01$. When all predictors were entered into the regression it was only vocabulary that remained significant. This suggests the possibility that the development of vocabulary could be a significant precursor to the development of rime awareness.

**Phoneme awareness**

When phoneme awareness was entered as the dependent variable in regression analyses the control variable vocabulary was entered first. In preliminary analyses there were no differences in results if age or vocabulary were entered as control variables so only vocabulary is reported. This was followed by rime awareness, letter-name knowledge and letter-sound knowledge in this order. Own-name identification was also entered in preliminary analyses but failed to explain significant variance even when entered first. Rime awareness, letter-name knowledge, and letter-sound knowledge together significantly explained 34% of the variance in phoneme awareness, $F(4, 105) = 16.14, p < .01$. 
Rime awareness and letter-sound knowledge remained significant predictors after all predictors were entered. Letter-name knowledge did not remain significant after letter-sound knowledge was entered, most likely because letter-sound knowledge develops after letter-name knowledge when there is no formal letter-sound instruction. Letter-sound knowledge, therefore, mediates the relationship between letter-name knowledge and phoneme awareness. When a measure of the correct number of phonemes read was added to the regression it failed to explain any further variance, $\Delta R^2 = .02$, $F(5, 104) = 13.38, p < .01$. When reading was entered in the step before letter-sound knowledge it explained a significant amount of variance change on its own, $\Delta R^2 = .13$, $F(4, 105) = 10.58, p < .01$. It could be that letter-sound knowledge contributes more to phoneme awareness and also contributes to reading ability.

Table 6: Summary of hierarchical regression analysis for variables predicting phoneme awareness ($n=110$)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$\Delta F$</th>
<th>Final $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vocabulary</td>
<td>.03</td>
<td>.04</td>
<td>4.71</td>
<td>-.06</td>
</tr>
<tr>
<td>2</td>
<td>Rime awareness</td>
<td>.15</td>
<td>.12**</td>
<td>14.50</td>
<td>.28**</td>
</tr>
<tr>
<td>3</td>
<td>Letter names</td>
<td>.21</td>
<td>.07**</td>
<td>8.66</td>
<td>-.05</td>
</tr>
<tr>
<td>4</td>
<td>Letter sounds</td>
<td>.37</td>
<td>.16**</td>
<td>26.88</td>
<td>.54**</td>
</tr>
<tr>
<td>4</td>
<td>Letter sounds</td>
<td>.37</td>
<td>.16**</td>
<td>26.88</td>
<td>.46**</td>
</tr>
<tr>
<td>5</td>
<td>Reading$^a$</td>
<td>.38</td>
<td>.02</td>
<td>3.34</td>
<td>.17</td>
</tr>
<tr>
<td>4</td>
<td>Reading$^a$</td>
<td>.28</td>
<td>.08**</td>
<td>11.58</td>
<td>.16</td>
</tr>
<tr>
<td>5</td>
<td>Letter sounds</td>
<td>.38</td>
<td>.10**</td>
<td>17.38</td>
<td>.46**</td>
</tr>
</tbody>
</table>

$^a$Phoneme reading score

** $p < .01$

The previous regression analysis found that there is an important relationship between letter-sound knowledge and phoneme awareness. The concurrent correlations that make up this analysis do not allow causality to be assumed. Examining the concurrent predictors of letter-sound knowledge, including the possible prediction of letter-sound knowledge by phoneme awareness provides a way to see how children’s phonological awareness differs when they are compared by level of pre-literacy knowledge. The other key predictor of letter-sound knowledge
is expected to be letter-name knowledge. There was a strong correlation between letter-name and letter-sound knowledge, $r = .64$. To show how letter-name knowledge influences letter-sound knowledge a scatter-graph is presented in Figure 12. The scatter-graph indicates that children with good letter-sound knowledge also have good letter-name knowledge. There are also some children with good letter-name knowledge but no letter-sound knowledge.

![Scatter-graph showing distribution of letter knowledge by letter-name knowledge and letter-sound knowledge.](image)

**Figure 12:** Distribution of letter knowledge by letter-name knowledge and letter-sound knowledge.

To examine the predictors of letter-sound knowledge a hierarchical fixed-order regression was carried out with letter-sound knowledge as the dependent variable. Age and vocabulary were entered first as control variables. Letter-name knowledge was entered next followed by own-name identification. Own-name identification was entered as it was thought that this early reading task might also generate some learning of letter sounds. The latent variable of rime awareness was entered at the last step but contributed little to the prediction of letter-sound knowledge.
As illustrated in Figure 12, only children with high levels of letter-name knowledge had high levels of letter-sound knowledge. Letter-name knowledge remained the only significant predictor after all other variables are entered. When entered before own-name identification letter-name knowledge contributed 31% of the variance in letter-sound knowledge. The results of the regression on letter-sound knowledge also showed that age and vocabulary contributed 11% of the variance to letter-sound knowledge, $F(2, 107) = 7.63, p < .01$. Own-name identification and rime awareness contributed nothing to the variance in letter-sound knowledge.

Table 7: Summary of the hierarchical regression analysis for variables predicting letter-sound knowledge ($n=110$)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$\Delta F$</th>
<th>Final $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Age</td>
<td>.06</td>
<td>.07**</td>
<td>7.77</td>
<td>.06</td>
</tr>
<tr>
<td>2</td>
<td>Vocabulary</td>
<td>.11</td>
<td>.06**</td>
<td>7.03</td>
<td>.12</td>
</tr>
<tr>
<td>3</td>
<td>Letter names</td>
<td>.42</td>
<td>.31**</td>
<td>55.51</td>
<td>.57**</td>
</tr>
<tr>
<td>4</td>
<td>Name reading</td>
<td>.42</td>
<td>.00</td>
<td>.61</td>
<td>.07</td>
</tr>
<tr>
<td>5</td>
<td>Rime awareness</td>
<td>.41</td>
<td>.00</td>
<td>.05</td>
<td>.02</td>
</tr>
</tbody>
</table>

When phoneme awareness is added at the fifth step instead of rime awareness it reduces the influence of letter-name knowledge, but not substantially. However, it does suggest that there is a reciprocal relationship between phoneme awareness and letter-sound knowledge. The concurrent correlational nature of the current study does not allow for any argument of the nature of the relationship based on regression analyses.

**Test of phonological awareness development by literacy level**

The results of the regressions indicate that there are some clear precursors to the development of phonological awareness. As a further test of the predictive nature of letter knowledge and reading ability two ANOVAs were performed. In the first, children were classified as either
readers or non-readers, with the non-readers then subdivided based on their letter name knowledge. This analysis enabled a check of the relationship of letter-names on rime awareness in particular while controlling for the predominate vocabulary. In the second analysis children were grouped on their letter-sound knowledge. This analysis was a check on the influence of letter-sound knowledge on phonological awareness while controlling for reading ability.

*Letter-names and reading ability*

For the first ANOVA 12 children were classified as readers based on their ability to read one or more words ($M = 3.92$), with 98 children classified as non-readers. The non-readers were further grouped in letter-name knowledge groups based on whether they were one or more standard deviations from the mean as given in Table 1. This resulted in 21 non-readers (LLN) with letter name knowledge of less than 1 standard deviation ($M = 1.38$), 12 non-readers (HLN) with letter name knowledge of more than 1 standard deviation ($M = 22.75$), and 65 non-readers (ALN) with average letter name knowledge ($M = 9.83$). Three of the five children with no vocabulary data came from the ALN group, one child came from the HLN group, and one child was in the reader group. The data from the five children’s missing vocabulary data are not included in these analyses as it was decided a priori that vocabulary would be controlled because of its relationship with rime awareness. The summary statistics for the groups on the experimental tasks are given in Table 8. The groups were first compared on age and vocabulary using one-way ANOVA, followed by post-hoc contrasts using the Bonferonni adjustment for multiple comparisons.

The results for age showed a significant difference between the groups, $F(3, 106) = 4.29$, $p < .01$. Follow-up contrasts indicated that the difference was due to the 1.64 months difference between the readers and the LLN group. The reason for this significant difference was that there was less variance in the LLN group who had no children older than 57 months. The reader group had the same lower age of 54 months but also included the older children who were 59 months. The results for vocabulary (BPVS) showed a significant difference between the groups, $F(3, 106) = 4.81$, $p < .01$. Follow-up contrasts found that the difference in the vocabulary standard scores between the LLN group and the reader group of nearly 13 standard score points was significant. Because these differences could influence the results the remaining comparisons were made using ANCOVA with both age and vocabulary as the covariates using Bonferonni to adjust for multiple comparisons in the post-hoc contrasts.
The results for letter-name knowledge showed that, as expected there was a significant
difference between groups, $F(3, 106) = 93.27, p < .01$. Follow-up contrasts showed that there
was no significant difference between the HLN group and the readers. There was also a
significant difference between groups for letter-sound knowledge, $F(3, 106) = 29.28, p < .01$.
Follow-up contrasts showed that the readers had an advantage over all the non-readers, even the
HLN group who had the same level of letter name knowledge. The HLN non-readers had greater
letter sound knowledge than the LLN and ALN groups who were no different from each other.

Table 8: Descriptive statistics on control variables, letter knowledge, and phonological awareness for reader
and non-reader groups

<table>
<thead>
<tr>
<th></th>
<th>LLN</th>
<th>ALN</th>
<th>HLN</th>
<th>Readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>21</td>
<td>62</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Age</td>
<td>55.00</td>
<td>1.18</td>
<td>55.81</td>
<td>1.44</td>
</tr>
<tr>
<td>BPVS SS</td>
<td>95.86</td>
<td>10.76</td>
<td>104.13</td>
<td>10.09</td>
</tr>
<tr>
<td>Letter Names</td>
<td>1.38</td>
<td>1.07</td>
<td>9.66</td>
<td>4.83</td>
</tr>
<tr>
<td>Sounds</td>
<td>.24</td>
<td>1.09</td>
<td>1.37</td>
<td>2.41</td>
</tr>
<tr>
<td>Rime awareness$^a$</td>
<td>33.02</td>
<td>23.80</td>
<td>46.36</td>
<td>29.73</td>
</tr>
<tr>
<td>Phoneme awareness$^b$</td>
<td>17.78</td>
<td>12.71</td>
<td>24.10</td>
<td>19.60</td>
</tr>
</tbody>
</table>

$^a$The rime awareness score is a latent variable consisting of the rime identity and onset-rime blending
measures and converted to a percentage correct.

$^b$The phoneme awareness score is a latent variable consisting of onset identity and phoneme blending
measures and converted to a percentage correct.

The groups were compared on the latent variables of rime and phoneme awareness that were used
as the dependent variables in the regression analyses, rather than the individual measures. There
was no significant difference between the groups on rime awareness, $F(3, 106) = 2.03, p = n.s.$
This suggests that letter-name knowledge and reading ability do not have any influence on rime
awareness and that vocabulary that has the greater influence. There was a significant difference
between the groups on phoneme awareness, $F(3, 106) = 4.77, p < .01$. None of the follow-up
contrasts using the Bonferonni adjustments were significant, but there were close to significant
differences between the reader group and the LLN ($p = .02$) and the ALN ($p = .011$) groups.
Letter-sounds

To examine the relationship between letter-sound knowledge and phonological awareness children were grouped based on their letter-sound knowledge. The 66 children with no knowledge of letter-sounds made up the biggest group. The children with some letter-sound knowledge were split into a group of 29 children who had an intermediate level of letter-sound knowledge, with a range of 1-7 sounds known ($M = 3.52$) and 15 children with high letter-sound knowledge, ranging from 8-20 sounds known ($M = 12.20$).

Table 9: Descriptive statistics on control variables, letter knowledge, and phonological awareness for letter-sound groupings

<table>
<thead>
<tr>
<th></th>
<th>No letter sounds</th>
<th>Some letter sounds</th>
<th>High letter sounds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n = 66$</td>
<td>$N = 29$</td>
<td>$n = 15$</td>
</tr>
<tr>
<td><strong>M</strong></td>
<td><strong>SD</strong></td>
<td><strong>M</strong></td>
<td><strong>SD</strong></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>55.52</td>
<td>1.43</td>
<td>55.97</td>
</tr>
<tr>
<td><strong>BPVS SS</strong></td>
<td>100.30</td>
<td>10.28</td>
<td>105.43</td>
</tr>
<tr>
<td><strong>Letter Names</strong></td>
<td>7.65</td>
<td>6.69</td>
<td>12.76</td>
</tr>
<tr>
<td><strong>Sounds</strong></td>
<td>0.00</td>
<td>0.00</td>
<td>3.52</td>
</tr>
<tr>
<td><strong>Rime Awareness</strong></td>
<td>41.52</td>
<td>26.99</td>
<td>49.66</td>
</tr>
<tr>
<td><strong>Phoneme Awareness</strong></td>
<td>17.68</td>
<td>12.35</td>
<td>34.48</td>
</tr>
</tbody>
</table>

*aThe rime awareness score is a latent variable consisting of the rime identity and onset-rime blending measures and converted to a percentage correct.
*bThe phoneme awareness score is a latent variable consisting of onset identity and phoneme blending measures and converted to a percentage correct.

Table 9 presents the summary statistics of interest for the letter-sound groups. One-way ANOVA found that the groups differed significantly on age, $F(2, 107) = 7.93, p < .01$. Post-hoc tests showed that the high letter-sound group was significantly older than the two other letter-sound groups. This explains the significant correlations between age and letter-knowledge in Table 3 which had not been expected because of the restricted age range of the sample. There was no significant difference between the groups on vocabulary at the previously set level of significance, $F(2, 107) = 4.60, p = .012$. The remaining analyses thus used age as well as reading.
as covariates. There was a significant difference between the groups on letter-name knowledge, $F(2, 107) = 16.28, p < .01$. All groups were significantly different from each other which support the regression finding that knowledge of letter names is needed before you can learn the letter-sounds. The scattergram in Figure 12 also supports this finding.

There was no significant difference between the groups on rime awareness, $F(2, 107) = 3.31, p = .04$. This is unsurprising as rime awareness can develop without needing to have letter-sound knowledge, and because vocabulary did not differ between the groups. There was a significant difference between the groups on phoneme awareness, $F(2, 107) = 13.37, p < .01$. Post-hoc comparisons with Bonferonni adjustments showed that this difference was due to the children with no letter-sound knowledge scoring significantly lower on phoneme awareness than either letter-sound group. Although variance is restricted in the no letter-sound group there is also a large amount of variance in the HLS group. However, this may still indicate that even when reading ability is controlled for knowing just one letter-sound may have an influence on the development of phoneme awareness.

**Summary**

To summarise briefly, the results presented in this chapter provide support for the definition of phonological awareness as one variable that includes both rime and phoneme awareness. The results also suggest that rime awareness precedes phoneme awareness. By preceding the development of phoneme awareness rime awareness, along with letter-sound knowledge, appears to be a potential precursor to the development of phoneme awareness. Letter-sound knowledge itself was best predicted by letter-name knowledge. The influence of letter-sound knowledge on phoneme awareness was tested on children with a range of letter-sound knowledge and provided support for the effect of letter-sound knowledge on phoneme awareness rather than phoneme awareness contributing to letter-sound knowledge. The development of rime awareness was found to be mainly influenced by vocabulary.
Chapter 5: Discussion

The purpose of this study was to examine the nature and development of phonological awareness in preschool aged children. Four hypotheses were formulated, two on the nature of phonological awareness and the two on the development of phonological awareness. The hypothesised nature and development of phonological awareness is modelled in Figure 6. The first hypothesis was that phonological awareness is a single latent ability that is represented by at least two levels of awareness, rime and phoneme. The second hypothesis was that although they both make up phonological awareness rime awareness manifests itself before phoneme awareness. It is expected that phonological awareness is like a continuum and children move along the continuum as they develop more literacy knowledge. Thus rime awareness must develop prior to phoneme awareness.

It was also the aim of this study to find out what preschool literacy abilities contribute to the development of phonological awareness. It was expected that there would be different precursors to the development of rime and phoneme awareness. Based on the model of phonological awareness development the third hypothesis was that the learning of one’s own name in conjunction with letter-name knowledge acts as a precursor to the development of rime awareness. Along with own-name and letter-name knowledge an increasingly well developed vocabulary was also hypothesised to contribute to rime awareness (see Figure 6). Fourthly, it was hypothesised that rime awareness would aid in the development of phoneme awareness but would not be sufficient to trigger the development of phoneme awareness. Letter-sound knowledge and the ability to read would be the main drivers of growth in phoneme awareness (see Figure 6).

The present study differs from the existing literature on phonological awareness in several ways. First, it has combined a variety of theoretical models of phonological awareness to develop a model of phonological awareness development based on a continuum. Within the continuum, phonological awareness develops based on the level of metacognition and linguistic unit. It examines the precursors to the development of increasingly fine-grained phonological awareness based on previous literature. Second, this study has involved only children who have had no formal literacy instruction but still encompasses a wide range of literacy knowledge. Studies that
utilise preschool children often have children with well developed alphabetic knowledge or begin literacy instruction during the study. Third, the age range was restricted which reduces the confounding variable of age while still having a wide range of knowledge levels. Finally, the study defined readers using a reading test that is sensitive to early reading ability. Thus children were classified as readers even though they might not have scored on a standardised reading test. This meant that even very early reading ability could be controlled for.

**Nature of phonological awareness**

The results supported the hypothesis that rime and phoneme awareness are both manifestations of a single construct labelled phonological awareness. There is a developing body of research that supports this conceptualisation of phonological awareness (Anthony & Lonigan, 2004; Anthony et al., 2002; Lonigan et al., 2000; Lonigan et al., 1998; Schatschneider et al., 1999; Stahl & Murray, 1994). In the current study one measure of phonological awareness, coda identity was an exception. This task did not correlate with the other phonological awareness tasks, not even correlating with the two other identity tasks that differed only in linguistic complexity. An explanation for the lack of correlation between the coda identity measure and the rest of the phonological awareness measures is the extreme difficulty that the children in this sample had with this task. Although it was not influenced by skew as it had an element of chance, the children in the sample scored below chance. Previous studies have also found that tasks that children have the greatest difficulty with do not correlate with other phonological awareness measures (Anthony & Lonigan, 2004; Hoien et al., 1995; Schatschneider et al., 1999; Stahl & Murray, 1994). These difficult tasks can influence whether one or two factor models of phonological awareness are described.

A possible explanation for the difficulty of the coda identity measure is that the required awareness of final phonemes is related to spelling ability. Holligan and Johnston (1991) for example, found that poor spellers were impaired in their ability to find the odd-word-out in final phoneme tasks compared to normal spellers. Spelling was something that most of the children in the present study could not do. A reason that awareness of the final phoneme is related to spelling is that it is not a psychologically relevant unit for children (Treiman, 1985). However, once children have begun spelling they have to be aware of all phonological units in words to be able to spell them accurately, thus they need to be able to identify the final phoneme in words.
Although it is not possible to test in the current study it may be that beginning to spell is a precursor to final phoneme awareness which includes coda identity and manipulation.

The results also supported the second hypothesis which hypothesised that rime awareness develops first and may be necessary for the subsequent development of phoneme awareness. The children in the current study were better on the tasks that measured larger units of phonological awareness. Children found the rime identity task easier than the phoneme identity tasks, as well as finding the onset-rime blending task easier than the phoneme blending task. The current findings were unable to distinguish between implicit (sensitivity) and explicit (manipulation) awareness for either rime or phoneme awareness. The phoneme measures were consistently difficult, indicating that in general children had very weak phoneme awareness but had strong rime awareness. This pattern is expected if rime awareness develops before phoneme awareness. The current finding joins a long list of research that has found that rime awareness occurs before phoneme awareness (e.g., Bryant et al., 1990; Burgess, 2002; Fox & Routh, 1975; Liberman et al., 1974; Schatschneider et al., 1999; Stahl & Murray, 1994). Commensurate with this, children in the present study did not differ on level of rime awareness when they were grouped by level of alphabetic and reading knowledge. Level of alphabet knowledge, indexed primarily by letter-sound knowledge, did differentiate the level of phoneme awareness.

It was found that rime awareness developed before phoneme awareness, and that both rime awareness and phoneme awareness were manifestations of the more generic phonological awareness. These findings support the concept of a continuum of phonological awareness which becomes increasingly fine-grained. It can be regarded as a continuum as the distinction between rimes and phonemes can be blurred. The ability to divide a word into its onset and rime, for example is not just rime awareness, but may also represent phoneme awareness if the onset is a single phoneme. Therefore, phonological awareness cannot be a set of stages or even phases, but must be considered a continuum in which earlier developing large-unit and implicit abilities are built upon until phonological awareness is all encompassing.

The proposed model of phonological awareness illustrated in Figure 6 also suggests that sensitivity to units develops prior to the manipulation of units. It was beyond the scope of this study to closely examine the development of awareness from sensitivity to manipulation. The age of the children in the study meant that it was anticipated that most children would now be
able to perform rime manipulation, thus it would be difficult to separate ability on sensitivity and manipulation of rime. The children’s ability on rime manipulation was illustrated by the rhyme production test in which most children could produce at least one rhyming word to each target, indicating that they could segment a rime from a word and find a new onset for it. Additionally it was also expected, and found, that phoneme manipulation would be a difficult task and thus not easily distinguishable on its own because of floor effects.

**Development of phonological awareness**

The next hypotheses extend the previous findings on what constitutes phonological awareness. Although the different levels of phonological awareness develop along a continuum they do not suddenly appear. There must be precursors to each level of phonological awareness, or some type of knowledge that drives the movement along the continuum of awareness. The first hypothesis on the development of phonological awareness was that vocabulary, letter-knowledge, and own-name knowledge would be precursors of rime awareness. This hypothesis was partially supported. The second hypothesis was that rime awareness would then act as a precursor to phoneme awareness along with letter-sound knowledge and reading ability. This hypothesis was also partially supported.

**Development of rime awareness**

Letter-name knowledge was expected to predict rime awareness along with vocabulary, and to significantly do so even after own-name spelling is controlled for. Own-name spelling was used as own-name reading did not correlate with the tests that made up the latent variable of rime awareness. The role of letter-name knowledge was not supported as it did not predict rime awareness after own-name spelling, and own-name spelling did not predict rime awareness after controlling for letter-name knowledge. These two variables were interchangeable in their importance for rime awareness, but neither remained significant predictors after vocabulary. Several studies (Arrow et al., 2003; Treiman & Broderick, 1998) have found that knowing one’s own name initially contributes to the development of letter-name knowledge by knowing the letters in one’s own name. This indicates that when children first learn to spell their own name they learn the letters in their own name, so that both letter-name knowledge and own-name spelling ability are measures of the same knowledge. This is likely to be because they have to
labour over the formation of letters when spelling and children may often repeat their name as a series of letters as they attempt to spell it.

It was hypothesised that vocabulary is a necessary precursor to rime awareness. This was supported with vocabulary the only variable to significantly predict rime awareness after controlling for all other variables. It was also correlated with the larger unit awareness measures including syllable blending. Although it was significantly correlated with the phoneme blending task this correlation only just reached significance. Further support for the role of vocabulary came from the comparisons between the non-reader and reader groups. When controlling for vocabulary children did not differ on their ability to complete rime awareness tasks based on their letter-name knowledge. When vocabulary was not controlled for there were significant differences at the .05 level of significance on the rime measures and on the onset identity task.

The current findings do not agree with other research into the development of rime awareness and the role that letter knowledge has on it (Stahl & Murray, 1994). However, Stahl and Murray did not control for vocabulary so it is difficult to compare results.

This study also found that although vocabulary explains a large amount of variance in rime awareness it explains little to no variance in phoneme awareness. Several other researchers have suggested that verbal ability and vocabulary does have a relationship with phoneme awareness (Bowey, 1994; Foy & Mann, 2001; Foy & Mann, 2003). It may be that the children in this study did not have phonological representations that were segmented enough to allow it impact on their phoneme awareness, even if they did show some levels of phoneme awareness. Another possibility is that phoneme awareness is predicted better by cognitive maturity than vocabulary (Tunmer, Herriman, & Nesdale, 1988). In early readers it is found that children with better vocabularies do better on tasks at the rime level (De Cara & Goswami, 2003). The children in this study may have required larger vocabularies to be able to distinguish between rime neighbourhoods, allowing them to do better on the rime tasks.

An explanation for the role of vocabulary in rime awareness is based on the theory that phonological representations become increasingly segmented due to increasing vocabularies in children’s mental lexicons (Fowler, 1991; Walley et al., 2003). Phonological representations underpin speech discrimination and phonological awareness. Children’s phonological representations are initially at word level, followed by syllable level representations, and rime
level representations. The greater the child’s vocabulary the more segmented it has to become to distinguish between words stored in the lexicon. It may be that better vocabularies are required to develop the initial levels of phonological awareness, particularly rime awareness, but then rime awareness and explicit knowledge about language are more important for phoneme awareness than the increasing segmentation of the lexicon. The division of words at the onset-rime level is more psychologically significant to people at all ages, and this would especially be the situation in which non-readers are not able to segment words at the phonemic level, either epi- or meta-linguistically (Gombert, 1992).

**Development of phoneme awareness**

In keeping with the continuum model of phonological awareness development it was hypothesised that rime awareness would, along with letter-sound knowledge and reading ability, contribute to phoneme awareness. The results support the hypothesised contribution of rime awareness, over and above both letter-sound knowledge and reading ability. Examination of Figure 7 suggests that children need a certain threshold of rime or large unit phonological awareness before they show phoneme awareness. The results of this study suggest that children may need more than 60% accuracy in large unit awareness tasks before they can score consistently on phoneme awareness tasks. In addition, the current study found evidence that rime awareness predicted a significant amount of variance in phoneme awareness. The findings support the suggested model of phonological awareness development (Figure 6) in which rime awareness acts as a developmental precursor to phoneme awareness. Longitudinal studies have also supported this position (Bryant et al., 1990; Lonigan et al., 2000).

The results also supported the hypothesised role of letter-sound knowledge in phoneme awareness, but it did not support the role of reading in phoneme awareness. In the present study letter-sound knowledge did predict variance in phoneme awareness, along with the expected rime awareness, together accounting for 33% of the variance. Unexpectedly letter-sound knowledge remained a significant predictor even after controlling for reading ability. Reading ability did not remain a significant predictor after controlling for letter-sound knowledge, adding a non-significant 2% of variance to phoneme awareness. A possible explanation for this is that the reading measure used was a phoneme correct score and not a whole word score. Thus the letter-sound measure and the reading score may be measuring the same thing if children are providing
letter-sound labels for each letter in the test words and not making reading attempts. A strict scoring criteria was used for the phoneme correct score to ensure it measured reading attempts and not the production of letter-sound labels, for example /u/ was accepted for the vowel in the word ‘to’ but /a/ was not. However, it still may not have fully controlled for the provision of letter-sound labels rather than producing phonemes in attempting the reading of words.

In addition, the readers group did not differ from the non-readers with the same amount of letter-name knowledge in phoneme awareness. This is the same result that Bowey (1994) found in her sample of preschool children. The readers had greater phoneme awareness than the non-readers with average and low letter-name knowledge. What did distinguish the readers and the non-readers with the same letter-name knowledge was the number of letter-sounds that they knew. In the current investigation, once children had developed knowledge of even just one letter-sound they were more likely to have developed phoneme awareness. The relationship between explicit phoneme awareness and letter-sound knowledge is consistent with other studies (Blaiklock, 2004; Foy & Mann, 2006; Treiman & Kessler, 2003).

Carroll, Snowling, Hulme, and Stevenson (2003) found that four letter-sounds was a potential threshold for developing phoneme awareness in a sample of four-year-old nursery children who could not read. The current findings also indicate that letter-sound knowledge is a better predictor of phoneme awareness than reading ability is. This finding was unexpected as previous research has found that reading is the key predictor of phoneme awareness (Bachman, 2001; Morais, 2003; Morais et al., 1979; Read et al., 1986). One reason for this may be that the level of reading in this sample was very low and it may be that reading needs to reach a higher level or threshold before phoneme awareness begins to develop.

Another reason for the lack of variance explained by reading may be that the phoneme tasks in this study better reflect phoneme sensitivity and not phoneme manipulation. Recent research has suggested that the making this distinction is important as they have different relationships with reading (Murray, 1998; Murray, Smith, & Murray, 2000). Phoneme sensitivity can occur prior to reading while phoneme manipulation must develop after reading. It is possible that the latent variable of phoneme awareness in the current study is best represented by performance on the phoneme sensitivity measures, particularly onset identity. Commensurate with this possibility Schatschneider et al. (1999) found that performance on onset matching and onset-rime blending
best represented phonological awareness in kindergarten children. This would make the 
prediction of phoneme sensitivity by letter-sounds and rime awareness, but not reading, expected 
under the model of phonological awareness in Figure 6.

It is possible that the coda identity task is a better reflection of phoneme manipulation as it 
requires the ability to split the rime unit. The coda could be considered the final level of 
children’s understanding of phonemes, and similar in difficulty to manipulation tasks (Johnston et 
al., 1996). However, it may be related to spelling ability, rather than reading ability, as spelling 
ability requires the application of the alphabetic principle in which both letter sound knowledge 
and phoneme awareness is required (Holligan & Johnston, 1991). In the current sample although 
the readers had better spelling ability than the non-readers they were still only able to spell a 
small number of full words correctly. Bowey (2002) suggests that knowing that the final 
phoneme of the word ‘gum’ and the initial phoneme of the word ‘mat’ is the same is a firm 
understanding of phoneme awareness. She also suggests that children need enough letter-sound 
knowledge, along with phoneme awareness, to be able to have a firm understanding of the 
alphabetic principle. Therefore, it is little surprise that even the readers in the current sample had 
difficulty on the coda identity task, as even the readers did not have strong letter-sound 
knowledge.

Summary

The findings suggest that there are possible precursors or drivers of phonological awareness that 
allows the child to begin developing increasingly finer-grained awareness. The initial 
development of rime awareness might begin once the mental lexicon needs to store phonological 
representations at this level of segmentation. The mental lexicon may then need to begin this 
level of segmentation once the spoken vocabulary is large enough, hence the role of vocabulary 
in rime awareness. Once rime awareness is sufficiently robust it may require the child to learn 
letter-sounds before phoneme awareness can begin to develop. The current findings also add to 
the body of research which suggests that rime awareness preceded and contributes to phoneme 
awareness (also see Stuart, 2005 for a review).
Conclusions and implications

The current research lends support to the proposed model of phonological awareness development provided in Figure 6. It builds on the continuum model of phonological awareness in which early rime awareness leads to phoneme awareness (Anthony et al., 2002; Lonigan et al., 2000; Lonigan et al., 1998). The developmental conceptualisation of phonological awareness progressing from large unit to small unit awareness is also supported by research showing that awareness of syllables occurs prior to the awareness of phonemes (Aidinis & Nunes, 2001; Fox & Routh, 1975; Liberman et al., 1974). It adds to the continuum model in that it provides a developmental conceptualisation of phonological awareness which includes precursors and drivers of phonological awareness development. It also adds to the large body of knowledge surrounding phonological awareness by examining the possible contributors to the development of different levels of phonological awareness. An advantage of the current study is that there were a relatively large number of participants with a varied distribution of literacy knowledge but whose ages where restricted to a range of six months.

Implications

This study has implications for the use of preschool screening measures. The current study suggests that measures such as vocabulary and own-name spelling ability could be used as early indicators of a child’s reading readiness. Once they are a little older and have begun school rime awareness and letter-sound knowledge would be the best indicators of a child’s reading readiness. Letter-name knowledge is also important in that it aids in children learning letter-sounds without the relationship between the grapheme and the phoneme being arbitrary. Rather, it is linked by the name of the grapheme. Thus, while also important in itself, preschool phoneme awareness is not the only predictive skill that should be assessed (see also Bryant, 2002). When wanting to identify children who will have the most difficulty in learning to read it is the level of rime awareness that is the more important indicator when there is very little or no phoneme awareness. Children with little rime awareness are those that will be most in need of literacy support once they begin formal literacy instruction (Christensen, 1997).

There are also implications for informal literacy instruction prior to children beginning school. The results of the current study would indicate that ensuring children have well developed
vocabularies will have a flow on effect on their phonological awareness. Reading to children and conversing with children will help them develop their vocabulary (Snow & Beals, 2006; Whitehurst et al., 1994). The increasing vocabulary may then contribute to the development of rime awareness. Based on the proposed phonological awareness model this will then contribute to the development of phoneme awareness and then possibly onto reading. In conjunction with this, informal alphabet instruction such as that provided by Murray et al. (1996) will also provide children with the skills that will help them develop both phonological awareness and alphabetic knowledge.

Limitations

The present study has some limitations. The main limitation is that the study was correlational with all variables measured concurrently. This limits the predictive generalisations from the hierarchical regression analyses. However, the comparisons of children by literacy level supported the regression results. Another limitation was that the sample was drawn predominantly from middle-class populations. A possible influence of this population base was that the children would have more advantaged literacy environments in the home. The current study, however, still found a large variation in literacy knowledge and skills. In addition children’s knowledge was at the lower end of ability level in all literacy measures including letter-name knowledge and reading. Thirty-five percent of the children were unable to recognise their name although more children were able to spell their own name.

Future directions

The current study investigated the development of phonological awareness in a preschool sample of children who had had no formal literacy instruction. The narrow range of ages in the current study limited the study because the development of phonological sensitivity and manipulation at the rime and phoneme level could not be separated. Future research could use a much broader range of preschool ages to longitudinally follow the development of rime sensitivity and manipulation. In addition, the current findings make it necessary to follow the development of phoneme sensitivity and manipulation in children as they progress from preschool to formal literacy instruction.
The importance of letter-sound knowledge on the development of phoneme awareness provides for more research opportunities. It may be that different reading instructional methods that are more or less explicit may also influence the development of phoneme awareness. Comparing children who are learning to read with those who are learning to spell would also allow the examination of different links that reading and spelling have with phonological awareness. The possible influence of spelling on the more explicit final phoneme awareness exemplifies the need to distinguish between the influence of learning to read and learning to spell. Learning to read and learning to spell are often confounded as they are taught at the same time so it is necessary to get children who are only learning to read or only learning to spell.

**Summary**

The purpose of the current study was to examine the nature of phonological awareness and the development of phonological awareness. In particular it was an aim of the study to uncover possible precursors of the different levels of phonological awareness. The results found that phonological awareness was a unitary construct that includes both rime and phoneme awareness. It was also found that although they both form the same latent variable rime awareness develops prior to phoneme awareness and contributes to phoneme awareness. In addition it was found that the main concurrent contributor to rime awareness was vocabulary. The main contributors to phoneme awareness were rime awareness and letter-sound knowledge. Reading did not contribute any significant variance to phoneme awareness although the overall level of reading was very low and it may need to be at a higher level before it begins to contribute to phoneme awareness. It is suggested that the development of phoneme awareness be further investigated, particularly the role of different reading and spelling instruction methods on the development of phoneme manipulation.
Part 2: An intervention study with children who cannot read or spell
Chapter 6: Literature review

Phonological awareness is an important meta-linguistic skill that has a long history of research documenting its relationship with reading (Adams, 1990; National Reading Panel, 2000). It is generally defined as the awareness of phonological units and the ability to manipulate those phonological units. There are at least two types of phonological units that comprise phonological awareness. The first is the rime unit which is acoustically available in early childhood (Tunmer & Chapman, 2007) and which is linguistically relevant (Treiman, 1983; 1985). Awareness of the rime unit can be on two levels, sensitivity to the rime and the ability to manipulate the rime. The second phonological unit is the phoneme. The phoneme is an abstract representation of sounds in spoken words that non-readers may be sensitive to, but the manipulation of this phonological unit can only be performed by those who can read (Morais et al., 1979). Sensitivity in both cases refers to the implicit awareness in which choices can be made but not articulated.

Part 1 of this thesis found concurrent correlational evidence that phonological awareness is best described as a continuum of awareness that begins with the awareness of larger phonological units, the rime unit in particular. Increasingly, phonological awareness can be influenced by other forms of knowledge. Rime awareness contributed to the development of the increasingly fine-grained phoneme awareness. The results from Part 1 were unable to distinguish between implicit (sensitivity) and explicit (manipulation) awareness in the current preschool sample so Figure 13 reflects this by combining implicit and explicit rime awareness into a single latent variable of rime awareness. It is not likely that rime awareness contributes to the development of phoneme awareness on its own, rather it requires additional external influences. In Part 1 of this thesis it was suggested that letter-sound knowledge is the most important external influence on the development of phoneme awareness. A revised model of phonological awareness development is illustrated in Figure 13 and illustrates the continuum and the influences on the development of the continuum. Unexpectedly, reading ability did not contribute to phoneme awareness over letter-sound knowledge in Part 1. A possible explanation for this is that the children who were classified as readers had not yet experienced formal literacy instruction and that there is a level of literacy that is reached in formal instruction that triggers the development of phoneme awareness.
This chapter begins with an introduction to the most prevalent and debated methods of reading instruction, phonics and whole-language. This is followed by an introduction to methods of teaching spelling. It is possible that formal instruction in reading and spelling may differentially affect the development of phoneme awareness. In particular the teaching of letter-sounds during literacy instruction may influence the development of phoneme awareness. Thus phonological awareness may show different patterns in the development of phoneme awareness when formal literacy instruction does not include letter-sound instruction. Phoneme manipulation is usually considered the hallmark of phoneme awareness after receiving literacy instruction in an alphabetic script (Bachman, 2001; Morais et al., 1979; Read et al., 1986). The proposed model of phonological awareness development (see Figure 13) suggests that it also develops after sensitivity to phonemes.

There is some disagreement over the nature of the relationship between phonological awareness and reading in particular. Some researchers argue that phoneme awareness influences reading, and that rime awareness has little to do with reading (Hulme, 2002). Others argue that rime awareness is important for learning to read, that children use this knowledge to help them read words by analogy, and that phoneme awareness develops later (Goswami, 1986; 1988; 1993a; 1998; 1999; Goswami & East, 2000; Goswami & Mead, 1992). One possibility is that both rime awareness and phoneme sensitivity aids reading, but that the manipulation of phonemes is a consequence of learning to read. It is also argued that spelling ability requires phoneme awareness as spelling requires segmentation of phonemes and the knowledge to represent them using letter-sound correspondences (Caravolas et al., 2001).

It may be that letter-sound knowledge is the key to reading, and not phoneme awareness itself. Thus, the type of instruction received may influence the development of phoneme awareness through the amount of letter-sound instruction given. If this is the case there are implications for theories of both reading and spelling, especially regarding the role that phonological awareness has in the development of both reading and spelling. The remainder of this review of the literature will examine the nature of reading and spelling instruction methods, as well as their relationship with phonological awareness. It will conclude with a summary of reading and spelling theories and the place of phonological awareness in current models of reading and spelling acquisition and development.
Figure 13: Modified version of the proposed model of phonological awareness development.
Methods of instruction

The teaching of reading

The approaches taken to reading instruction in the early classrooms differ from one another in the focus on meaning and skills. The reading instructional approach that is generally labelled whole-language is focussed on a reading for meaning approach (Smith, 1999; Smith & Elley, 1994; Tunmer, Prochnow, & Chapman, 1999). The spelling instructional approach that is often called invented spelling is also a meaning-based approach in the classroom, with an emphasis on writing a story and not on correct spelling (Scott, 2000). In both cases the teacher emphasises the understanding or meaning of text over accuracy. In such approaches reading or spelling skills are not taught, rather children are left to work them out. In contrast, the reading approach that is labelled as phonics emphasises learning skills first so that words can be read accurately (Stahl, Duffy-Hester, & Stahl, 1998). Traditional spelling approaches also emphasise spelling conventionally and require children to learn spelling rules before children spend time writing stories (e.g., Lloyd, 1992).

Whole language

The whole language method of reading instruction has also been called a natural language approach or whole language approach (Thompson, 1997). This method of reading is considered to be a philosophy of instruction based on several principles, rather than a set of steps taken to teach reading (Goodman, 1986; Hempenstall, 1996; Hempenstall, 1997; Smith, 1999). The principles underlying whole language reading instruction are, in turn, based on a top-down model in which ‘higher’ mental processes such as processing meaning precede ‘lower’ mental processes such as perceiving letters and sounds (Goodman, 1986; Goodman & Goodman, 1979; Smith & Elley, 1994). Based on this model, it is expected that children will induce knowledge of letter-sounds through their experiences with print and reading (Sears, 1999; Thompson, 2002; Vellutino, 1991). It is believed that children will learn to read “naturally”, just as they learn to speak and to use language (Smith, 1985; 1999; Smith & Elley, 1994). Because of this children will learn to recognise words rather like they learn environmental print (Smith, 1985).
One of the whole-language principles is that the child who is learning to read should be in a literacy environment that is rich in authentic texts (Smith, 1999; Smith & Elley, 1994). While children are reading the authentic texts they learn that reading has a purpose (Routman, 1997). As such it is believed that expecting a story to make sense is just as important as the parts that make up the story, the sentences, the words, the letters (Smith & Elley, 1994). Thus, the most important principle behind whole-language instruction is that reading is for meaning (Smith, 1985; 1999; Smith & Elley, 1994; Tunmer et al., 1999). Other principles underlying the whole-language approach are the emphasis on risk-taking, empowering learners, providing choices for learners, and creating social communities of readers (Goodman, 1986; Goodman, 1989; Hempenstall, 1997).

It is difficult to describe methods of teaching within this philosophy, as it is believed that children do not need to be taught to read but that children need help to learn (Goodman & Goodman, 1979). In practice, teachers do not make prior decisions about what to teach during reading instruction, rather they make instructional decisions based on what arises during a teaching session (Smith, 1999). This is emphasised in the incidental nature of teaching children about word attack skills and graphophonic relationships (National Reading Panel, 2000; Smith & Elley, 1994). This incidental teaching only occurs when children are not able to make use of any other cues to attempt reading a word. Such cues that children are encouraged to make use of include using context when they come to a difficult word. They are encouraged to read the entire sentence again, and then to make approximations by sampling and predicting what the word could be. Children then check and confirm the meaning and self-correct (Nicholson, 2000; Thompson, 1993; Tunmer et al., 1999).

This is the way reading is taught in many New Zealand schools (New Zealand House of Representatives, 2001). New Zealand reading instruction at its earliest stages emphasises children’s pre-existing knowledge of language and helps children to understand that print represents oral language (Wagemaker, 1993). The Ministry of Education (2003) recommends that teachers teach phonemic awareness within the early reading program, but it is not specific in how teachers can implement these strategies, possibly contributing to the lack of use described in the 2001 report by a select committee of the New Zealand House of Representatives. Generally teachers use a form of implicit phonics by instructing readers to attend to the sound at the beginning of the word and to other words that have the same sound at the beginning. There are
no explicit letter-sound correspondences taught. Thompson (2002, p. 164) gives an example of this in which the teacher asks the child if they can “hear this letter” while pointing to the ‘c’ in ‘cot’ and telling the child that “it is the same sound as in this word”, and pointing to the ‘c’ in ‘car’. This only occurs when the teaching moment occurs as required for words in the text.

Phonics

Phonics instruction is best defined as a type of reading instruction that teaches children about the alphabetic principle or the connections between letters in written words and sounds in spoken words. Children are taught about the alphabetic orthography and that letters in words are representations of the sounds in words (Stahl, 1992; Texas Education Agency, 2000). There is an emphasis on letter-sound correspondences, in which children are taught letters of the alphabet and their corresponding sounds, e.g., /buh/ for b. In contrast to the whole language approach to reading, phonics instruction is bottom-up in that knowledge of letters and sounds is taught first, and then meaning develops out of reading accuracy. This is based on the belief that beginning readers must have a thorough knowledge of letter-sound correspondences before they can make further progress in reading and writing (Bryant, 1995). Once children have knowledge of letter-sounds they are then taught the blending of phonemes in reading new or unfamiliar words (Adams, 1990). To do this, children must use their knowledge of grapheme-phoneme correspondences and apply them to the unfamiliar word. Rules are not necessarily taught, especially in English in which rules have just as many exceptions as they have examples (Stahl et al., 1998). Instead, the teaching of units larger than phonemes, such as phonograms has been suggested (Adams, 1990).

There are many different approaches to phonics instruction that differ in the number of letter-sound correspondences taught, how fast they are taught, the type of fonts they are taught in, the number and types of rules taught, the order in which consonants and vowels are taught, and the use of modified alphabets (Adams, 1990). In general there is a distinction between systematic phonics and embedded, receptive phonics. Embedded or receptive phonics is non-systematic in that letter-sounds and patterns are only taught as the need arises (Stahl et al., 1998; Thompson, 1997). The most common approach to phonics instruction is systematic phonics instruction in which the teaching of sounds and rules is explicit and structured. Systematic phonics instruction
covers several versions of phonics instruction, the most common ones being synthetic phonics and analytic phonics (National Reading Panel, 2000; Stahl et al., 1998).

Analytic phonics instruction begins after children have been introduced to reading. It is also referred to as a mixed-method as it begins with reading text but includes explicit phonics. Children are introduced to sounds using words that they already know (Johnston & Watson, 2005; Stahl et al., 1998). Johnston and Watson described analytic phonics as it is taught in Scotland. In the first year of primary school children are taught the sounds of all 26 letters using the initial sound in words, learning for example that the first sound in ‘bed’ is /b/. Once they have learnt them in the initial position they learn the sounds of words as they appear at the end and in the middle of words. Once they have learnt the 26 letters in the three positions only then do they learn how to blend sounds together to form CVC words. In the second and third years they learn initial blends, final blends, consonant and vowel digraphs, and silent ‘e’ patterns.

In contrast, synthetic phonics can be considered the more ‘pure’ form of phonics instruction (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). In this phonics instruction method children are first taught the sounds of the letters, and then taught to blend the sounds together to read new words (Johnston & Watson, 2005; Rayner et al., 2001; Stahl et al., 1998). In synthetic phonics programs letters and their sounds are introduced in blocks. The sounds are taught and then children are taught to blend the taught sounds together in order to read words. Johnston and Watson implemented synthetic phonics instruction in Scottish children by first introducing the sounds of the letters ‘s’, ‘a’, ‘t’, ‘i’, ‘p’, and ‘n’. Once children had learnt the sounds of these letters that occur most often in three-letter words they began learning to blend three-letter combinations together to enable the children to read words.

Embedded phonics is the phonic instruction method most often found in New Zealand classrooms, although application of this can vary based on the teachers philosophical and ideological stance on reading education. Some teachers do employ some embedded phonics techniques, but others steadfastly oppose the use of any analytic approaches to reading (New Zealand House of Representatives, 2001). When teachers do employ phonics techniques it is often during spelling instruction rather than in reading instruction. The Ministry of Education (2003) gives examples of phonics instruction that are placed within spelling instruction rather than reading. However, there are some schools in New Zealand that use systematic phonics as a
springboard for reading acquisition and development (New Zealand House of Representatives, 2001; Rowan, 2000).

**The teaching of spelling**

Like reading, spelling has two main approaches that differ from one another in the focus on meaning and skills. The two extreme ends of the spelling instruction continuum are distinguished by the emphasis on spelling to write compared with the emphasis on spelling correctly. The emphasis on spelling to write is based on the same child-centred philosophy that the whole-language reading approach is based upon. Children learn to spell by writing in authentic contexts, and are encouraged to make spelling attempts rather than spelling correctly. More formal, traditional, spelling approaches are based on teaching spelling skills and as such require that children learn to spell the conventional spellings of words. The first approach is labelled as an invented spelling approach as children are encouraged to invent spellings based on how words sound.

**Invented spelling**

The invented spelling instructional approach developed out of research on the development of spelling. Read (1971) found preschool children aged between 3 and 5 years old who were able to spell before they were able to read. These children could generate spellings based on their knowledge of letter names and their knowledge of sounds in language (see also Beers, Beers, & Grant, 1977; Beers & Henderson, 1977; Read, 1986). Based on such research findings Chomsky (1979) suggested that children’s invented spellings allowed them to learn about words and thus helped them learn to read. Longitudinal studies have supported this claim, in which spelling contributes to reading (Caravolas et al., 2001; Ellis & Cataldo, 1990). It has also been suggested by researchers of children’s spelling that children will come to learn about conventional spelling through invented spelling (Beers, 1980; Read, 1971).

This focus on the child’s individual development in spelling has been embraced by whole-language proponents (Clarke, 1988; Invernizzi, Abouzeid, & Gill, 1994; Rieben, Ntamakiliro, Gonthier, & Fayol, 2005). It is a top-down approach to spelling, in which writing for meaning comes before spelling correctly. Invented spelling approaches uphold the major principles of
whole-language. The principles that invented spelling especially uphold include risk-taking, authenticity, and empowering learners. Children take risks in how words are spelt, they begin spelling in authentic writing contexts such as stories to be shared by the class, and they are empowered by what they are able to write. In keeping with Chomsky’s (1979) belief that invented spelling will help children learn to read it is believed by whole-language proponents that invented spelling, which requires sound-to-letter knowledge, will transfer to letter-sound knowledge (Thompson, 1993). This transfer from sound-to-letter knowledge to letter-sound knowledge has not been found in research studies (Thompson, Cottrell, & Fletcher-Flinn, 1996; Thompson & Fletcher-Flinn, 1993).

The teaching of spelling in New Zealand is begun through the use of creative writing which is begun early in formal education (Thompson, 1993). In their writing children are encouraged to write their own stories based on their experiences without the help of the teacher. In most classrooms, children have available to them a list of early vocabulary words that are found in their early reading books through personal dictionaries and wall charts (Ministry of Education, 2003; Nicholson, 2000). For words that children do not know how to spell they are usually encouraged to use self-generated ‘invented spellings’ (Thompson, 1993). Once children have written their stories they are read by the teacher who will give the child feedback, which does not necessarily include the conventional spelling (Ministry of Education, 2003). As in whole-language reading instruction the teacher takes advantage of teaching opportunities as they arise (Nicholson, 2000; Scott, 2000). Spelling is not taught as an individual subject, it is taught only as needed within the context of authentic writing (Scott, 2000).

**Traditional spelling**

More traditional, formal, spelling instruction methods are based on developing explicit word knowledge. This explicit word knowledge will then allow children to learn the rules associated with spelling words. In classrooms that employ more traditional methods, such as the ‘Jolly Phonics’ program (Lloyd, 1992), children may be taught all letter-sounds before they are able to start writing and spelling. In other classrooms the learning of letter-sounds and blends may be gradually introduced during the year through phonics worksheets and oral drills (Clarke, 1988). Although some invented spelling classrooms also explicitly teach letter-sounds, the emphasis in the traditional spelling approaches is on spelling correctly. Once initial letter-sounds are learnt
and can be applied children begin to learn spelling patterns through teacher directed instruction (Templeton & Morris, 1999). The emphasis in formal instruction is on studying word patterns by attending closely to the spellings of words (Scott, 2000).

Teaching spelling in this way is usually begun by teaching basic phoneme-grapheme correspondences. These are initially taught in single syllable words with the placement of the phonemes in the words varied (Scott, 2000). This explicit instruction in analysing sounds and words and representing them with letters can be aided by computer software at the beginning stages of spelling instruction (Uhry & Shepherd, 1993). Beyond this initial stage of spelling instruction children begin more word study. This involves grouping, comparing, and contrasting words based on patterns and principles of conventional spelling (Bloodgood, 1991; Templeton, 1991). In contrast to spelling in authentic contexts this type of spelling instruction usually means that children write less when story writing and that they spend more time looking for the correct spellings of words than attempting them (Clarke, 1988).

There is a third method of spelling instruction in which children are given lists of words to learn. These lists of words are usually arbitrarily grouped and often share semantic properties rather than phonetic properties (Rieben et al., 2005; Scott, 2000; Templeton, 1991; Treiman, 1998). This type of traditional spelling instruction is usually accompanied by a ‘look, memorise, cover, attempt’ approach to spelling words out of context (Foorman, Francis, Novy, & Liberman, 1991). Rieben et al. (2005) call this method of spelling instruction ‘copied spelling’ in that the child is expected to learn to spell by copying and memorising the correct spellings of words. In contrast to both the word analysis approach and the invented spelling approach this type of spelling instruction does not allow children to learn about the nature of words (Templeton, 1991).

**The nature of phonological awareness and literacy**

Measures of phonological awareness appear to be strong predictors of reading and spelling success. This is the direction of causation that is most often investigated (National Reading Panel, 2000). However, the nature of the relationship between reading and phonological awareness is also thought to be reciprocal. Perfetti, Beck, Bell, and Hughes (1987) found evidence that not only does phonological awareness predict reading acquisition and development, but that reading also added to phonological awareness. Evidence that reading adds to
phonological awareness comes from the common finding that preschool children are unable to complete phonemic manipulation tasks until after they have begun learning to read and spell (Schatzschneider et al., 1999). This must then be reconciled with the consistent finding that phonological awareness training improves reading outcomes. In this review of the literature literacy is used an umbrella term for early reading and spelling ability including alphabet knowledge and early reading and writing such as own-name knowledge. It is not intended to incorporate sociological aspects of literacy such as the role of literacy in the home and ethnic group. This section begins with a review of the literature regarding the nature of the relationship between phonological awareness and reading. This includes the possible influence of instructional influence and letter-knowledge. This is followed by a review of the literature on the relationship between phonological awareness and spelling.

**Phonological awareness and reading**

Three different views have been espoused regarding the nature of the relationship between phonological awareness and reading. The first is that phonological awareness influences reading acquisition and development. The second view is that reading ability influences phonological awareness. The third view is that there is a reciprocal relationship between phonological awareness and reading. In this reciprocal relationship preschool phonological awareness influences reading acquisition and development which in turn influences further phonological awareness. This third reciprocal relationship in which phonological awareness is both a cause and consequence of reading is that which would be expected based on the proposed model of phonological awareness development illustrated in Figure 9. It will be argued that the directionality of cause and consequence is based on the level of phonological awareness being assessed. All three of the hypothesised relationships will be reviewed, concluding with the reciprocal relationship and the influence of reading instruction methods.

**PA aids reading acquisition and development**

Training studies and longitudinal studies are the usual designs for examining the influence of phonological awareness on reading acquisition and development. The effects of phonological awareness training were examined by the National Reading Panel (Ehri et al., 2001b; 2000) as well as by Bus and van Ijzendoorn (1999). Studies that examine the influence of phonological
awareness on reading are most often conducted with children who have already begun learning to read and write in formal instructional environments (Bowey, Cain, & Ryan, 1992; Wimmer, Landerl, Linortner, & Hummer, 1991; Zifeck, 1981). Children in such samples are often from at risk or reading disabled populations in first to fifth grades. These children are given phonological awareness training and compared to controls on outcome measures of phonological awareness, reading, or spelling (Bus & van Ijzendoorn, 1999; Ehri et al., 2001b; National Reading Panel, 2000). However, the use of studies with children who are concurrently learning to read and write at the same time of the research, does not allow the investigation of any possible individual influences of reading and spelling.

In meta-analyses of phonological awareness training studies which include samples of preschool children with no formal literacy instruction the strongest effects of training on both reading and phonological awareness were on preschool children (Bus & van Ijzendoorn, 1999; Ehri et al., 2001b; National Reading Panel, 2000). A problem for many of the studies on preschool children is that in preschool samples children are less likely to have been pretested in a manner that ensures that they have no pre-existing literacy skills that could influence their phonological awareness or reading and spelling posttest outcomes (Castles & Coltheart, 2004). Lower levels of phonological awareness such as rime awareness are often displayed by preschool children who have knowledge of letter-names. To fully control for literacy levels both reading and spelling ability must be assessed as well as letter-name and letter-sound knowledge. It may be that these early skills may underlie the effects of any phonological awareness training.

In the studies reviewed by the National Reading Panel (Ehri et al., 2001b; National Reading Panel, 2000) reading ability was often pretested using standardised reading tests that only have two or three early level reading words (e.g., Korkman & Peltomaa, 1993). A reading score based on being able to read or not read only two or three words may not reflect low level reading vocabulary on its own. Reading ability was also pretested using nonwords (e.g., Byrne & Fielding-Barnsley, 1991; Davidson & Jenkins, 1994; Torgesen, Morgan, & Davis, 1992). Nonwords do not give a measure of children’s reading of high frequency words. Children may be able to read a small number of high frequency words which could be enough to trigger the development of phoneme awareness. Thus training in phoneme awareness may not in itself contribute to better reading outcomes; it could be pre-existing underestimated reading ability that contributes to the better outcomes. Nonwords would not reflect the small number of any implicit
relationships between the sounds in words and the word in print in very early readers, but which exist nonetheless.

In the preschooler and kindergartener training studies reviewed by the National Reading Panel (Ehri et al., 2001b; 2000) some studies assessed only a selection of letters as a measure of letter knowledge (e.g., Lundberg et al., 1988; O'Connor, Notari-Syverson, & Vadasy, 1996). Others gave letter-name and letter-sound knowledge equal weight in that either response was accepted (e.g., Iversen & Tunmer, 1993; Schneider et al., 1997). Others did not assess letter knowledge at all (e.g., Brennan & Ireson, 1997; Davidson & Jenkins, 1994; Torgesen et al., 1992). The problem with assessing a sample of letters is that because children don’t know the eight to ten most common letters of the alphabet does not mean that they do not know the rest. For example, Treiman and Broderick (1998) found that children knew the first letter of their name better than any other letters. Arrow, Fletcher-Flinn, and Nicholson (2003) found that children were more likely to know the letters in their name over others. This suggests that children may not necessarily know the most common letters, but may still know other letter names.

Bus and van Ijzendoorn (1999) noted that training effects were higher for preschool children than for primary school children on both reading and phonological awareness outcomes. They suggest that this is because the primary school children had already received letter and reading instruction. Thus the effects of phonological awareness training may have been reduced because the primary school children already had the skills that predict both reading and phonological awareness and training in phonological awareness would be less effective. In both meta-analyses (Bus & van Ijzendoorn, 1999; Ehri et al., 2001b; National Reading Panel, 2000) phonological awareness training combined with letter-instruction proved to be the most effective. This supports the role of letter-sound knowledge in both phoneme awareness and reading.

Bradley and Bryant (1983) and Lundberg et al. (1988) conducted two landmark phonological awareness training studies. Bradley and Bryant (1983) studied the ability to categorise sounds and reading ability in a group of children aged four and five. From a larger group, 65 children were selected who could not read and had low sound categorisation scores from an odd word out task. Sound categorisation tasks are representative of phoneme sensitivity. These 65 children were divided into four smaller groups matched on verbal intelligence, age, and sound categorisation scores. Two of the groups were experimental groups and two were control groups.
The first experimental group received training in categorising sounds only; the second experimental group received training in categorising sounds and in letter-sound correspondences. Of the two control groups one received no training; the other received an equal amount of training as the experimental groups but in conceptual categorisation only. Post-test scores on reading ability showed that the first experimental group only had significantly better reading ability than the control group that received no training at all. The second experimental group demonstrated significantly better progress in reading than both control groups. They had better reading scores than the first experimental group but the difference failed to reach significance. The results from Bradley and Bryant (1983) suggest that although sound categorisation training can have a positive effect on reading ability it is sound categorisation combined with letter-sound training that may have the greatest effect on reading ability.

The second longitudinal training study by Lundberg et al. (1988) followed an experimental group and a control group from pre-school to second-grade. Over eight months of daily training sessions while at pre-school the experimental group was trained to attend to the phonological structure of language. This was done through listening games, rhyming games, games that required the segmentation of sentences into words, marching to syllabic intonations, and identifying the initial phoneme of each child’s name. The training was conducted by the children’s own pre-school teachers who were trained to follow the training program. The control group received no training and followed the regular program of their pre-school, which did not include any reading instruction. Lundberg et al., (1988) found that the experimental group exhibited better reading and spelling skills that persisted into second-grade. The training program used in this study was purely phonological with no letters or reading included in the program. bus and van Ijzendoorn (1999) found that purely phonetic programs, including the Lundberg et al. program, are effective in increasing phonological awareness but have smaller effects on reading outcomes than programmes that have phonological awareness instruction embedded in letter-instruction or reading instruction.

Much of the phonological awareness training in the Lundberg et al. (1988) study was training in larger phonological units, such as listening to rhyming. Additional longitudinal studies have highlighted the role of preschool rhyme awareness in predicting reading acquisition and development. Maclean et al. (1987) for example, examined rhyme awareness in three-year-olds as measured by nursery rhyme knowledge, a rhyme odd word out task using pictures, an onset
odd word out task using pictures, onset and rhyme production. Performance on the tasks at three years of age predicted later phonemic awareness and also predicted variance in later reading ability. Bryant and colleagues (Bryant, 2002; Bryant & Cavendish, 2001; Bryant et al., 1990; Goswami & Bryant, 1990; Kirtley et al., 1989) developed a hypothesis in which rhyme awareness may be directly predictive of reading. Rime awareness is also thought to be indirectly predictive of reading by aiding in the development of phoneme awareness which then predicts reading.

In contrast, Hulme and colleagues (Hulme, 2002; Hulme et al., 2002; Hulme et al., 2001; Muter et al., 1998) have argued that preschool phoneme awareness is predictive of later reading ability. Hulme et al. (2002) found that rime played no role in the acquisition of reading in 5-year-old children in English reception and Year 1 classrooms. However, all the children in their study could read at least one word and their letter knowledge was not measured. If the proposed model of phonological awareness development is correct it could be that the potential letter-sound knowledge of the children meant that they had enough phoneme awareness that it subsumed any variance that rime awareness may contributed to reading ability. In another study Caravolas et al. (2001) reported on 5-year-old children in an English reception class. The children in this study knew an average of 15 letter and digraph sounds. If the children in the Hulme et al. (2002) study knew just as many letter-sounds this could be enough to trigger the development of phoneme awareness prior to reading according to the proposed model of phonological awareness development.

From the studies reviewed it appears that phonological awareness training is most effective in preschool children who have not yet begun to read. The studies that this conclusion is based on may overemphasise the influence of training as the children may have had more literacy skills than were measured. Children’s outcomes in phonological awareness and reading may be a result of their pre-existing literacy skills, such as letter-sound knowledge or reading ability. These pre-existing literacy skills may be underestimated because of the way these skills were measured. Letter-sound knowledge rather than letter-name knowledge is used here because knowledge of letter-sounds was a better predictor of phonological awareness than letter-name knowledge in Part 1. This could be because letter-sounds provide better approximations of phonemes than letter-names.
Phonological awareness training in the larger phonological units such as syllables and rime may also be more effective in preschool children than training in phoneme awareness. Lundberg et al. (1988) trained children in rhyme and syllable rather than just phoneme awareness. Rhyme awareness also seems to be a good predictor of later reading ability when measured before phoneme awareness has developed. A potential reason for this is that rime awareness and phoneme awareness are both forms of phonological awareness. However, once children develop phoneme awareness the continuum nature of phonological awareness means that any variance that rime awareness did provide towards reading is subsumed by phoneme awareness and will no longer predict later reading ability on its own (Bowey, 2002). This could be predicted by the proposed model of phonological awareness development (see Figure 13) by the addition of a link between phoneme sensitivity and reading. Phoneme sensitivity is a better indicator of pre-reading phoneme awareness (e.g., MacLean et al., 1987). In addition, when phoneme training is given this is most effective when combined with letter-sound instruction (Bradley & Bryant, 1985; Bradley & Bryant, 1983). This is also predicted by the model of phonological awareness development because it proposes that letter-sound knowledge is important for phoneme awareness to develop.

Learning to read aids PA development

The second view on the nature of the relationship between phonological awareness and reading is that reading ability influences the development of phonological awareness. Proponents of this view argue that reading can begin without phonological awareness. It is also argued that learning to read facilitates the development of explicit phoneme awareness, specifically the ability to manipulate phonemes. This ability to manipulate phonemes is posited as the end of the continuum of phonological awareness development. The awareness and manipulation of rhyming words and syllables are proposed as the initial levels of phonological awareness that develop without the process of learning to read and alphabetic script.

Illiterate adults, for example, do not exhibit measurable explicit phoneme awareness but have an awareness of rhyming words and can manipulate syllables. Morais et al. (1979) asked Portuguese adults to delete a phoneme or add a phoneme to both words and nonwords. The adults who had learnt to read as adults performed significantly better than the illiterate adults in both adding and deleting phonemes from words. The adults who had learnt to read could complete the phoneme
awareness tasks because they had been exposed to alphabetic literacy. In a similar sample of 12 illiterate Portuguese adults Cary and Morais (1979, cited in Morais et al., 1979) found that while the adults were unable to manipulate phonemes they were able to manipulate syllables.

These findings have been replicated with additional samples of illiterate Portuguese adults (Cary, Morais, & Bertelson, 1989 cited in Cardoso-Martins et al., 2003). Cardoso-Martins et al. also found in their own sample of illiterate Brazilian adults the ability to complete rhyme and phoneme sensitivity measures but the inability to complete a phoneme deletion task that required explicit phoneme manipulation. Morais et al. (1979) also compared the performance of their subjects to the performance of first and second-graders in Belgian classrooms. The illiterate adults were worse than the first graders, while the adults who had learnt to read were similar in phoneme manipulation to second-graders. These studies of illiterate adults suggest that non-readers would also develop rime and syllable awareness, but not phoneme manipulation. The better performance of first-graders compared to adult illiterates also suggests that the development of phoneme manipulation ability may develop early in learning to read. This would be predicted by the proposed model of phonological awareness development if the method of reading instruction included explicit letter-sound instruction.

Read et al. (1986) compared the ability to complete phoneme manipulation tasks in literate Chinese adults. Half of the subjects were adults who had initially learnt to read using a pinyin script which is a phonemic Romanisation of the Chinese script. The usual Chinese orthography is morpheme-syllabic in which symbols represent one-syllable morphemes (Coulmas, 1989). The remaining half of the subjects had learnt to read the syllabic script directly. Subjects were asked to add or delete phonemes from the beginning of syllables. They found that the adults who had initially learnt to read Chinese using an alphabetic script were able to manipulate phonemes, but those who had not learnt an alphabetic script could not.

Children who have not yet learnt to read an alphabetic script also have difficulty in completing phoneme manipulation tasks, but show syllable and rime awareness. Wimmer et al. (1991) found in a series of studies on Austrian kindergarten children aged from 6 to 7 years of age that prior to beginning school children exhibited awareness of syllables, but not phoneme awareness. Their awareness of syllables was assessed using a syllable counting task. They found that children were not able to score on the phoneme tasks until they were retested at the end of grade-one.
Blaiklock (2004) tested children nine times over their first two years of school, beginning within the first month of school which they started when they turned five. From the first test point children showed rime awareness which was assessed using rime oddity which tests children’s rime sensitivity. They could not score on the phoneme deletion task until they had been at school for three to four months. Muter (1998) also provides evidence that phoneme manipulation does not occur until after formal literacy instruction, but that children have an awareness of rimes. Muter found that at the age of four children had great difficulty with phoneme deletion, but found the rhyme detection task the easiest. In addition, Muter found that the rhyme production task which requires the manipulation of the rime unit was more difficult than the rhyme detection task that is a measure of rime sensitivity.

Phoneme sensitivity may also develop prior to the formal process of learning to read in the classroom. Bowey (1994) tested preschool children who had had no formal reading instruction on letter knowledge, rime and onset oddity, phoneme oddity, onset identity, initial phoneme identity, final phoneme identity and word identification. All phonological awareness measures used are measures of phonological sensitivity rather than manipulation. Children were considered novice readers if they could identify one or more words on a beginning reading word list (Clay, 1985). The non-readers were divided into smaller groups by letter-knowledge. The groups were designated as non-readers with high letter knowledge, those with intermediate letter knowledge and those with low letter knowledge. The high letter knowledge non-readers were equivalent to the novice readers on letter knowledge. Novice readers performed significantly better on all tasks of phonological sensitivity than all groups of non-readers except on the on the onset identity task which was easy for all children, and the phoneme oddity task which was too hard for all children.

Bowey (1994) concluded that the process of learning to read was likely to trigger an awareness of phonemes but did not make the distinction between phoneme sensitivity and phoneme manipulation skill. The difference between the novice readers and the non-readers with the same level of letter-knowledge does not support the suggestion that phoneme awareness develops out of letter-knowledge. However, Bowey accepted both letter-name and letter-sound responses to the letter-knowledge task and did not distinguish between them which could mask the distinctive influence of letter-sounds as opposed to letter-name knowledge. It could be that the children who could read were able to do so because of their increased sensitivity to phonemes. It may also be
that they had better letter-sound knowledge than the non-readers with the same measured letter-knowledge and was masked by the way letter-knowledge was reported. Wimmer et al. (1991) found in their study of six- and seven-year-old children that the children who could read at kindergarten had increased phoneme awareness measured by a vowel substitution task and phoneme counting. They also found that there was an association between their vowel substitution task and letter-sound knowledge. Thus, it may be that phoneme awareness and reading ability prior to formal reading instruction was influenced by letter-sound knowledge.

Perfetti et al. (1987) tested first-grade children at different points during the year on phoneme deletion, phoneme blending, and phoneme tapping. The easier phoneme awareness measures were correlated with the children’s reading gain over the first year of reading instruction. Reading, however predicted the more advanced phoneme manipulation measure of phoneme deletion. It is unclear how many of the children in this study were able to read at each of the testing time points, or how much letter-sound knowledge they had, so it is uncertain whether the phoneme segmentation and blending task scores were also the result of reading ability or letter-sound knowledge. It may be that the easier phoneme awareness measures were influenced by earlier letter-sound knowledge. There is, however, a clear effect of learning to read on the most advanced phoneme manipulation measure. Bachman (2001) also reported a unique effect of school instruction on children’s phoneme segmentation. In this study young first-graders were compared to old kindergartners, both of whom were within four months of age of each other. The young first-graders were able to segment words with no more than two or three phonemes better than the old kindergartners. However, by the time the old kindergartners at been at school for a year the differences in segmentation ability had gone.

The ability to read without exhibiting any explicit phoneme awareness, or phoneme manipulation skill, has been found in case-studies of precocious young readers. One such precocious reader is described by Fletcher-Flinn and Thompson (2000). At 3 years, 4 months of age ‘Maxine’ had a reading age of 8.6 years. She had awareness of rimes and syllables but had no phoneme awareness. This pattern was also found in a 3.1 year-old boy who had a reading age of 7.0 years (Henderson, Jackson & Mukamal, 1993). It is stated, but not clear from the provided results, that this boy had no explicit phoneme awareness. It is mentioned that he was unable to match words on initial sounds but that he did enjoy playing rhyming games. After a year of reading, ‘Maxine’
still did not have measurable explicit phoneme awareness beyond awareness of the onset of words (Fletcher-Flinn & Thompson, 1999).

Group studies of precocious readers have found that precocious readers are better than age-matched non-readers on some measures of phonological awareness, but not on others. Backman (1983) found that precocious readers were no better than non-readers on syllable blending. They were also no better on phoneme segmentation, a measure of phoneme manipulation which both precocious readers and non-readers found difficult compared to a group of older readers who were reading-age matched to the precocious readers. Stainthorp and Hughes (1999) found that phoneme manipulation tasks such as phoneme segmentation were difficult for both precocious readers and non-readers of the same age until after first grade. In contrast, the precocious readers were precocious in rime awareness compared to the preschool non-readers (see also Singson, 1999).

Children’s knowledge of letter-sounds gives them a good foundation to begin recoding phonetically spelt words and words with regular spellings. They are able to provide accurate or near-accurate phonemes for letters based on their knowledge of the sounds of letters. The influence of this type of knowledge is illustrated by the speed in which pre-readers and novice readers learnt to read phonetically accurate words (Ehri & Wilce, 1985). Although Ehri and Wilce compared the pre-readers and the novice readers it is important to note that there was a significant difference in letter-sound knowledge between the two groups. Four- and five-year-old children were grouped based on their reading ability with a group of pre-readers who could read no words and a group of novice readers who could read some words. Both groups of children were then taught to read visually distinctive words (e.g., XGST for balloon) and phonetically spelt words (e.g., JRF for giraffe). The pre-readers learnt to read the visually distinctive words faster than they learnt to read the phonetically spelt words. The novice readers displayed the opposite pattern, they learnt to read the phonetically spelt words faster than they learnt to read the visually distinctive words.

Phonological recoding is the conversion of letters and graphemes in printed words into the spoken or phonological form of the word (Thompson, 1999; Tunmer & Chapman, 2007; Ziegler & Goswami, 2005). Explicit phonological recoding is when children apply their phonic knowledge to the reading of words (Thompson, 1999). This is usually employed when children
encounter words they don’t know and attempt to ‘sound out’ the letters in the word. The key to
the link between phonological awareness and reading is the assumption that beginning readers
will apply their phonological knowledge to words to help decode them. Gough and Hillinger
(1980) call the development of this ability to apply phoneme awareness to reading ‘breaking the
code’. The best way for children to learn to break the alphabetic code is to learn letter-sounds in
conjunction with learning how to apply them to words, spoken or written (Bus & van Ijzendoorn,
1999; Foorman et al., 2003; National Reading Panel, 2000).

The phonic knowledge that children employ to explicitly recode words is knowledge of the
alphabetic principle. The alphabetic principle is the understanding that words consist of sounds
and that these sounds are linked to the letters in printed words (Moats, 2000). It is a combination
of phoneme awareness and letter-sound knowledge. The first step in most phonic instruction
programmes is instruction in letter-sounds. When children begin learning to read they are taught
to use phonic strategies such as sounding out and blending. These strategies, along with letter-
sound instruction give children the opportunity to learn about the nature of phonemes (Ehri,
Nunes, Stahl, & Willows, 2001a). They employ this early understanding to discover that words
consist of these sounds and discover how to manipulate the sounds utilising this knowledge.
Explicit reading instruction that begins with letter-sound instruction and includes word-analysis
skills such as blending, facilitates the development of phoneme manipulation. Children can
explicitly use this awareness of phonemes and words to recode unfamiliar words such as
nonwords.

From the literature review it would be expected that if children begin school with some phoneme
awareness they will become better readers than children who come to school without this
knowledge. The child who comes to school without phoneme awareness is not necessarily
disadvantaged if they already have an awareness of rimes or letter-sound knowledge. The child
who comes to school without rime awareness is also not necessarily disadvantaged, but this child
will probably still have to develop rime awareness before they can develop and utilise phoneme
awareness (Christensen, 1997). Because they have yet to learn these essential metalinguistic
strategies they will take longer to learn to read and may fall behind. However, this gap may close
over time as reading becomes more fluent and reading strategies and processes change. There is
evidence to suggest that phoneme awareness actually declines over time as larger orthographic
‘chunks’ are used to read new words and are used in phoneme awareness tasks (Scarborough, Ehri, Olson, & Fowler, 1998).

Duncan et al. (1997) found evidence of explicit phonological recoding in Year one children who were taught with an eclectic reading approach including a controlled vocabulary reading scheme and letter-sound instruction. Children were better at reading nonwords that were made up from the onsets, vowels, and codas of words that were in their early reading vocabularies than nonwords that were made up from onset and rime units that occurred in the same early reading vocabulary. This was especially the case for children who started with better phonological awareness and rhyming skills. The relationship that children’s nonword reading had with letter-sound knowledge also suggests that children were decoding at the phoneme level, using their letter-sound knowledge and phoneme awareness. This pattern continued into the second year of primary school (Duncan, Seymour, & Hill, 2000). Duncan et al. (2000) found that the children in the sample had better phoneme awareness than rime awareness over the first two years of school. This unusual pattern of phonological awareness development could explain why they were able to use explicit phonological recoding to read unfamiliar nonwords. It can also explain why they were not so good at reading nonwords that contained rime units from words that they were familiar with.

Children who are taught to read using whole-language instructional methods are not encouraged to develop the same word-analysis knowledge. Seymour and Elder (1986) studied a classroom in which children were taught to read using a whole-word approach. The children were not explicitly taught any letter-sounds or word attack skills. They found that children were utilising a holistic approach to reading. These children were only able to read words that they had already learnt and were not able to attempt to read new words. They had sight words stored in their reading lexicons but did not have the knowledge to use explicit phonological recoding. The same has been found in seven-year-old non-phonics taught New Zealand children although the non-phonics taught children did make attempts to read unknown and novel words. Connelly, Johnston, and Thompson (1999) found that the non-phonics taught children were less likely to attempt to read words that they didn’t know than phonics taught children of the same age, and made less nonword attempts. They were unable to make use of strategies that are taught to phonics taught children and were more reliant on word-recall procedures, as were the children observed by Seymour and Elder (1986). Thus children who don’t receive explicit letter-sound
instruction or explicit word analysis reading instruction lack the knowledge to recode explicitly when they first start learning to read.

If children don’t receive explicit instruction in word-analysis and blending, or in letter-sound instruction then they have other knowledge that they can use to attempt new words. Goswami and colleagues (Goswami, 1986; 1988; 1990; 1993a; 1998; Goswami & Bryant, 1990; 1992; Goswami & East, 2000; Goswami & Mead, 1992) have argued that children utilise their preschool rime awareness to attempt reading once they begin school. She has found that children in their first year of school can explicitly learn to read words by analogy when the analogous word is presented concurrently (Goswami, 1986). They have most success when using analogous rime units rather than phoneme units, but the ability to use phoneme units, particularly the vowel, increases over time (Goswami, 1993b). This pattern of large-size phonological unit use in reading mirrors the development of phonological awareness development from rime to phoneme. Goswami, Ziegler, Dalton and Schneider (2003) found that children aged from 7 to 9 years of age will use both rime-analogy and phoneme-recoding strategies in reading English nonwords if they have been taught strategies such as sounding out (see also Goswami, 2002). Goswami et al. (2003) also found that German children do not use rime strategies because the transparency of the German orthography means that all words can be read using phoneme-level strategies.

Rime-analogy may be useful for children who have sufficiently large sight words in their lexicons, but children who are only just learning to read without any explicit phonics instruction or letter-sound instruction do not yet have a large number of sight words and have no other explicit strategy that they can use. Additionally, Marsh, Friedman, Welch, and Dresberg (1981) suggest that analogy use is not spontaneous until much later in reading acquisition, and even then is not used often. One way they may approach the reading of new words is to implicitly learn and apply induced sublexical relations (ISRs) from the sight words that they have learnt. ISRs are the relations between orthographic or visual components of words and their corresponding phonological components, which are held in memory (Thompson, 1999). The first ISRs formed are sensitive to position within words, but after a year or more of reading experience larger context-sensitive ISRs are formed. As the reader’s sight vocabulary and lexicon expands so their ISRs are being continuously updated (Fletcher-Flinn & Thompson, 2000) for use in implicit phonological recoding. Some precocious readers without any formal instruction also have no explicit knowledge of the phonological structure of language and just like non-phonics taught
children apply the implicitly learnt sublexical relations to generate a response to unknown words (Fletcher-Flinn & Thompson, 2004).

Beginning to read without explicit phonological recoding could mean that there are fewer opportunities for phoneme manipulation ability to develop. Yet, children in nonphonics taught classrooms do develop phoneme awareness, even if they do not employ this knowledge when reading. Blaiklock (2004) showed that whole-language taught children develop phoneme awareness but not until the end of the first year of instruction. Connelly et al. (1999) found that there were no differences between Scottish children taught using explicit phonics instruction and New Zealand children with no phonics instruction in phoneme awareness tasks in Year 1 and Year 2 children. In a different sample of Year 2 children Connelly, Johnston, and Thompson (2001) found that phonics taught children were better on a phoneme segmentation measure, but that the difference was small. Foorman et al. (1991) also found no difference in phoneme awareness in their sample of Grade 1 students who received more or less letter-sound instruction. A possible explanation for this is that phoneme manipulation ability develops out of the process of learning to spell for children who do not receive phonics instruction through an emphasis on invented spelling in the first few years of school, as occurs in New Zealand classrooms (Ministry of Education, 2003).

The research reviewed here supports what would be expected based on the proposed model of phonological awareness development (see Figure 13). Learning how to read does influence phoneme awareness. Less explicit phoneme awareness, such as that required for phoneme detection develops prior to learning about words. However, it is the process of learning about the alphabetic principle and learning about words that allows children to begin consciously manipulating phonemes in words. In addition it may be that explicitly learning about letter-sounds and phoneme-grapheme correspondences aids in the ability to manipulate phonemes. When reading instruction does not include the suggested triggers of explicit phoneme awareness children still develop phoneme awareness and it is possible that the process of learning to spell at the same time as learning to read provides the trigger for this.

Summary
It is likely that phonological awareness will predict reading if the measures used with preschoolers and pre-readers are at a low enough level of awareness. In preschoolers this is rime awareness and implicit phoneme awareness in which they can make decisions about phonemes in words but may not be able to articulate them. Explicit phoneme awareness may also predict reading ability, but it may be mediated by preschool letter-sound knowledge. Based on the proposed model of phonological awareness development, if children have high letter sound knowledge then it would be expected that they have explicit phoneme awareness and that it does predict their reading ability. Naslund and Scheider (1996) found that both rhyme detection and phoneme oddity predicted reading in first- and second-grades. Most children could do the rhyme detection task, which measures rime awareness, while only a few children were able to the phoneme oddity tasks. For the children who already have explicit phoneme awareness then it would predict reading, but if they don’t have explicit phoneme awareness then rime awareness, or even syllable awareness would predict reading (e.g., Fletcher-Flinn & Snelson, 1997).

The research also suggests that being able to read, and learning to read influences phoneme awareness, and the ability to manipulate phonemes in words in particular. However, as already suggested, it may not be simply learning to read that influences the development of explicit phoneme awareness but something that occurs within the process of learning to read such as learning explicit letter-sound correspondences. It has also been already shown that letter-sound knowledge has an influence on the development of phoneme awareness as it makes explicit the relationship between letters and sounds, thus the relationship between the letters in written words and the phonemic structure of the spoken word. It has been suggested that it is not just being able to read that triggers phoneme awareness, rather it may be the sets of skills that children are taught while learning to read. Implicit phonological recoding would not provide those skills as stored associations between graphemes and phonemes are not available to consciousness. Accordingly, it may be that different instructional approaches to reading may further influence the nature of the relationship between phonological awareness and reading.

When the approach to reading instruction makes clear the link between graphemes and phonemes children will develop explicit phoneme awareness, such as the ability to manipulate phonemes. This explicit awareness is made available to children through letter-sound instruction and word-analysis study. This method of instruction allows children to attempt to read unfamiliar words through explicit phonological recoding as well as utilising implicit phonological recoding. When
the link is not made clear, such as in top-down approaches to reading children potentially attempt to read unfamiliar words through rime analogy and through implicit phonological recoding as they don’t have the required knowledge for explicit phonological recoding. The phonemic structure of words is not made explicit and children are unlikely to develop explicit awareness of phonemes from learning to read alone. Thus, it is suggested that the process of learning to spell may be what helps children develop explicit phoneme awareness when the reading process is more implicit.

**Phonological awareness and spelling**

A problem with many of the studies on the relationship between reading and phonological awareness is that children are often learning to spell at the same time. Spelling requires that children be able to hear the sounds in the word they wish to spell and then be able to represent each sound with a grapheme or letter. Reading requires that children identify the letters in the word they wish to read and to attach a sound or phoneme to the letter or grapheme and to pronounce the word. Although reading and spelling are different tasks that require different cognitive responses they use the same knowledge base of phoneme-grapheme correspondences (Ehri, 2000). The use of the same knowledge base means that any phonemic awareness that is explained by reading may also be explained by spelling when children are learning to read and spell at the same time. It is therefore important to also examine the role of learning to spell in the development of phoneme awareness.

Distinguishing between reading and spelling instruction is particularly important when researching the development of phoneme awareness in children who receive top-down approaches to reading instruction. It was suggested in the previous section that reading instruction that does not provide explicit instruction in the phonemic structure of words does not aid in the development of phoneme awareness. It is possible that children learning to read in non-phonics classrooms are not developing phoneme awareness through learning to read but through the way they are learning to spell. This is in contrast to phonics taught children who are developing phoneme awareness through the explicit teaching they receive for reading instruction. This could explain why non-phonics taught children do not use explicit phonological strategies in reading as often as phonics taught children (Connelly et al., 1999).
As with the relationship between reading and spelling there are two schools of thought on the relationship between phonological awareness and spelling. The first school of thought is that phonological awareness contributes to spelling ability, and the second is that spelling ability contributes to phoneme awareness. In reviewing the nature of the relationship between phonological awareness and spelling three broad categorisations of spelling are made. The first level is invented spelling; the second is phonologically accurate spelling, and lastly, conventional spelling. The relationship of letter-knowledge is also examined. Letter-knowledge is suggested to play an important role in the nature of the relationship between phonological awareness and reading and so will also be reviewed in this section.

**Contributors to beginning spelling**

There is evidence that phonological awareness contributes to spelling ability (Cataldo & Ellis, 1988; Muter, 1994; Torneus, 1984). The first level of spelling that phonological awareness may contribute to is invented spelling. Invented spelling is used to describe the early stages of spelling when children are experimenting with spelling and usually describes children’s developing letter-name knowledge applied to spelling (Invernizzi et al., 1994). Syllable awareness may be important for this first step in spelling development. Children also need to have an awareness of syllables to utilise the use of letter-name knowledge in spelling because letter-names may represent syllables. An example of this is given by Treiman and Bourassa (2000) in which a child spelt the word *enough* as NF, with one letter representing each syllable.

It is also possible that children begin to use their onset-rime awareness to spell words in which they represent both the onset with one letter and the rime with one letter, such as KR for *car*. Bear and Templeton (1998) call this type of spelling early letter name spelling. The onset-rime level of spelling is short-lived, possibly only a couple of weeks long (Gentry, 1982). The syllabic representation effect is thought to be due to letter-names representing syllables rather than awareness of syllables (Pollo, Kessler, & Treiman, 2005). The onset-rime effect is also likely to be the result of letter names and early developing letter sounds that represent onsets and rimes, and not an explicit awareness of onsets and rimes.

Phonological spelling is used to describe the level of spelling in which children begin to represent each of the phonemes in a word. It also includes the testing of spelling using phonologically
transparent words such as regular CVC words and nonwords. This is not necessarily conventional as children are not yet able to spell irregular orthographic patterns in the conventional manner. Phonological spelling is usually only measured in children who have begun formal school instruction, or who are precocious spellers. Phonological awareness, and phoneme awareness in particular, has been found to aid in the development of phonological spelling. Castle, Riach, and Nicholson (1994) gave children in a whole-language classroom phonemic awareness training including letter-sound knowledge. They found that the children trained in phoneme awareness made better gains on nonwords in an experimental spelling test. The training had allowed the children to utilise their taught alphabetic knowledge to the spelling of the nonwords. However, it may be that it was the teaching of letter-sounds that lay the foundation for the contribution of phoneme training to spelling outcomes.

In a longitudinal study of children over the first two years at school Cataldo and Ellis (1988) found that phoneme sensitivity and segmentation abilities both predicted phonological spelling which was measured with a nonword spelling task as well as regular CVC words. Letter-sound knowledge played no role in the development of spelling in this study. It is possible that the children in this study had enough letter-sound knowledge to contribute to phoneme manipulation that letter-sound knowledge was mediated by phoneme awareness. However, letter-sound knowledge did not contribute to phoneme awareness at any time during the first two years of formal instruction. The contribution of phoneme sensitivity diminished as phoneme manipulation ability increased over time. This indicates that earlier levels of phonological awareness can also predict spelling if the more advanced phoneme manipulation is still not well developed.

In contrast to the study of Cataldo and Ellis (1988) several other longitudinal studies have found a strong influence of letter knowledge on early phonological spelling ability. Muter and colleagues (1994; 1997b; 1998) followed children from nursery school to their second year of school testing IQ, segmentation, rhyming, letter-sound knowledge, reading, and spelling. The combined product variable of letter knowledge and segmentation from the end of nursery school predicted spelling in the first year of school. Although both phoneme segmentation and letter knowledge individually predicted spelling the combined product of phoneme segmentation and letter knowledge explained more variance than each individual predictor. Mommers (1987) found that phoneme awareness measured by phoneme manipulation tasks had little role in
spelling for Dutch children at the beginning of Grade 1. A general learning prerequisite factor that included letter identification did predict spelling ability. The role of letter knowledge is still unclear however, as it may have been any of the other factors also included under general learning prerequisites that played a role in the development of spelling.

Caravolas et al. (2001) examined the relationships between phonological awareness, letter-knowledge, spelling, and reading. They followed children for the first three years of school, testing twice in their nursery year, once in their first-grade year and once in their second-grade year. During the nursery and first-grade years phonological spelling was measured. Conventional spelling was measured in both first and second grade. At the end of the nursery year phonological spelling was predicted by letter-sound knowledge and phoneme awareness as measured by a phoneme isolation task. More variance was explained by letter-sound knowledge than phoneme isolation. In addition, phoneme isolation was predicted as much by letter-sound knowledge as it was by its autoregressor (phoneme isolation measured at the previous time). This suggests that letter-sound knowledge was the ability that was influencing the development of phonological spelling directly, and indirectly through phoneme isolation. First-grade phonological spelling was predicted by previous phonological spelling ability and phoneme awareness, but it was primarily predicted by letter-sound knowledge.

The third level of spelling is conventional spelling and it is used here to describe both transitional and correct spelling stages (Bear & Templeton, 1998). Standardised and conventional spelling assessments such as the Schonell graded word spelling test (Schonell & Goodacre, 1974) assesses conventional spelling knowledge. The Schonell spelling test begins with words that can be spelt phonemically and becomes progressively more difficult, requiring more orthographic knowledge. At this level of spelling children are aware of the orthographic nature of words and attempt to use spelling patterns rather than just spell words as they sound. In the Caravolas (2001) study conventional spelling ability was also measured in Grade 1 and was predicted by the same variables as phonological spelling – letter-sound knowledge and phoneme awareness. Letter-name knowledge had a negative predictive influence on conventional spelling which can be anticipated as when a word contains the name of a letter it is very rarely represented only by that letter. Conventional spelling was, however, best predicted by earlier reading ability. As children become better readers they store word representations in their lexicons and are able to use them to
spell by analogy, or use their stored lexical representations. Manipulation of words at the phonemic level then becomes unnecessary when attempting to spell words.

Although phonemic level manipulation becomes redundant in conventional spelling, awareness of larger phonological units may be required for the spelling of new words. The prediction of more conventional spelling by rhyme awareness is a reflection of the use of rhyme level orthographic patterns and analogy in spelling words. Foorman, Jenkins, and Francis (1993) also provide some evidence of the relationship of larger phonological units with conventional spelling ability. They compared children’s ability to spell regular words, which is a measure of phonological spelling, and exception words, which is a measure of conventional spelling ability as they can’t be spelt using one-to-one grapheme-phoneme correspondences. They found that when children could delete sounds from the words they were more likely to be able to spell them. This effect was stronger when the words were exception words. Foorman et al. (1993) found that their phonological awareness was best described as an onset-rime level of awareness as these were the types of responses that were most common in the deletion task. Muter et al. (1998) also found that rhyme awareness made an independent contribution over phoneme segmentation in Grade 2.

Longitudinal studies indicate that phonological awareness can predict the spelling of regular and irregular words and nonwords six years later. In a longitudinal study Stuart and Masterson (1992) tested the literacy skills of 10 year olds who had their pre-reading phonological skills tested at 4 years of age. The phonological tasks at the age of four included rhyme and phoneme tasks but the measures were combined into one phonological awareness variable. Partial correlations indicated that there were strong correlations between early phonological awareness and the spelling of regular words, nonwords, and irregular words at the age of ten. By combining the phonological awareness measures the individual effects of rime and phoneme awareness are concealed. This would be pertinent as the spelling of both regular and irregular words were tested. In addition any letter-sound knowledge is not reported so the role of phonological awareness in spelling may be over-estimated.

Rapid automatic naming (RAN) is another predictor of conventional spelling. Evans et al. (2000) found that preschool phonological awareness and letter-knowledge predicted phonological spelling ability in Grade 1 in their sample of children. Conventional spelling, measured by the
WRAT-3 spelling test in Grade 3 was best predicted by RAN of colours at kindergarten. RAN is thought to be a measure of the ability to learn arbitrary relationships (Manis, Seidenberg, & Doi, 1999). If RAN is the ability to learn arbitrary relationships it may reflect the learning of orthographic patterns, particularly irregular orthographic patterns, such as \( -ight \), that occur in many of the words that beginning spellers try to use in their writing. As many of the irregular orthographic patterns used are also rimes the link between RAN and conventional spelling dovetails with the link between rhyme awareness and conventional spelling.

*Spelling to Phoneme Awareness*

It is difficult to find clear evidence to suggest that spelling ability leads to phoneme awareness because formal instruction in spelling and writing occurs in tandem with the process of learning to read (e.g., Treiman, 1993). It is difficult to examine the influence of spelling on phonological awareness without the confounding influence of reading ability and reading instruction (Fletcher-Flinn, 2000). However, there is some research that does indicate that spelling ability can influence the development of phonological awareness. Once children have knowledge of alphabet names they are able to use that knowledge to represent sounds in words, particularly vowels (Read, 1986). Stahl and Murray (1998) suggest that once children can begin to use letter-names to represent sounds in words in their invented spellings they are beginning to learn phoneme identities. Phoneme identity is the recognition that words start, or end, with the same sounds, and is measured using phoneme sensitivity tasks. An example is the word *cat* as the test word and the target word of *sit* among the distracters *men* and *ball*. It requires sensitivity to the last sound but not necessarily the manipulation of the last phoneme.

Invented spelling has been suggested as a contributor to early phonological awareness (McBride-Chang, 1998; Silva & Alves-Martins, 2003). In many cases invented spelling has been used as a proxy measure of phonological awareness (Mann, 1987; McBride-Chang, 1998; Robinson, 1991). The use of invented spelling as a proxy measure is because invented spelling requires the production of phonologically accurate spellings and as such requires attention to the phonemic properties of words and their corresponding orthographic representations (Adams, 1990; Frost, 2001). Just as phonological awareness has been used as a predictor of reading acquisition and development, so has invented spelling been found to predict reading ability (Mann, 1987; Richgels, 1995). One possibility is that after children have developed knowledge of some letter-
names and sounds they may start inventing spellings and it is this that helps phonological awareness develop. The type of phonological awareness, syllable or phoneme may initially depend on how syllabic or phonemic children’s invented spellings are.

Training studies have provided evidence of the causal relationship of spelling to phonological awareness. At the syllabic level Silva and Alves-Martins (2002) trained five-year-old Portuguese speaking children in either spelling or in phonological awareness. The children in the spelling condition were unable to spell, writing combinations of letters that were not phonemically linked to the words they were asked to spell. In the spelling training children were forced to confront the difficulties in reading their own writing by being shown examples of syllabic writing in which one letter represented one syllable alongside their own non-syllabic and non-phonemic spellings. The children were asked to say which spelling was better and to justify how their own spellings and the syllabic examples were spelt. Thus they were forced to confront the deficiencies in the phonetic representations of their own spellings. The children in the phonological awareness training condition learnt to identify and delete initial syllables and phonemes. At posttest the children who had learnt to spell outperformed controls on initial phoneme identification and on initial syllable deletion. As would be expected they were no different on these measures as the children who had received training in syllable awareness. Teaching children to become aware of the syllabic nature of spelling is as effective as teaching them syllabic awareness directly.

In another study, Silva and Alves-Martins (2003) trained more five-year-old Portuguese children in phonemic spellings, using the same confrontational approach as in the previous study. In both studies the words used ranged in size from two to five syllables. In this study the children in the experimental group were initially able to spell by representing sounds with syllables. In the training they were asked to spell words and then shown a phonemic spelling of the same word and asked to say which spelling was better and why. In the training sessions children were also encouraged to think of the letters that went best with the sounds in the words. The trained children in this study increased in phoneme sensitivity and deletion compared to controls who drew pictures in their equivalent sessions. Both training studies indicate that this kind of confrontational training in spelling increases phonological awareness. The level of phonological awareness that increases the most is equivalent to that which they were encouraged to spell, either at the syllable level or at the phoneme level.
Training studies with English speaking children are aimed at correct phonemic representations of sounds in words. Ehri and Wilce (1987) taught kindergarten children to spell using an analytic method of instruction. The trained children learnt to spell phonetic spellings that were a combination of real and nonwords by representing the sounds with the appropriate letter on a tile. All vowels in this study were long vowels and were marked with a horizontal bar to indicate the long vowel. The control group were taught isolated letter sounds, including the long vowels, using the same tiles as the training group. The letter-sounds were the same as those that the experimental group used in the spelling of phonetic words. At posttest the trained children were better at nonword spelling, learning to read new words, and on a phoneme segmentation task. For the children in this study the act of learning to spell increased their phoneme manipulation ability. Uhry and Shepherd (1993) also trained first graders in spelling with computerised instruction and taught them to segment words by representing the sounds with letters on tiles. A control received similar computerised instruction but it was focussed on learning to read and did not include segmentation. After the training the children who had learnt to spell performed better on segmentation tasks, as would be expected, but they also did better on deletion and phoneme blending. Teaching children how to spell using regular letter-sound correspondences may make more children’s understandings of phonemes more concrete.

Castles and Coltheart (2004) suggest that phoneme awareness cannot be measured until after children have explicitly learnt grapheme-phoneme correspondences. Van Bon, Schreuder, Duighuisen, and Kerstholt (1994) found that Dutch first-graders and spelling-matched learning disabled children could complete a phoneme segmentation task but only when the stimuli were simple CVC words. These children had knowledge of grapheme-phoneme correspondences and could use them to segment simple words, a measure of phoneme awareness, even though they could not spell them all. The knowledge of grapheme-phoneme correspondences can come from phonics instruction for some children. However, not all children explicitly learn grapheme-phoneme correspondences in formal literacy instruction. For children without explicit instruction in grapheme-phoneme correspondences it may be that the act of learning to spell makes children’s understanding of phonemes more concrete. As evidence for this, children who are not explicitly taught these correspondences in reading still have phoneme awareness ability to the same level as children who are explicitly taught grapheme-phoneme correspondences when they
have the same reading age (Connelly et al., 1999). The process of learning to spell may increase letter-sound knowledge and make this knowledge more accessible for manipulation.

Evidence of the development of phoneme awareness occurring after learning to spell also comes from research on precocious and early readers. Stainthorp and Hughes (1999) found in their sample of young early readers that spelling ability lagged behind their precocious reading ability. Although the children had very good phoneme awareness measured with phoneme addition and deletion, they had the most difficulty with phoneme segmentation. It is possible that this more difficult measure of phoneme awareness was lower than the others because of the lower spelling ability. Their phoneme segmentation ability may have been more in line with their spelling ability than their reading ability. At the time that phoneme awareness was measured the children were already able to spell which would explain why the precocious readers had such well developed phoneme awareness in all other measures except phoneme segmentation. Two other case studies on precocious readers also found that both explicit phoneme awareness and spelling lagged well behind their reading ability (Fletcher-Flinn & Thompson, 2000; Henderson, Jackson, & Mukamal, 1993). This supports the position that explicit phoneme awareness develops in conjunction with, or at the same time as, spelling ability rather than reading ability.

Stainthorp and Hughes (1999) suggest that there is a relationship between the comparable lag in spelling development and the most explicit measure of phoneme awareness in the early readers. As with precocious readers the ability to complete more explicit and difficult phoneme awareness tasks may be related to spelling ability rather than reading ability in normally developing readers and spellers. Awareness of the final phoneme in words, particularly words with final consonant clusters is possibly the most difficult level of phoneme awareness to attain (Treiman, 1985). It is difficult to segment the coda from the vowel because it violates the cohesion of the rime unit. The link to spelling could be because the acquisition of orthographic representations makes it possible to manipulate the final phoneme. Holligan and Johnston (1991) for example, found that children who are better spellers are better at final phoneme tasks. Lazo, Pumfrey, and Peers (1997) found that spelling predicted final phoneme identity task performance during the first year of school instruction. The results presented in Chapter 4 also indicate that spelling ability and final phoneme awareness may be related in preschool children.
Castles, Holmes, Neath, and Kinoshita (2003) also argue that phoneme awareness is a reflection of spelling ability or knowledge of orthographic representations. They found that phoneme manipulation measured by phoneme deletion and phoneme reversal correlated with spelling ability in adults. The items in each of the phoneme tasks were a combination of transparent, regular spellings and opaque, irregular spellings. It was concluded that adults with better spelling ability used orthographic knowledge to complete the phoneme tasks but that it was of little use to them when the words in the phoneme tasks were irregular words. In a similar experiment with 11-year-old children a simpler phoneme deletion task with transparent and opaque items was used and orthographic knowledge was tested with a homophone judgement task and irregular word reading task. As did the adults the children did better on the transparent items than the opaque items on the phoneme awareness task. Children with better orthographic knowledge did better on the transparent items but not on the opaque items. Both adults and children were attempting to use their spelling knowledge to complete the phoneme deletion task but were being inhibited by their knowledge of orthographic patterns on the opaque items. This suggests that spelling knowledge may underlie the performance on phoneme awareness tasks. In a study of Dutch first-graders and spelling-matched learning disabled children van Bon et al. (1994) also found the need for orthographic representations of more phonologically complex words. They found that children could spell CVCC words (65%) better than they could segment them (53%). This suggests that being able to spell and having orthographic representations of more complex spellings helps in phoneme segmentation. This is especially when the word requires segmentation of final consonant clusters.

Summary

To summarise, early spelling ability, especially that representing language at a phonological level or an invented spelling level, may be a reflection of children’s early phonological awareness rather than a predictor of it. When words are more phonologically complex children may need to have an orthographic representation of the word stored in their lexicon to help them segment, especially the ends of words. This has been argued by Frith (1985; 1986) in that children need to start identifying orthographic units in print words before they can use them in spelling. Just as importantly, she also suggests that alphabetic (phonological) spelling drives reading at the alphabetic level. The possible use of orthographic representations in the manipulation of final
phonemes lends support to the proposal that learning to spell and spelling ability provide the knowledge base to develop explicit phoneme awareness.

**Theories**

The influence of reading and spelling instruction on reading and spelling outcomes and processes must be able to be explained by models or theories of reading acquisition, just as theories of reading must also be able to explain unexpected reading difficulties. At the heart of reading theories is the development of a sight vocabulary or orthographic lexicon. This orthographic lexicon is that which is modelled by theories of adult fluent reading (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Seidenberg & McClelland, 1989). Also at the heart of most theories of reading acquisition is a form of phonological recoding, or the application of the alphabetic principle in reading unfamiliar words. Well-established theories such as that of Ehri (2005) and Share (1995) explain the development of readers as they learn to read with the assumption that they begin learning to read with explicit instruction in the alphabetic principle. Thus, they explain the process of learning to read in phonics taught children.

In contrast, the psycholinguistic model of reading of Goodman (1970; 1994) forms the basis of whole-language reading instruction in which the key assumption is that learning to read is like learning to speak, and develops naturally. Like speaking the focus is on meaning construction rather than individual word reading with semantic and syntactic cues more important than letter cues (Tunmer et al., 1999). This theoretical basis has generally not had much support in reading research (Liberman & Liberman, 1990; Tunmer et al., 1999). One theory that attempts to account for possible differences in reading processes due to instructional influences is the knowledge sources account of reading (Thompson et al., 1996; Thompson & Fletcher-Flinn, 2007; Thompson, McKay, & Fletcher-Flinn, 2004). The following section will review the theories of Ehri, Share, Goodman, and Thompson et al. and will attempt to place the proposed model of phonological awareness development in the context of theories of word learning.

The earliest models of reading were stage theories of reading. Stage theories of reading begin with a logographic stage of reading (Rack, Hulme, & Snowling, 1993). Logographic reading refers to the ‘reading’ of whole words based on the visual distinctiveness of features that make up the words, or based on the context in which the word is identified. An example of the former is
when the word *dog* is read by the ‘tail’ at the end of the word. Children’s ability to read environmental print such as the McDonalds logo when accompanied by the ‘golden arches’ is an example of the latter. The next stage is often an alphabetic stage where the phonemic structure of language begins to exert its influence on learning to read. It is at this stage that reading new words is expected to be attempted by ‘sounding-out’ each grapheme and any word reading errors would be phonological, such as reading /kʰærn/ for ‘chain’ (Stuart & Coltheart, 1988). The final stage is usually an orthographic stage of reading whereby children begin to use larger chunks of language, or spelling patterns to recognise words, and thus read them.

Ehri (1995; 1998; 2005) provides a four phase model of word learning which incorporates both reading and spelling. She suggests that the development of reading and spelling involves a series of phases that reflect the predominant knowledge utilised at a point in time. The predominant knowledge is not the only way that children can attempt new or novel words, and they may use any other knowledge that is described in phases before or after. In this model of word learning the alphabetic system acts as a mnemonic for remembering words, and as an aid for storing words in the orthographic lexicon (Ehri, 2005). The development of reading and spelling occurs in conjunction with each other as children remember what they learn about the spellings in words while also remembering what they learn about reading the same words. What they remember about the reading and spelling of words forms one knowledge base from which they can retrieve words for reading or spelling. What they remember about the alphabetic principle and the reading and spelling of words lays the foundation for each of the alphabetic phases.

The first phase is the pre-alphabetic phase. This is when children form connections between the most salient features of words, and their pronunciations. Children remember visually salient and non-phonemic attributes of words, as they do with environmental print. The non-phonemic nature of environmental print reading is shown by both children and illiterate adults who are beginning to read who are unable to ‘read’ environmental print when the logo is printed in a different font and not accompanied by the logo (Cardoso-Martins et al., 2003; Masonheimer et al., 1984). Beginning readers are reading the logo symbol, or the distinctive feature of the word in question, rather than the word itself. Figure 14 illustrates how children may correctly ‘read’ the printed word *look* but they are only reading the distinctive diphthong which they may remember as a pair of eyes. Thus they may also read the printed word *look* as ‘boot’ as well,
remembering that the word boot also has the distinctive pair of eyes, or perhaps they remember that eyes can see and read the word ‘see’ (Ehri & Snowling, 2004).

Figure 14: Possible responses a pre-alphabetic reader may make to the word 'look' (adapted from Ehri & Snowling, 2004).

The pre-alphabetic phase reflects rote-association of features rather than processing words at a phonological or alphabetic level (Ehri, 1995; Gough, 1993). Children do not need to have any alphabetic knowledge because they are not attending to letters and their corresponding sounds. Although children may be able to identify letters during this phase and can identify the letters in their name, they are not able to provide letter-sounds for these letters (Treiman & Broderick, 1998). Spelling at this phase may consist of random letter strings or an overuse of known letters such as the letters in a child’s name. This is similar to the first type of prephonemic spellings suggested by Bear and Templeton (1998). It is the letter-sound correspondences that are important, and not just letter identification for the movement to the next phase (Ehri, 2005).

The second phase of Ehri’s (1995) model is labelled partial alphabetic and is based on what Ehri and Wilce (1985) term ‘phonetic cue reading’. In the partial-alphabetic phase beginning readers and spellers begin using their newly developed alphabetic knowledge. Ehri (2005) suggests that children are not able to form connections between all the letters and sounds in words as they are not yet able to segment and detect all the sounds. The beginning reader will use the easier to detect sounds, such as the initial and final sounds, to remember how to read words. The beginning speller uses the same sounds to represent the spelling of these words. The child who learns the word spoon and remembers that it begins with /s/ and ends with /n/ might also misread
“spoon” for the word ‘skin’, for example (Ehri, 2005; Ehri & Soffer, 1999). The spelling of the word spoon might be spelt as SP or SPN. In these cases it is the first and last sounds that are acting as phonetic cues for the child. The easier to detect sounds are also usually consonant letters, and not vowels. This is the beginning of the development of the sight vocabulary in which we store representations of the words we read and are familiar with (Ehri, 1995).

In the partial alphabetic phase children are beginning to store partial representations in their orthographic lexicons. These representations are partial in that they are at the letter level rather than word or even grapheme level. Using the example of “spoon” the partial representations that are stored are the “s” and the “n”. The earliest representations linked in the phonological lexicon are a combination of letter-names and letter-sounds (Jackson & Coltheart, 2001). Children in this phase are unable to use explicit phonological recoding because they lack a full knowledge of letter-sounds and lack in phoneme awareness. The lack of phonemic awareness in this phase was shown by children considered younger in their literacy acquisition who were seemingly unaware that not all letters in words make sounds (Ehri & Soffer, 1999). These children could produce sounds for all the letters in words but did not compare the sounds with words in their spoken vocabulary by blending the sounds back into a word. The proposed model of phonological awareness development also expects that children can begin to read without phoneme awareness.

The following phase is the full alphabetic phase in which beginning readers store complete phonological representations of words in their sight-word lexicons. Words stored in this way have links between graphemes and phonemes. In this phase a grapheme is remembered as being more than one letter, for example the grapheme CH is stored as the single phoneme /tʃ/. The reader uses this stored knowledge to read and spell new words while also utilising their phoneme awareness. When reading the child in the full alphabetic phase will blend phonemes together, and when spelling the child will segment the sounds. It is at this point in reading acquisition and development that children will use phonological recoding. They have full use of letter-sound and grapheme knowledge and they are able to combine this with their phoneme awareness to apply the alphabetic principle.

When the reader is aware that a word can be broken into its respective sounds the reader can use the identified sounds to compare the spoken word with the printed spelling of the word (Ehri, 2000). By comparing the spoken with the printed they are able to begin understanding that not
all graphemes in a word make a sound, but that one sound can be represented by two or more letters that comprise a single grapheme, such as vowel digraphs (Ehri & Soffer, 1999). As the representation of digraphs become increasingly secure in memory the spelling of these spelling patterns become increasingly accurate. Children in the full alphabetic phase remember irregular words by utilising the regular sounds in the word and storing in memory when the exception sound occurs. They remember what makes the exception grapheme special, for example it could be silent or it could be an usual spelling (Ehri, 1998). The storage in memory of words in letter-by-letter detail allows the use of analogy in reading and spelling new words as well.

The final phase of Ehri (1995; 2005) is the consolidated alphabetic phase. Within this phase children recognise that a combination of phonemes has the same pronunciation across a number of different words, for example –ight, has the same pronunciation /aɪt/ across ‘night’, ‘light’, ‘right’, and ‘fight’. This recognition occurs as more words are stored in the sight word lexicon. During the full alphabetic phase words that are seen frequently are unitised, this is the words are identified as wholes and are not decoded (Ehri, 1998). In the consolidated alphabetic phase chunks of words, such as morphemes, rimes, and syllables are also unitised. These units are then used to easily read and remember new, larger, multisyllabic words. When reading the larger words it is just the chunks that are read, making it unnecessary to decode grapheme by grapheme.

Ehri and Soffer’s (1999) finding that children who were beyond early literacy overestimated the size of sounds in words by identifying multiphonemic groups of letters as one sound provides support for the use of consolidated units in reading. This finding was also replicated with adults in teacher training (Scarborough et al., 1998). These sound patterns are secure in memory because they are represented as both individual grapheme-phoneme correspondences and as consolidated units (Ehri, 2000). At the beginning of this phase children could be considered transitional spellers (Morris & Perney, 1984). The transitional speller is attempting to use rules that they have stored in memory, such as the marking of long vowels, and the doubling of consonants. Another example is when the child accurately spells the suffix –ed across the different pronunciations that it has, because it has been unitised in memory.

Although Ehri does not specify the role of instruction in the development of reading it is suggested that the explicit teaching of letter-sound correspondences and phonemic skills are essential for the initial application of the alphabetic principle in the early phases of reading.
acquisition (Ehri, 2000). In particular this would help children move from the partial alphabetic phase to the full alphabetic phase. This move from partial alphabetic to full alphabetic may also coincide with the development of phoneme manipulation skill in the proposed model of phonological awareness development. In contrast, the psycholinguistic guessing game suggested by Goodman (1970; 1976; 1994) argues against the explicit teaching of word-level reading skills. Within this model of reading grapho-phonic information is learned as reading develops, but alone is not necessary for the reading of words. Word-level graphic information is only sampled and used in conjunction with predictions. This lack of use for the alphabetic principle is best explained by the core premise of the psycholinguistic model of reading which is that learning to read is essentially the same as learning to speak (Liberman & Liberman, 1990; Tunmer et al., 1999).

It is not necessary to understand or be aware of the structure of words to learn to speak, and so there is no need to expend effort on word-level processes when learning to read either. It is argued that reading is a transaction between the text and the reader and that as long as the reader is making some sense of the text the accurate recoding of the words is secondary (Goodman, 1976; 1994). As the reader reads text they use three cuing systems, graphophonic, semantic, and syntactic. The reader perceives the printed text which is then given meaning by the interaction between graphophonic knowledge and syntax (Goodman, 1997). Within this interactive model it is the preservation of meaning that is paramount. Prediction is the most important aspect of reading and as long as meaning is gained from the print, it is not necessary to use grapheme-phoneme knowledge unless all else fails (Goodman & Goodman, 1979). Children begin to read by recognising the context in which words appear and identifying print in context, such as environmental print. This reading of environmental print is considered a building block to reading in authentic texts in context.

Although the Goodman (1970; 1994) model of reading underpins the whole-language method of reading instruction there is very little experimental research that supports the key assumptions of this model (Liberman & Liberman, 1990; Tunmer et al., 1999). Yet most children who are in whole-language classrooms do learn to read. It has been suggested that children in whole-language classrooms do learn to read because there are multiple sources of knowledge that can be used for reading new words and those used are influenced by teaching instruction method (Connelly et al., 1999). Ehri (2005) suggests that there are different sources of knowledge that
beginning readers can use; explicit recoding, analogy, context, and sight word activation. However, this cannot explain how children in a whole-language context without any instruction in explicit recoding also learn to read and develop sight word or orthographic lexicons. In particular they may have more trouble moving from reading in utilising partial alphabetic knowledge to full alphabetic knowledge. Context is not enough on its own (Nicholson, 1991; Nicholson, 1993a; 1993b) and analogising requires that you already have sight words to form analogies with. Words in the partial alphabetic lexicon are only partially represented and don’t allow the use of analogy. One possibility is that children in non-phonics classrooms are getting explicit information about grapheme-phoneme correspondences through invented spelling.

Frith (1985; 1986) proposed a model of literacy development to explain where the origins of developmental dyslexia lay. In this model she argues that reading and writing form the same knowledge base, but the strategies for understanding words change over time step-wise for both reading and spelling. Frith suggests three strategies, in line with most stage theories, the logographic stage followed by the alphabetic stage, and lastly, the orthographic stage. At the logographic stage reading drives the development of spelling, but importantly, it is spelling that drives the alphabetic stage and builds up the strategy for use in reading. Reading then drives the orthographic stage in which identification of orthographic units in print words contributes to the ability to use them in spelling.

Implicit phonological recoding is another possible explanation for how children learn to read without explicit instruction. Implicit recoding is the unconscious mapping of sounds onto letters using the stored knowledge of letters and words in the orthographic and phonological lexicons. Share (1995) proposed a ‘self-teaching’ model of reading acquisition in which children utilise their phonological knowledge and orthographic knowledge to read new words. Their phonological and orthographic knowledge increases as they experience more words, and as such Share describes his model as item-based and not stage-based. A set of simple letter-sound correspondences, perhaps taught formally, allows children to begin to develop their reading lexicon through explicit phonological recoding. Initial reading is explicit until the word has been identified enough times it can be retrieved directly from the orthographic lexicon (Share, 1999). Gough and Hillinger (1980) suggest that once a child has knowledge of the alphabet and the insight that written words represent spoken words they can begin to link individual graphemes with phonemes. These are the start of the orthographic and phonological lexicons. Once they
have seen enough pairings of the sound of /k/ in ‘car’-‘cot’-‘cat’ they can store the phoneme and its graphemic or lexical representations and have a link between them to use in the identification of new words.

Share (1995; 1999) suggests that the earliest self-teaching requires minimal phonological sensitivity, letter-sound knowledge, and the ability to use contextual clues. Most children who are learning to read in a whole-language classroom have available to them the phonological sensitivity and the ability to use contextual clues, but they do not have letter-sound knowledge (e.g., Blaiklock, 2004). Another model of reading that is also item-based rather than stage-based and which has implicit phonological recoding, called lexicalised phonological recoding, at its core is the Knowledge Sources theory (Thompson, 1999; Thompson et al., 2004). In this theory the orthographic representations of words are connected to the phonological representations and it is the orthographic representations that play the important role in phonological recoding.

Lexicalised recoding can occur at the earliest stages of reading. At the beginning of learning to read children induce sublexical relations from the earliest learning of reading vocabulary, for example the inducement of the grapheme-phoneme relationship of ‘s’ from reading ‘said’, ‘see’, ‘some’ as well as ‘comes’ and ‘bus’. As the reading vocabulary increases larger lexical units are used to read words, such as ‘et’ that has been induced from the words ‘get’, ‘let’, and ‘bet’ that are already orthographically stored with connections to their phonological representations (Fletcher-Flinn & Thompson, 2004; Thompson et al., 2004). This knowledge source is similar to the development of self-teaching described by Share (1995; 1999) but does not require the first correspondences to be explicitly taught as they are a separate and independent source of knowledge.

This model of reading acknowledges that children make use of contextual clues when reading, and this is another source of knowledge when reading a new word. Two other sources of knowledge, analogy cues and letter-sound cues may not be available to children in whole-language classrooms as these cues are taught in phonics classrooms. Taught sounds for letters are the knowledge that the theories of Ehri (2005) and Share (1995) have as the core source of knowledge in reading new words beyond initial reading attempts that also make use of letter names and more easily induced letter sounds (Ehri & Snowling, 2004; Treiman et al., 2001b). Analogy cues refer to the child’s ability to see part of a unfamiliar word (e.g., the rime) and to
make an attempt of the word using an analogy with that part of the word with an already known word, for example to read the unfamiliar word *coat* in analogy with the known word *boat*. This source of knowledge requires that the analogy cue (e.g., *boat*) already occurs in the orthographic lexicon. According to Marsh et al. (1981) analogy use isn’t spontaneous until later in reading acquisition and even then is not used often.

The explicit knowledge required in the theories of Ehri and Share assumes that the beginning reader develops phoneme awareness and the ability to manipulate phonemes in words. The reader needs to be able to connect phonemes to graphemes and to be able to blend the phonemes together into a word. It is usually explicit phonics instruction that teaches children how to blend sounds in words. Ehri (2000) suggests that the process of learning to read will also allow children to use most of the knowledge they gain from the explicit application of the alphabetic principle to the required phoneme segmentation skill used in spelling. The knowledge sources account of reading contrasts with the need for phoneme awareness. In knowledge sources theory children can learn to read without needing to have explicit phoneme awareness and manipulation skills. Gough and Hillinger (1980) were unsure of the relationship between learning to read and phoneme awareness, but still believed it was important that phoneme awareness was already held or developed. It may be that it is just implicit phoneme sensitivity that is required for learning to read. Tunmer et al. (1999) suggest that children who have no problem in learning to read without explicit instruction in the alphabetic principle are those who begin school with sufficient phonological sensitivity.

The theories of reading that have been reviewed, with the exception of the psycholinguistic transactional account of Goodman (1970; 1994), support the development of a sight word vocabulary in which the orthographic representations are stored in an orthographic lexicon and linked to the phonological lexicon which provides the pronunciations of the orthographic representations. The proposed model of phonological awareness development is similar to Ehri’s (1995; 2005) model of word recognition in that both models specify that the same knowledge base in used in both reading and spelling. Except for the actual learning to read and spell this underlying knowledge base will be reflected in the use of the term word learning, rather than learning to read or learning to spell, in the remainder of this thesis.
Although children have the same knowledge base for reading and spelling this may be influenced by the method of reading and spelling instruction that they receive. In particular, explicit instruction which includes letter-sound instruction may provide the means to use explicit phonological recoding while also contributing to the development of phoneme manipulation skill. When children receive instruction that is contextual-based with no explicit letter-sound instruction they may need to rely primarily on implicit lexicalised recoding which would not help the development of explicit phoneme manipulation as the knowledge stored for implicit recoding is not available to consciousness. The process of learning to spell, even using a contextually based instruction method may contribute to the development of letter-sound knowledge and explicit phoneme awareness (e.g., Uhry & Shepherd, 1993).

The explicit instruction in the use of letter-sounds in reading and spelling is thought to facilitate explicit recoding (Share, 1995). The more often that words are recoded the stronger their representation in the orthographic lexicon (Ehri, 2005; Share, 1999). For beginning readers already receiving formal instruction this may be as few as four presentations of the word (Reitsma, 1983; Share, 1995). Spelling may play an important role here as phonemic spelling may initially fix the letter-sound to grapheme knowledge used for early lexicalised recoding. Increased spelling knowledge of conventional spelling patterns helps to fix larger lexical representations in the orthographic lexicon. This same spelling knowledge may help the development of phoneme awareness.

As previously reviewed, the relationship between early spelling and phonological awareness suggests that they are representations of the same knowledge. If this is the case then it would be expected that early invented and phonological spelling would predict reading, just as phonological awareness does. If preschool spelling is an indicator of phonological awareness then it would be a predictor of later reading. The predictive influence of spelling on reading, has been found in training studies (Ehri & Wilce, 1987) and longitudinal studies (Caravolas et al., 2001; Ellis & Cataldo, 1990; Mommers, 1987). Frith (1985; 1986) encapsulates this in her step-wise theory of literacy acquisition in which alphabetic spelling drives alphabetic reading, but that an orthographic strategy is then acquired through more reading and that drives the use of orthographic strategies in reading. It comes as no surprise that the most effective methods of teaching phonological awareness to children make use of the same knowledge children use when spelling. The National Reading Panel (2000) found that the most effective phonological
awareness training method involved the use of letters to help children “make the connection between PA [phoneme awareness] and its application” (p. 2-41). They conclude that children should receive instruction in letters as well as phoneme awareness. Thus it would be expected that teaching children spelling would aid in learning to read.

Learning to read is not as effective in transferring knowledge to learning to spell (Bosman & Van Orden, 1997). This is highlighted by the gap in spelling and reading ability of precocious readers (Fletcher-Flinn & Thompson, 2004; Henderson et al., 1993; Jackson & Coltheart, 2001; Stainthorp & Hughes, 1999). The difficulty in transferring knowledge from reading to spelling is that when reading a word there is usually only one phoneme represented by each grapheme. When attempting to spell a word there can be several graphemes that a phoneme can be represented by. Waters, Bruck, and Seidenberg (1985) give the spelling pattern of –eef which when read only has one sound as in the word ‘beef’, but when trying to spell the sound /if/ there are different ways to attempt it, such as in the words beef, chief, and leaf. There has been research that has found evidence that knowing how to spell and learning how to spell can have an influence on how well or how fast children learn to read, providing evidence that spelling may help with the storage of word reading information (Caravolas et al., 2001; Ellis & Cataldo, 1990; Mommers, 1987; Richgels, 1995).

Richgels (1995) studied children who had begun to invent spelling without any explicit letter-sound instruction for either reading or spelling. These children were 16 non-readers and were matched on alphabet knowledge with 16 non-readers who had not begun producing invented spellings. All children knew either 25 or 26 letters of the alphabet. The children were trained to read six easy phonetically simplified words, and six more difficult 2-3 syllable phonetically simplified words. The inventive spellers learnt more of the easy words than the non-inventive spellers, and were the only ones who could learn any of the more difficult words. The results of this study indicate that being able to spell can contribute to learning to read using knowledge that partial-alphabetic readers use.

There are many longitudinal studies that provide evidence of the causal role of spelling in learning to read. Mommers (1987) followed the acquisition and development of reading, spelling, and reading comprehension of Dutch first-graders. Regardless of instruction type which was distinguished by more or less letter-sound instruction, children’s spelling ability after three to
four months of school instruction predicted decoding skill at the same time. There was also a predictive relationship from spelling to reading comprehension four months later for children who had less letter-sound instruction. After 8 months of instruction reading predicted spelling and spelling exerted no influence on reading. Ellis and Cataldo (1990) also found that spelling predicted the reading of real and nonwords over the first year-and-a-half of formal schooling, then lost its influence in the second and third years of school. An explanation for both findings could be that the children had enough information in their orthographic lexicons that it no longer needed to be strengthened by learning to spell, thus spelling no longer contributed to reading.

A similar finding was made by Caravolas et al. (2001) who followed children through their first year of school. The children in this study were tested on phonological spelling, the spelling of regular words, during their reception year and first-grade, with conventional spelling tested in first and second grades. During the reception year phonological spelling predicted reading better than phonological awareness. By first-grade phonological spelling no longer predicted reading, but reading did predict conventional spelling. The prediction of conventional spelling by reading carried on into the second-grade year as well. These longitudinal studies provide evidence that spelling predicts reading as well as phonological awareness. They also provide evidence of the development of orthographic lexicons that are utilised when spelling conventionally which includes irregularly spelled words, and which develops after children have begun to spell using sublexical processes based on their application of the alphabetic principle. Caravolas et al. provide some evidence of this in the prediction of phonological spelling by letter-sound knowledge and phonological awareness.

There is some evidence to suggest that the transfer of spelling ability to reading is influenced by the type of literacy instruction in the classroom (Connelly et al., 1999). Children who receive explicit instruction in letter-sounds have available to them strategies to link graphemes to sounds in words. This gives them insight into the alphabetic principle and may aid in their reading attempts of new words through explicit recoding. This explicit knowledge and the application of such strategies are illustrated by the large number of regularisation errors made by phonics taught children in their spelling attempts. Research on beginning readers and spellers in non-phonics classrooms suggest that there is little transfer between reading and spelling, or spelling and reading. It is believed by some non-phonics educators that when explicit letter-sound instruction is not given that invented spelling instruction will encourage the learning of sound-to-grapheme
correspondences which transfers to the grapheme-to-sound correspondences that are used in reading (see Thompson, 1993). Research on the dissociation of spelling and reading in non-phonics taught children suggests that these children treat each as a different skill and do not apply the same knowledge base to them. For example, Thompson and Fletcher-Flinn (1993) examined the parallel use of grapheme-to-phoneme knowledge with the corresponding phoneme-to-grapheme knowledge for ‘y’ in nonwords. They found that phoneme-to-grapheme spelling knowledge was lower than the corresponding grapheme-to-phoneme reading knowledge.

To further highlight the dissociation between reading and spelling in children without explicit letter-sound instruction Thompson and colleagues provided evidence where spelling knowledge is better than reading knowledge. Thompson, Cottrell, and Fletcher-Flinn (1996) found dissociation with the grapheme ‘b’. Year 1 children could use it in the final position for spelling but had difficulty reading it in the same position in a nonword. In another study of 5-year-old beginners receiving whole-language reading instruction and invented spelling instruction children participated in two conditions, a ‘spelling’ and a ‘reading’ condition (Thompson et al., 1999). In the ‘spelling’ condition the children had to choose a letter that represented the sound that they heard. The sound was a phoneme heard out of context so that any partial spelling knowledge would have no influence. In the ‘reading’ condition the children had to provide a sound to a presented letter. The two target letters were c and g, the sounds in question for each of these letters were /s/ for c and /dʒ/ for g. In the spelling condition 14% of children gave the letter c on hearing the phoneme /s/, while in the reading condition 33% gave the phoneme /s/ to the letter c. In the spelling condition 30% of children in the spelling condition gave the letter g on hearing the phoneme /dʒ/, while in the reading condition 55% of children gave the phoneme /dʒ/ to the letter g.

The difference in application of the letter-sound correspondences between the reading and spelling conditions supports the idea that there is little influence of reading knowledge on spelling. This is especially obvious when children have no way of using explicit recoding when reading and are only able to derive knowledge from the orthographic lexicon. Without spelling knowledge and without the knowledge used in explicit recoding children may not be able to strengthen the items in their orthographic lexicon enough to transfer them from reading grapheme-phoneme knowledge to spelling phoneme-grapheme knowledge.
Summary

Children without explicit instruction in letter-sounds seem to approach reading and spelling as different tasks in the initial stages of formal literacy instruction. The relative difficulty of reading and spelling is dependent on the nature of the phoneme, and its position in words. A similar conclusion can be made about the initial development of young precocious readers who even with extensive implicit phonological recoding ability, are often unable to spell beyond the initial sound of words if they have not acquired or had instruction in letter-sound knowledge (Jackson & Coltheart, 2001). The effects of not explicitly learning letter-sounds are reflected in the differences in the way 7-year-old phonics and non-phonics taught children approach spelling. Connelly et al. (1999) found the two groups of children did not differ on real word spelling ability but the group who had received explicit letter-sound instruction were better at spelling regular nonwords, even though they had similar levels of phoneme awareness.

Hypotheses

This review of the literature has provided an overview of two influential instructional approaches to reading and to spelling (Hempenstall, 1997; Liberman & Liberman, 1990; Thompson, 1997). The first is a top-down approach in which meaning is primary. This is reflected in contextually-based approaches, in reading where comprehension is important, and in writing where getting the story across is more important than the spelling of words. The second approach is bottom up which is reflected in approaches that begin with explicit instruction in letter-sounds and then word analysis. The review has also shown that the act of learning to read or learning to spell can influence the development of explicit phoneme awareness or phoneme manipulation. Previous research findings, including those in Part 1 of this thesis have also shown that letter-sound knowledge is important for the development of explicit phoneme awareness.

Phoneme awareness may then be the result of letter-sound knowledge, and so may also be the result of learning to read if explicit letter-sound instruction is a part of the reading instruction received. The method of instruction is also reflected in the processes that children use when they are attempting to read or spell words. Children who receive explicit letter-sound instruction would have available to them the ability to use explicit recoding in both reading and spelling new words. This would be strongest in children learning to spell with explicit instruction because the
process of learning to spell requires phoneme awareness beyond sensitivity. Children without explicit letter-sound instruction are expected to use implicit phonological recoding when trying to read new words. However, this is a form of knowledge that takes longer to utilise as it requires that child has some sight words in their orthographic lexicon before use. For those not receiving explicit letter-sound instruction, learning to spell may provide a mechanism for developing letter-sound knowledge for the development of explicit recoding. In both top-down and bottom-up approaches learning to spell may strengthen the representations in the orthographic lexicon, providing the foundations of fluent lexical-route reading (Coltheart et al., 2001; Jackson & Coltheart, 2001).

The current study adds to the body of literature on the development of phonological awareness and the relationship between formal literacy instruction and explicit phoneme awareness. It tests the proposed model of phonological awareness development. The study differs from previous studies examining the relationship between formal literacy instruction and phoneme awareness by removing the confounding influence of learning to read and to spell at the same time in a sample of preschool children. The present study will examine the individual effects of learning to read and learning to spell on phoneme awareness by teaching preschoolers who are less than six months away from beginning formal school instruction to either read or to spell. There will be two experimental reading groups and two experimental spelling groups, each receiving reading or spelling instruction that is either letter-sound based or contextually based (see Table 10 in Chapter 7). There will also be a control group to ensure that any phonological awareness is attributable to the instructional intervention and not to another, unobserved, third variable.

Additionally, the current study will add to the body of literature on the acquisition of reading and spelling knowledge by utilising the separation of reading and spelling knowledge to examine the acquisition of new words in either reading or spelling.

The study will test the proposed model of phonological awareness, illustrated in Figure 13, through a short longitudinal design utilising the intervention phase of the study. It is expected that all children will develop in their rime awareness regardless of experimental group membership as the intervention received is not thought to influence rime awareness. Rime awareness is expected to continue to develop as children mature and their vocabulary increases. It is also expected that regardless of experimental group membership pretest rime awareness and letter-sound knowledge will contribute to phoneme awareness, as proposed by the model of
phonological awareness development. The intervention design tests whether instruction that provides explicit letter-sound instruction will contribute to larger gains in phoneme manipulation than instruction that is contextually-based. In addition, when explicit letter-sound instruction is not provided learning to spell will provide the knowledge for phoneme manipulation. The following explicit hypotheses were derived to examine the hypothesised precursors and triggers for the development of rime and phoneme awareness.

1. All children will improve in rime awareness across pretest to posttest.

2. Pretest rime awareness and letter-sound knowledge will contribute to larger phonemic awareness gains.

3. Explicit letter-sound instruction, regardless of reading or spelling will lead to larger phonemic awareness gains from pretest to posttest than the contextually-based groups.

4. In the contextually-based groups, spelling instruction will have a larger influence on phonemic awareness gain.

The secondary aim of this study is to examine the effects of the different types of reading and spelling instruction on reading and spelling after the intervention. It is expected that children who have learnt to read or spell with explicit letter-sound instruction will have available to them explicit letter-sound knowledge source to draw from. Thus, they should be able to both read and spell both the taught words and generalisation words using this explicit knowledge of the alphabetic principle for explicit recoding. Children who have not had explicit letter-sound instruction first need to build up a sight vocabulary to be able to use an implicit lexical source to read new words. However, some explicit knowledge of the alphabetic principle will be derived by children who learn to spell without explicit letter-sound instruction because attempting to spell provides opportunities to test letter-sound correspondences. Children who receive reading instruction without explicit letter-sound teaching will also not transfer their knowledge of words to the spelling of the same words as they approach both tasks differently. Hence, the following additional hypotheses will be tested.

5. Explicit letter-sound instruction will provide the knowledge to use explicit recoding to read and to spell.
6. Contextually-based groups will have to develop orthographic representations of words before recoding can occur.

7. Across skills children who have learnt to spell will be able to use their knowledge to read words but children who have learnt to read will not be able to use their knowledge to spell words as they need practice at spelling words before they can use that knowledge.
Chapter 7: Methodology

Participants

The participants in this study were the 98 children from Part 1 (see Chapter 3) who did not read any words on the administration of the Clay Word Reading List (1985). The original sample was drawn from seven kindergartens in the western suburbs area of Auckland, New Zealand. The original sample was predominantly middle-class with an ethnicity breakdown which was predominantly Pakeha/New Zealand European (80%), followed by children who were identified in kindergarten records as either Maori or Pakeha and Maori (6.3%), children of Pacific Island descent (4.5%), children who identified as Indian (3.6%), children who identified as Chinese (2.7%), and others (1.8%). In the current study children had to be aged between 4 years 6 months and 4 years 10 months. The lower boundary was set so children would be cognitively similar to children who are just beginning school at age five, while the upper boundary was set so that children could complete the training and posttesting before they left kindergarten for school.

Of the 98 non-readers one child was too young, ten children did not wish to participate in the intervention and six left the kindergarten for various reasons before the end of the study. This left 81 children in the sample. Children who were English as a Second Language (ESL), but who were fluent in English were also included, although one child whose British Picture Vocabulary Scale (Dunn et al., 1997) standard score was below 75 was not included. Such a score is at the 5th percentile and has an age equivalence of less than 3 years of age. It was thought that a child with the language level of a three-year-old would have trouble understanding what was expected. The ESL children with fluent English were included as they were no different in pretested abilities, including vocabulary, than the native English speakers. It has recently been found that ESL children learn to read at the same speed as native English speakers (Chiappe, Siegel, & Gottardo, 2002). The total sample in the current study consisted of 80 children (43 girls, 37 boys) with a mean age of 55.65 months ($SD = 1.28$) or 4 years 7 months.

Design

This study had a pretest-intervention-posttest design with five conditions. The five conditions included four experimental groups and one control group. The experimental groups received
either explicit instruction, such as in phonics and formal spelling approaches, or contextual instruction such as whole-language and invented spelling. To remove the confounding variable of learning to read and to spell at the same time children learnt to either spell or read, but not both. Table 10 shows how the four experimental groups were constructed. There were two groups that received explicit letter-sound instruction; one group received this in conjunction with reading instruction (LSR) and one group received it in conjunction with spelling instruction (LSS). The two remaining experimental groups received a contextually-based instruction without letter-sound instruction; one group learnt to read words in context without letter-sound instruction (CR) and one group learnt to spell words embedded in sentences (CS). A control group was also formed to ensure that any significant findings were due to instructional influences, and not solely attributable to maturation effects. Each of the experimental groups and the control group contained sixteen children.

Table 10: Differentiation of experimental groups and group labels

<table>
<thead>
<tr>
<th>Letter-sound</th>
<th>Reading</th>
<th>Spelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letter-sound</td>
<td>LSR</td>
<td>LSS</td>
</tr>
<tr>
<td>Context-based</td>
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<td>CS</td>
</tr>
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</table>

Descriptive statistics showing children’s pre-literacy skills are in Table 11. Phonological awareness scores are shown in Table 15. The 80 children were range-matched on the variables from Study 1 into the control and experimental groups. Range-matching is a form a matching across group means rather than matching individuals across groups. Children were placed into conditions based on how their scores would keep the group mean as close as possible to the means of the other conditions. Range-matching was used rather than five-way matches for each condition because children were recruited into the study at different times over the course of two years. Five-way matches can only be used if children are recruited at the same time. Because of the smaller number of subjects within each group the level of significance was set at .05. No significant differences were found between groups, indicating that the range-matching was accurate.
<table>
<thead>
<tr>
<th></th>
<th>CR</th>
<th>LSR</th>
<th>CS</th>
<th>LSS</th>
<th>Control</th>
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<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
<td>$SD$</td>
<td>$M$</td>
</tr>
<tr>
<td>Age (months)</td>
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<td>1.18</td>
<td>55.50</td>
<td>1.37</td>
<td>55.50</td>
</tr>
<tr>
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<td>10.06</td>
<td>101.00</td>
<td>11.02</td>
<td>103.50</td>
</tr>
<tr>
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<td>.63</td>
<td>.50</td>
<td>.63</td>
<td>.50</td>
<td>.63</td>
</tr>
<tr>
<td>Word reading (phonemes)</td>
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<td>.31</td>
<td>1.25</td>
<td>.06</td>
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<tr>
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<td>.69</td>
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<td>.63</td>
</tr>
<tr>
<td>Letter Names</td>
<td>9.06</td>
<td>7.21</td>
<td>8.75</td>
<td>6.94</td>
<td>10.81</td>
</tr>
<tr>
<td>Sounds</td>
<td>1.63</td>
<td>2.31</td>
<td>1.38</td>
<td>2.53</td>
<td>1.75</td>
</tr>
</tbody>
</table>

Note: in all conditions $n = 16$

$^a$Reported as mean proportions as they were scored as 0 = not correct and 1 = correct
Pre and post-test sessions for experimental and control conditions were approximately four weeks apart, the average length of time for training was 27.07 ($SD = 10.64$, range 16-90) days, which included weekends and public holidays. Times varied due to the training being individual and based on a set number of sessions. Some children took longer than others to complete the training as they went on school visits, went on short holidays, or were sick. There was an average of 1.26 ($SD = 1.73$, range 0-7) days between pretesting and training beginning, and 2.70 ($SD = 5.50$, range 0-39) days between training ending and posttesting beginning. The children who were outliers in the number of days taken to complete the training session (90 days) and the number of days between the end of the training sessions and the posttest (39 days) were compared to the other children. Their posttest scores were no different to the other children in their intervention condition, and there was no change in results by removing them from the analysis so it was decided to keep their data in the sample.

**Materials**

*Training materials*

The regular three-letter words that the children were taught to read or spell were derived from three consonant stops; m, t, and p. These letters provided a range of place of pronunciation and of the place of the letter-sound within the letter-name. They are also letters that commonly occur at the both the beginning and ending of early reading vocabulary words while also having a consistent letter-sound pronunciation (Thompson et al., 1999). The consonants were combined with the five vowels to derive the training and posttest generalisation words (see Appendix D for all words generated). This gave 45 possible words and nonwords. The training and generalisation words were restricted to real words to be as similar as possible to words children came across in reading classrooms. This yielded a sample of 21 real words that could be used. The vowel i was not included in either the trained or generalisation items to reduce the number of letters to be taught to children leaving a total sample of 17 words. The eight words selected as training items were selected based on their frequency in early reading books as reading schemes from the Children’s Printed Word Database (Stuart, Masterson, Dixon, & Quinlan, 2002).

The eight generalisation words were chosen to match as closely as possible to the training words. Both the training and generalisation words are shown in Table 12 along with their frequencies per
million taken from the Children’s Printed Word Database (Stuart et al., 2002). They were matched by initial phoneme and final phoneme, except for the mum-mut pairing as there was no other item that could match with ‘mum’ that New Zealand children would know. The generalisation words were not expected to be of the same frequency as the trained words as they were to be unfamiliar to children in their attempts to read them at posttesting. The distribution of vowels differed to ensure that the children were attempting the generalisation words at the phoneme level rather than the rime unit level. Unfortunately the real word and CVC restrictions on the sampling meant that there were no generalisation items with the vowel o.

Table 12: Words used in training and words used for generalisation testing at posttest

<table>
<thead>
<tr>
<th>Initial letter</th>
<th>Trained items</th>
<th>Generalisation items</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>mop (24)</td>
<td>map (122)</td>
</tr>
<tr>
<td></td>
<td>mat (32)</td>
<td>met (149)</td>
</tr>
<tr>
<td></td>
<td>mum (3099)</td>
<td>mut (0)</td>
</tr>
<tr>
<td>p</td>
<td>pet (95)</td>
<td>pat (122)</td>
</tr>
<tr>
<td></td>
<td>pop (111)</td>
<td>pup (76)</td>
</tr>
<tr>
<td></td>
<td>pot (184)</td>
<td>put (1904)</td>
</tr>
<tr>
<td>t</td>
<td>top (500)</td>
<td>tap (81)</td>
</tr>
<tr>
<td></td>
<td>tom (162)</td>
<td>tum (11)</td>
</tr>
</tbody>
</table>

*Note*: Values in brackets are frequencies per million in reading schemes from the Children’s printed word database (2002).

The trained items were presented differently to each of the training conditions. In the LSR and LSS conditions children were presented with the items printed individually on 152mm x 102mm index cards in 24pt Arial font. Arial font was used as was most similar to the fonts used in the early children’s reading books that were sourced to use in the CR and CS conditions. In the CR and CS conditions the trained words were presented in a sentence context with additional pictorial context. The trained items in these conditions were found in short sentences contained
in early reading books. The entire page was used to ensure context was intact and all but one is provided in Appendix F. The missing item is not provided as copyright was unable to be obtained. In the CR condition the trained word was highlighted by a red ring around it, distinguishing it from the rest of the text. In the CS condition the trained word only was covered by a removable piece of sticky paper which allowed the children to put the word they were learning to spell in context. During the training sessions the children in the spelling conditions used small lower-case plastic letters to spell the words. They were given the required number of plastic letters to spell each of the words that they were leaning in the session which ranged from 4 to 9 letters depending on the number of vowels that occurred across the trained words, and if there were any consonants that occurred twice in a word, which was necessary for the words pop and mum.

**Pre- and posttests**

Pretests for this study consisted of the tasks that are described in Chapter 3 and will not be repeated here. The posttests were the same measures as for the pretest but without the vocabulary measure. The posttest had additional reading and spelling measures to measure how many training words were read or spelled correctly, and the generalisation of reading and spelling to new words with the same phonemes. Table 13 provides a summary of the pretest and posttest tasks and the order in which they were presented to children.

*Posttest reading.* The trained words and the generalisation words (see Table 12) were administered separately. Each list of words were printed in 24pt Arial font down the middle of an A4 sheet. The trained words were presented first and children were not told that they were the words that they had learnt so as to ensure that they were reading the words. The children were simply told that the experimenter wanted to see if they could read some words. During the presentation of the trained words the words were uncovered one by one as the child attempted to read each one and no feedback was given other than general praise for “good work” and “great trying”. The generalisation words were blocked and presented in the same way.

The children’s reading of both the trained and generalisation words was scored in two ways. The first score calculated was the number of words read correctly to a maximum of 8 for each of the trained and generalisation words. The second score calculated was to count the number of sounds
that were accurate representations of the phonemes pronounced in the correct position, to a maximum of 24 for each of the trained items and the generalisation items. A sound was scored correctly if the child pronounced the phoneme in the correct position. The trained item ‘mat’ for example, had a score of 1 if a child produced the phoneme /m/ on its own. If a child produced the word ‘mum’ this also received a score of 1 as the phoneme /m/ was pronounced in the correct initial position. A score of 0 would be given if the word ‘tom’ was produced as no phonemes are in the correct position in the word. A maximum score of three was available to each word pronounced correctly or if the correct sounds for each of the three letters was produced. Refer to Chapter 3 for additional scoring examples. One of the generalisation words ‘put’ is normally pronounced as /pUt/, but it was expected that these children who were initially non-readers would not know this, so it would have been scored correctly if the vowel was pronounced as /ə/, as well as /U/. The latter response was not given by any child.

Table 13: Summary of pretest and posttest measures and the order in which they were given

<table>
<thead>
<tr>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own name reading</td>
<td>Own name reading</td>
</tr>
<tr>
<td>Word reading</td>
<td>Trained word reading</td>
</tr>
<tr>
<td>Own name spelling</td>
<td>Generalisation word reading</td>
</tr>
<tr>
<td>Word spelling</td>
<td>Own name spelling</td>
</tr>
<tr>
<td>Letter names</td>
<td>Trained word spelling</td>
</tr>
<tr>
<td>Letter sounds</td>
<td>Generalisation word spelling</td>
</tr>
<tr>
<td>Identity tasks: onset, coda, rime</td>
<td>Letter names</td>
</tr>
<tr>
<td>Blending tasks: syllable, onset-rime, phoneme</td>
<td>Letter sounds</td>
</tr>
<tr>
<td>Rhyme production</td>
<td>Identity tasks: onset, coda, rime</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>Blending tasks: syllable, onset-rime, phoneme</td>
</tr>
<tr>
<td></td>
<td>Rhyme production</td>
</tr>
</tbody>
</table>

*Not reported in this Study

Posttest spelling. The same trained words and generalisation words were used in the spelling measures and also administered separately. The spelling words were presented in the same order as the reading words. The children had nine letters placed in front of them, made up of the seven taught letters and an additional ‘m’ and ‘p’ to enable the spelling of the words ‘mum; and ‘pop’ in
the trained words spelling task, and the word ‘pup’ in the generalisation word spelling task. In the trained word spelling task the children were not reminded that these were the words that they had learnt. The experimenter pronounced each word clearly to the child, repeating it if necessary and the children had as long as they needed to attempt the spelling of each word. After the child had attempted a word the letters were returned to the front of the child before the next word was provided. No feedback was provided other than general praise and encouragement. The generalisation word spelling task was presented in the same way.

The spelling words were scored in the same way as for the reading words with a score to the maximum of eight for each task for the number of words spelt correctly, and a score out of 24 for the correct spelling of each phoneme in the correct position. Inadvertently, however, one of the generalisation words, ‘put’ was pronounced as the word /pUt/ instead of /pat/ which is the vowel spelling the children had learnt. To account for this the vowel in this word was not scored so the maximum phoneme score was 23. The word was not included in the total words correct score so the maximum words correct score was 7. When a child used more than three letters in the spelling of a word the first three letters were used to score the correct phonemes, hence it was possible for a child to receive a correct phoneme score of 3 for a word, but not have the word scored correctly due to there being too many letters. An example of this would be the spelling of ‘mum’ as MUMTPA. It would receive a score of 0 for word correct, but a correct phoneme score of 3. A score of 2 would go to the spelling of ‘mum’ as MUA or TUM. A score of 1 would go to spellings of MAP or PUT and a score of 0 to PTUMP. Although this 0 scoring has a spelling of UM within it, they are not in the correct position.

Procedure and description of training

The same experimenter completed the pretests, training, and posttests in a quiet corner of children’s kindergartens or in the staff office which was unoccupied during kindergarten sessions. The training consisted of 12 individual sessions with the each child. The control group were given a pre-math worksheet to work on at each of the 12 sessions. The children practised writing the numerals 1-10 and counted objects on the page. It was attempted to spend as much time with the children in this group as with the children in the experimental groups to control for Hawthorne effects. A random selection of the children in the control condition was timed to check that they spent the same amount of time with the experimenter (n = 7). The mean amount
of time spent with the experimenter across the 12 sessions was 70.84 minutes ($SD = 16.13$, range 53.62 – 103.76). This was more than the total average time spent with experimenter by the experimental groups across 12 sessions (see Table 14).

**Letter training**

For the experimental groups the first two sessions were letter training sessions in which the children were taught the seven letters that formed the trained words. Letter-training was given to ensure the children were familiar with the letter names or letter sounds on which the reading or spelling instruction was dependent. The LSR and LSS groups received explicit letter sound instruction, adapting the techniques employed by the Jolly Phonics program (Lloyd, 1992). For each of the trained letters children were given the sound of the letter, and then given an action and short story by which to remember the sound by. The letters and their storylines that were used in the letter sound training are provided in Appendix E. The top half of Table 13 shows the structure of the letter-sound sessions for the LSR and LSS groups. Children were first shown the seven letters one at a time, and demonstrated the sound and storyline. After they had been shown each of the seven letters the experimenter randomly chose each of the seven letters from the array in front of the child and asked what sound that letter made until all letters had been presented. This random choosing of the letters so that each letter was presented once was repeated twice in the second letter-training session. Corrective feedback was given for each response, and if incorrect the child had to repeat the sound after the experimenter verbalised it.

The CR and CS groups received instruction in the names of letters in keeping with the philosophy underlying these conditions. As shown in Table 14 these two groups were first demonstrated the name of the letter, and asked to repeat it after the experimenter. This was followed by the experimenter randomly choosing each of the seven letters from the array and asked the child what that letter was called. This was repeated three times, and again in the second letter-training session. Corrective feedback was given after each response, and the child had to repeat the letter name after the experimenter if they had been incorrect. The CR and CS groups had more presentations of letters than the LSR and LSS groups to ensure children spent the same amount of time learning the letters. A random selection of children in each condition was timed to check if this occurred. This was not achieved with the LS conditions still taking longer for the children who were timed, $F(1, 38) = 30.15, p < .01$. 

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Table 14: Description of training sessions and mean total time across sessions for a selection of the sample

<table>
<thead>
<tr>
<th></th>
<th>Context conditions</th>
<th>Letter-sound conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CR</td>
<td>CS</td>
</tr>
<tr>
<td><strong>Letter training 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child asked</td>
<td>Demonstration</td>
<td>Child asked</td>
</tr>
<tr>
<td>Repeat x 3</td>
<td>Repeat x 3</td>
<td>Repeat x 3</td>
</tr>
<tr>
<td><strong>Letter training 2</strong></td>
<td>Child asked</td>
<td>Child asked</td>
</tr>
<tr>
<td>Repeat x 3</td>
<td>Repeat x 3</td>
<td>Repeat x 2</td>
</tr>
<tr>
<td><strong>Mean total time</strong></td>
<td>6.40 (1.82)</td>
<td>5.24 (2.22)</td>
</tr>
<tr>
<td></td>
<td>n = 12</td>
<td>n = 11</td>
</tr>
<tr>
<td><strong>Word intro</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1 &amp; 6)</td>
<td>Demonstration</td>
<td>Demonstration</td>
</tr>
<tr>
<td>Repeat x 4</td>
<td>Repeat x 4</td>
<td>Repeat x 4</td>
</tr>
<tr>
<td><strong>Word training</strong></td>
<td>Child attempt</td>
<td>Child attempt</td>
</tr>
<tr>
<td>(2-5 &amp; 7-10)</td>
<td>Demonstration</td>
<td>Demonstration</td>
</tr>
<tr>
<td>Repeat</td>
<td>Repeat</td>
<td>Repeat</td>
</tr>
<tr>
<td><strong>Mean total time</strong></td>
<td>38.18 (9.90)</td>
<td>54.01 (9.68)</td>
</tr>
<tr>
<td></td>
<td>n = 9</td>
<td>n = 6</td>
</tr>
</tbody>
</table>

*Note.* Total *n* in each condition is 16. The *n* reported are the number of children in each condition who were timed.

*Time in minutes*

**Word-training**

The word training sessions followed the letter training sessions. There were a total of 10 word training sessions, each occurring on a different day. Four of the eight trained words were taught in the first five sessions, and the remaining four in the second five sessions. The words used in
the training sessions are given in Table 12. The words were separated to make it easier for the children to learn, by minimising the number of words they were exposed to at one time. In addition, five sessions for each set of words was decided upon based on findings that children can learn words after only four presentations (Reitsma, 1983). The words to be trained first were randomly selected at the time of the training. The first session for each set of words (sessions 1 and 6 in Table 14) introduced the children to the words they were learning. In the spelling conditions they were shown the words once and had to copy the experimenter’s spelling. In the reading conditions the children were shown the words four times, and had to repeat each word after the experimenter. More presentations were made in the reading conditions to equate for the time the children in the spelling conditions spent manipulating the letters in their copying of the spellings.

The next four sessions for each set of words (sessions 2-5 and 7-10 in Table 14) consisted of the children attempting to either read or spell the four current training words, followed by corrective feedback. The words were then again demonstrated by the experimenter and either repeated (in the reading conditions) or copied (in the spelling conditions) by the child. As with sessions 1 and 5 the reading conditions the children were asked what each word was twice (an isolated response) and there were two demonstrations to equate for the time the children in the spelling conditions spent manipulating letters. As can be seen by the mean total time spent learning in Table 14 this was not quite achieved with a significant difference between the experimental groups, \( F(3, 26) = 3.21, p < .05. \) Tukey post-hoc tests indicated that this was due to a significant difference between the CR (\( M = 38.18 \) minutes) and CS (\( M = 54.01 \) minutes) groups.

**Contextual reading (CR).** In the demonstrations children were shown the page with the target word embedded in the printed sentence, for example “My mouse makes a good pet” (see Appendix F for all the stimuli). The experimenter then read the sentence aloud while pointing to each word. The experimenter then pointed to the target word which was highlighted by a red circle, and said it to the child, for example “This word is pet, can you say pet?” The child was corrected if they repeated the entire sentence. In the isolated responses children were shown the page with the experimenter pointing to the target word. The experimenter asked the child to “tell me what this word is”. If the child gave the correct word they were praised and the experimenter again read the sentence while pointing to each word. If the child provided an incorrect word, or
gave no reply the experimenter provided the word and asked the child to repeat it. This was also followed by a rereading of the sentence.

**Letter-sound reading (LSR).** In the demonstrations children were shown the target word printed on an index card, for example, pet. The experimenter then read the word by saying the sounds and blending them together, for example saying “/p/ /e/ /t/, pet” while pointing to each letter, then running a finger under the word as the whole word was pronounced. The children were then asked to repeat how the experimenter had sounded out and blended the target word. In the isolated responses children were asked to read each of the words themselves. If the child gave the correct word they were praised and the experimenter again sounded and blended the word. If the child gave an incorrect word, or gave no response, the experimenter provided the same dialogue as in the demonstrations.

**Contextual spelling (CS).** In the demonstrations the children were presented with the page that had the target word embedded in a sentence, such as “My mouse makes a good pet” (see Appendix F for stimuli), but the target word, in this example pet, was covered. The experimenter read the sentence aloud, repeating the covered target word. The child was then told that they were going to spell the covered word. The experimenter then provided the sound, followed by the letter name, while selecting the appropriate plastic letter from their own set of letters, for example, “/p/, p, /e/, e, /t/, t, spells pet”. The presentations of letter-sounds were followed immediately by the letter-name so that the sounds in the spoken words were connected to letter-names, they were not explicitly referred to at any time. The children then had to copy the word after the experimenter while being encouraged to produce the letter name at the same time, after which they could remove the sticky paper covering the word and the experimenter repeated the sentence. In the isolated responses the experimenter again read the sentence, repeating the target word, and this time telling the child it was their turn to spell the covered word, using their plastic letters. If the child produced the correct spelling they were praised and the experimenter pointed to each of the child’s letters while saying the sound and name of each, finally saying the word and rereading the sentence to the child, removing the sticky paper covering the word so that the child could see it. If the child produced an incorrect spelling, or made no attempt, the experimenter followed the same procedure as for the demonstration.
Letter-sound spelling (LSS). In the demonstrations the children were presented with an index card, as also used in the LSR condition. In this condition the card was presented with the word face-down to the table. The children were told that the word they were going to try to spell, for example, pet, was on the other side of the card. The experimenter segmented the sounds in the word while selecting the appropriate plastic letters from their own set of letters, for example, “pet, /p/, /pə/, /ɛ/, /pɛt/, /t/, pet”. The children then had to copy the spelling of the word with their plastic letters, and were encouraged to produce the sounds as they did so. The letter names were never given by the experimenter and if a child produced a letter name the experimenter instead provided the letter sound. Once the child had attempted the spelling they could turn the card over to check the spelling. In the isolated responses the card was also presented face down on the table in front of the child as the experimenter presented the target word aloud. The child attempted spelling the word themselves and was able to turn the card over when they had finished. If the child produced the correct spelling they were praised and the experimenter pointed to each letter in the child’s spelling while saying the sounds, finally saying the word aloud and confirming with the child that the letters on the card and in their spelling were the same. If the child produced an incorrect spelling, or made no attempt, the experimenter followed the same procedure as in the demonstrations.
Chapter 8: Results

The purpose of this study was to assess the learning of phonological awareness as a result of literacy instruction. It was a short-term study that included an intervention in literacy instruction. The main aim was to examine the learning and development of rime awareness and explicit phoneme manipulation ability in order to test a proposed model of phonological awareness (see Figure 12). A secondary aim was to examine word learning across different methods of instruction. This study adds to existing studies in that it enables the examination of individual influences of learning to read and learning to spell without the confounding influence of learning both these skills in a formal environment at the same time. This chapter presents the results of the training intervention.

In this study the influence of instruction on phonological awareness, and particularly phoneme awareness, was examined to test a proposed model of phonological awareness development (see Figure 13). It was hypothesised that all children would improve in rime awareness across time due to maturation and vocabulary development and that pretest rime awareness and letter-sound knowledge would contribute to phonemic awareness gains. It was hypothesised that instruction that includes explicit letter-sound instruction would increase phoneme awareness. For those who did not receive explicit letter-sound instruction, learning to spell would increase phoneme awareness.

In this section phonological awareness gains are analysed by ANCOVAs on posttest scores with pretest scores as the covariate across all conditions. The main effects show learning while the covariate F-scores are taken to indicate development of phonological awareness over the time of the intervention. To further examine the development of the latent variable of phoneme awareness multiple regression was used to provide further evidence of the potential indicators of phoneme awareness development.

The second aim is to examine word learning and the influence of different methods of instruction on word learning. It was hypothesised that explicit letter-sound instruction provided knowledge to use explicit recoding in reading and spelling. It was hypothesised that groups who did not receive explicit letter-sound instruction would have to develop orthographic representations in this short-term study and so would not be able to attempt generalisation words. It was predicted
that children who learned to spell would find reading words easier than would children learning to read find spelling. This would be because the spelling of words ‘fixes’ orthographic representations in the orthographic lexicon in a way that reading words does not. The learning of words was examined by one-way ANOVAs for each word reading and spelling measure. One-way ANOVAs were used so that the control condition was included in the analysis of learning. This was to ensure that any gains were due solely to the experimental intervention and not to some other undetected variable (Troia, 1999).

In the final section differences in children’s word-learning ability is compared using two ANCOVAs. In the first children are grouped by their letter-name knowledge to examine the role letter-names play in acquiring word reading and spelling ability. Letter-sound knowledge is the covariate in this analysis. In the second ANCOVA children are grouped by their pre-existing letter-sound knowledge to examine if letter-sound knowledge is important for the development of early word reading and spelling. Letter-name knowledge is the covariate to control for the lack of independence between letter-name and letter-sound knowledge. These results were confirmed by analysing the reading and spelling errors of the letter-name groups and the letter-sound groups. In all the following analyses the alpha level was set at $p < .05$ because of the smaller sample size than was the case in Chapter 4.

**Learning and development of phonological awareness**

The first analyses examined the learning and development of phonological awareness across conditions. To examine both learning and development for each phonological awareness measure of phonological awareness a series of univariate ANCOVAs were conducted on posttest scores with the pretest score of each measure used as the covariate. Learning due to the intervention would be indicated by significant main effects. The pretest and posttest scores are shown in Table 15. There were no significant differences between each of the conditions on any of these measures at pretest (see Table 11). Significant learning of phonological awareness due to the intervention was found only for phoneme blending, and to a lesser extent for onset-rime blending. The significant learning of phoneme blending is evident only in the LSR condition who performed significantly better than the other experimental conditions and the control group. The significant learning of onset-rime blending is only evident in the LSR condition and only compared to the LSS experimental condition.
Table 15: Mean (SD) Pretest and posttest scores for all conditions with ANCOVA F scores for posttest comparisons

<table>
<thead>
<tr>
<th>Reading conditions</th>
<th>Spelling conditions</th>
<th>Main effect</th>
<th>Covariate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CR</td>
<td>LSR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pre Post</td>
<td>Pre Post</td>
</tr>
<tr>
<td>Letter Names</td>
<td></td>
<td>9.06 (7.21)</td>
<td>11.63 (5.94)</td>
</tr>
<tr>
<td>Sounds</td>
<td></td>
<td>1.63 (2.31)</td>
<td>2.06 (3.21)</td>
</tr>
<tr>
<td>Identitya Onset</td>
<td></td>
<td>3.06 (2.72)</td>
<td>3.75 (2.02)</td>
</tr>
<tr>
<td>Final</td>
<td></td>
<td>3.00 (2.22)</td>
<td>3.81 (2.43)</td>
</tr>
<tr>
<td>Rime</td>
<td></td>
<td>3.69 (3.24)</td>
<td>6.06 (3.49)</td>
</tr>
<tr>
<td>Blendingb Syllable</td>
<td></td>
<td>2.25 (1.57)</td>
<td>3.00 (1.41)</td>
</tr>
<tr>
<td>Onset-rime</td>
<td></td>
<td>2.88 (1.71)</td>
<td>3.69 (1.54)</td>
</tr>
<tr>
<td>Phoneme</td>
<td></td>
<td>.38 (.89)</td>
<td>.75 (1.70)</td>
</tr>
<tr>
<td>Rhyme productionc</td>
<td></td>
<td>4.94 (6.02)</td>
<td>8.63 (7.14)</td>
</tr>
</tbody>
</table>

Note: n = 16 for all groups

*a maximum = 10,  
ah maximum = 5,  
c maximum = 25

*p < .05, **p < .01, ***p < .001
The development of phonological awareness is reflected in the covariate F-scores shown in the final column of Table 15. This effect shows the influence of time on the phonological awareness posttest measures rather than the effects of the intervention. This effect shows that phonological awareness, measured using the identity, blending and rhyme production tasks, developed significantly across all conditions including the control group. This is especially relevant as there was little learning as a result of the intervention. Performance on the coda identity task showed the least development, but the development of both rime and phoneme awareness continued during the intervention. Although it didn’t reach significance in the analyses it is important it note that the control group made little to no gains in the rime awareness measures of rhyme production and rime identity. They did make gains in the onset-rime blending task, which may have been a result of learning in the task procedure in which the child discovers the correct response directly after their response. They made no gains at all in rhyme production and in the rime identity task the mean stayed the same although the variance reduced. The development of rime awareness, indicated by the effect of time on pretest and posttest comparisons was expected as the first hypothesis. However, because it did not develop consistently for the control group it may be a residual effect of intervention rather than development per se.

Although the intervention can explain the learning of phoneme blending abilities in one condition there was little effect on any of the other phoneme awareness measures, namely onset identity. Interestingly, in coda identity the mean score of the two spelling conditions actually decreased. Overall no differences were detected among groups and the other conditions did improve, still showing overall development. The proposed model of phonological awareness development (see Figure 11) suggests that earlier rime awareness, along with earlier letter-sound knowledge, would predict the development of phoneme awareness. A hierarchical regression analysis was used to examine the predictive nature of letter-sound knowledge and rime awareness on phoneme awareness while also controlling for the effects of learning within conditions. This model of phoneme awareness development was earlier tested without including the final phoneme identity measure (see Chapter 4) so it will not be included in this test of the model. The previous analysis did not show any discernable difference in development between the proposed sensitivity and manipulation measure thus they are combined in the current analysis as they were in Chapter 4.
The regression analysis allows for longitudinal prediction rather than concurrent correlations. In this regression analysis, see Table 17, pretest phoneme awareness was entered at the first step as the autoregressor. The auto-regressive technique is used to ensure that the independent variables continue to contribute to growth in phoneme awareness and is not just due to the relationship with pretest phoneme awareness. The control variable of vocabulary was not significant in the regression analysis in Part 1 so was not entered into this regression. Letter-name knowledge was also not entered as it did not remain significant after letter-sound knowledge was entered in Part 1 (see Table 6). The control variable of condition was entered second, with pretest rime awareness and pretest letter-sound knowledge entered next, respectively. Condition was entered after the autoregressor as it could also be influenced by the auto-regressor.

Table 16: Summary hierarchical regression analysis with posttest phoneme awareness as the dependent variable ($n = 64$)

<table>
<thead>
<tr>
<th>Step</th>
<th>Predictor</th>
<th>$R^2$</th>
<th>$\Delta R^2$</th>
<th>$\Delta F$</th>
<th>Final $\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pretest phoneme awareness</td>
<td>0.33</td>
<td>0.33**</td>
<td>37.58</td>
<td>0.38**</td>
</tr>
<tr>
<td>2</td>
<td>Condition</td>
<td>0.31</td>
<td>0.00</td>
<td>0.41</td>
<td>-0.06</td>
</tr>
<tr>
<td>3</td>
<td>Pretest rime awareness</td>
<td>0.36</td>
<td>0.06*</td>
<td>6.94</td>
<td>0.21*</td>
</tr>
<tr>
<td>4</td>
<td>Pretest letter-sound knowledge</td>
<td>0.40</td>
<td>0.05*</td>
<td>6.08</td>
<td>0.25*</td>
</tr>
</tbody>
</table>

**$p < .001$  
*p < .05

The autoregressor, entered first, had the strongest predictive power, $\Delta R^2 = .32$, $F(1, 78) = 37.58$, $p < .001$. The control variable of letter-training condition was entered next and was not a significant predictor of phoneme awareness development, $\Delta R^2 = .00$, $F(2, 77) = 0.41$, $p =$n.s. At the third step pretest rime awareness was a significant predictor $\Delta R^2 = .06$, $F(3, 76) = 6.92$, $p < .05$. Pretest letter-sound knowledge retained its predictive power, $\Delta R^2 = .05$, $F(4, 75) = 6.08$, $p < .05$. Pretest rime awareness and letter-sound knowledge contribute to the development of phoneme awareness over the contribution of already existing phoneme awareness.
Summary

To summarise, rime awareness developed over time independent of the type of literacy instruction. Although the analyses do not show a significant effect the control group did not have higher rime awareness scores at posttest. Phoneme awareness also developed over time, largely independent of the reading or spelling intervention. This development was influenced by prior letter-sound knowledge and rime awareness. Explicit phoneme awareness measured by a phoneme blending task was, however, learnt by the condition in which blending was a part of the explicit reading instruction.

Influences on word-reading and word-spelling

This section examines the types of learning methods that children are best able to utilise very early in formal literacy instruction and word learning, be it in reading or spelling. It also examines how children develop in their ability to read and spell where no learning occurred during the intervention. Learning and development of letter-knowledge is first examined using ANCOVAs on the posttest letter-name and letter-sound measures and pretest knowledge as the covariate. Word-learning from the intervention is examined using ANOVA with condition as the dependent variable. Development of word reading and spelling is then examined in two analyses. The first used pretest letter-name knowledge as the independent variable and the second uses pretest letter-sound knowledge as the independent variable.

Letter-knowledge learning and development is shown in Table 15. The ANCOVA results showed that there were significant differences in letter-name posttest scores between the CR and control conditions, suggesting that the CR condition did learn some letter-names. No other significant differences as a result of learning were found. There was significant development of letter-knowledge across all conditions. However, revision of the pretest and posttest scores in Table 15 indicates that the CR and CS conditions, who received letter-name instruction had a mean increase of two letter names compared to the other conditions who ranged from a mean increase of -.25 in the control condition to 1.19 in the LSS condition. The results of the ANCOVA conducted on the learning of letter-sounds showed no difference in the learning of letter-sounds between conditions. However, letter-sound knowledge did develop between pretest
and posttest for all conditions, regardless of receiving instruction in letter-sounds (LSR and LSS) or not (CR, CS, and Control).

Table 17: Analysis of variance for experimental group performance on word learning

<table>
<thead>
<tr>
<th></th>
<th>Reading</th>
<th>Spelling</th>
<th>Control</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CR</td>
<td>LSR</td>
<td>CS</td>
<td>LSS</td>
</tr>
<tr>
<td><strong>Reading</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trained words</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWR(^a)</td>
<td>.13</td>
<td>1.13</td>
<td>.50</td>
<td>.81</td>
</tr>
<tr>
<td></td>
<td>(.50)</td>
<td>(1.71)</td>
<td>(.82)</td>
<td>(1.11)</td>
</tr>
<tr>
<td>TWRphoneme(^b)</td>
<td>1.75</td>
<td>4.88</td>
<td>1.94</td>
<td>3.56</td>
</tr>
<tr>
<td></td>
<td>(4.07)</td>
<td>(6.49)</td>
<td>(2.35)</td>
<td>(4.31)</td>
</tr>
<tr>
<td>Generalisation words</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GWR(^a)</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
<td>.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GWRphoneme(^b)</td>
<td>.75</td>
<td>2.13</td>
<td>.44</td>
<td>1.38</td>
</tr>
<tr>
<td></td>
<td>(1.95)</td>
<td>(2.66)</td>
<td>(1.03)</td>
<td>(2.53)</td>
</tr>
<tr>
<td><strong>Spelling</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trained words</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWS(^a)</td>
<td>.13</td>
<td>.25</td>
<td>1.31</td>
<td>1.56</td>
</tr>
<tr>
<td></td>
<td>(.34)</td>
<td>(.58)</td>
<td>(1.89)</td>
<td>(2.22)</td>
</tr>
<tr>
<td>TWSletter(^b)</td>
<td>3.25</td>
<td>3.81</td>
<td>8.06</td>
<td>9.25</td>
</tr>
<tr>
<td></td>
<td>(3.03)</td>
<td>(4.58)</td>
<td>(5.95)</td>
<td>(7.01)</td>
</tr>
<tr>
<td>Generalisation words</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GWS(^a)</td>
<td>.00</td>
<td>.25</td>
<td>.25</td>
<td>.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GWSletter(^b)</td>
<td>2.75</td>
<td>2.87</td>
<td>3.50</td>
<td>5.69</td>
</tr>
<tr>
<td></td>
<td>(2.67)</td>
<td>(4.19)</td>
<td>(4.98)</td>
<td>(5.57)</td>
</tr>
</tbody>
</table>

*Note: n = 16 in all conditions*

\(^a\)maximum number of words correct is 8

\(^b\)maximum number of phonemes correct is 24

**\(p < .01\)**
There were two main dependent variables in these analyses, trained words (TW) and generalisation words (GW). The trained words are the eight words taught to the experimental conditions. The generalisation words are the eight words constructed using the same seven letters as the trained words. The trained words were measured by reading (TWR) and spelling (TWS), as were the generalisation words (GWR and GWS, respectively). Each of these four measures are word correct scores, but there was also a phoneme correct score in reading (TWRphoneme and GWRphoneme) and a letter correct score in spelling (TWSletter and GWSletter). The number of words correct is taken to indicate the storage of word-specific orthographic representations in the orthographic lexicon. For the phoneme and letter score there had to be the correct pronunciation of phonemes in the correct position for reading, and the correct representation of letters in the correct position for spelling. This sub-word measure was included as few children could read or spell correctly, but could make close approximations.

**Word learning**

To examine the instructional effects on very early word learning an ANOVA was run on all conditions to discover if any learning occurred as a result of the intervention. The means, standard deviations and ANOVA results are shown in Table 17. There was no evidence of learning as a result of the intervention except in TWS and TWSletters. The LSS condition showed significant learning compared to the control and CR in TWS, showing significantly more whole words spelt correctly. The LSS condition also correctly represented the sounds in words using the correct letters significantly more than all conditions except the other spelling condition, CS. The CS condition did not, however, show significant learning compared to the other conditions.

**Development of word reading and spelling ability**

Significant learning only occurred for the spelling condition that also received short instruction in letter-sounds. However, there is still evidence of posttest word reading and spelling across conditions. This includes the control condition who was not taught any of the relevant letters or words. An examination of the effect of pre-existing letter-name and letter-sound knowledge on the development of early word-reading and word-spelling ability was carried out. To do so,
children were grouped according to their letter-knowledge. The 80 children kept the letter-name group membership that they held in Part 1 (see chapter 5). This meant that there were three groups, low letter-name (LLN) knowledge \((N = 18, M = 1.56, \text{range } 0-3)\), average letter-name (ALN) knowledge \((N = 52, M = 9.58, \text{range } 4-19)\), and high letter-name (HLN) knowledge \((N = 10, M = 22.80, \text{range } 21-25)\). Three letter-sound groups were also formed, low letter-sound (LLS) knowledge \((N = 52)\), average letter-sound (ALS) knowledge \((N = 13, M = 1.62, \text{range } 1-3)\) and high letter-sound (HLS) knowledge \((N = 15, M = 6.87, \text{range } 5-18)\). Children tended to be members of the same equivalent groups across letter-name and letter-sound knowledge. A child with high letter-sound knowledge, for example, tended to also be in the high letter-name group but this was not always the case. Figure 12 illustrates this with the sample of 110 children that the 80 children in the current study were drawn from.

Although letter-name knowledge and letter-sound knowledge may differently effect word reading and spelling development they are not independent. To control for this individual analyses were carried out using ANCOVAs with pretest letter-sound knowledge and pretest letter-name knowledge as co-variates respectively. It must be noted that the control group was also included in these analyses although the variable labels of trained words and generalisation words are misnomers. However, the control condition is equally represented among ability level groups as expected based on the range-matching of children into the experimental conditions from pretest variables. The means, standard deviations and ANOVA results are shown in Table 19.

**The role of letter-name knowledge**

To examine the role of letter-name knowledge on the development of reading and spelling ability ANCOVAs with pretest letter-sound knowledge as the co-variate were conducted on each of the reading and spelling measures. There were significant differences between letter-name knowledge groups on the whole-word correct measures for the trained words, TWR and TWS. This was due to the HLN group reading and spelling more words than both the LLN and ALN groups. This was repeated in the TWRphoneme measure, and with the HLN group making better spelling attempts in the TWSletter measure.

ANCOVAs could not be conducted on the generalisation whole-word correct measures, GWR and GWS. Only the HLN group read any generalisation words correctly. On the GWS measure
the LLN group did not spell any words correctly so a t-test was conducted between the ALN and HLN groups. The HLN group spelt significantly more generalisation words correct than the ALN group, \( t(60) = 3.25, p < .01 \). There were no differences between ability groups on the letter- and phoneme-level measures on the generalisation words. Thus, letter-name knowledge appears to have a relationship with early reading and spelling at whole-word level, but not at the letter- or phoneme-level attempts for unfamiliar words.

**The role of letter-sound knowledge**

To examine the role of letter-sound knowledge on the development of reading and spelling ability ANCOVAs with pretest letter-name knowledge as the co-variate were conducted on each of the reading and spelling measures. In contrast to the previous analysis there were no significant differences between ability groups on the whole-word correct measures. As with the letter-name groups, the LLS group did not score on the GWR and GWS whole-word measures. The ALS did not score on the GWR measure but did on the GWS so a t-test was carried out to compare the performance of the two groups. Following the pattern of no group differences on the whole-word correct measures, there was no significant difference between the ALS and HLS groups, \( t(26) = 1.10, p = n.s \) on the GWS measure.

There were significant differences between letter-sound ability groups at the letter- and phoneme-level measures for the generalisation words, GWRphoneme and GWSletter, which no children had been taught. The HLS group made more phoneme correct responses when reading the generalisation words than the LLS and ALS conditions. This is of particular interest as there was no significant covariate effect of letter-name knowledge. Thus, letter-sound knowledge has a particularly strong relationship with this measure. The HLS group also made more letter-level attempts on the GWSletter measure than the LLS group. Thus, letter-sound knowledge appears to have a relationship with phoneme and letter-level attempts at reading and spelling, and especially in words that are unfamiliar to all children.
Table 18: Analysis of co-variance for letter ability group performance on reading and spelling measures

<table>
<thead>
<tr>
<th>Letter-name ability&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Letter-sound ability&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLN (&lt;i&gt;n&lt;/i&gt; = 18)</td>
<td>ALN (&lt;i&gt;n&lt;/i&gt; = 52)</td>
</tr>
<tr>
<td>Trained words</td>
<td>TWR&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TWRphoneme&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Generalisation</td>
<td>GWR&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>GWRphoneme&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Spelling</td>
<td>TWS&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>TWSletter&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Generalisation</td>
<td>GWS&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>GWSletter&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>L = low, A = average, H = high, LN = letter-names, LS = letter-sounds, <sup>b</sup>maximum number of words correct is 8, <sup>c</sup>maximum number of phonemes correct is 24

<sup>*</sup><i>p</i> < .05, **<i>p</i> < .01
Summary

Learning of the trained words did not occur in the experimental conditions. Learning of spelling did occur in the LSS condition, specifically compared to the control and CR conditions. There were no differences on whole-word attempts or on letter-level attempts between the two spelling conditions, suggesting that the process of learning to spell did facilitate some learning of phoneme to grapheme correspondences. For early word reading and spelling, letter-name knowledge appears to play a role in the early development of word-level orthographic representations in the accurate reading and spelling of words. This is specific to words that most of the children had already experienced during the intervention, as only the children with high letter-name knowledge were able to attempt the unfamiliar words. In contrast, children’s letter-sound knowledge has a role in the attempts at reading and spelling of words. When controlling for letter-name knowledge this is particularly evident for words that are unfamiliar to the beginning readers and spellers.

To confirm that letter knowledge is the key to word learning, and not just phoneme awareness, children were grouped into three groups based on pre-existing phoneme awareness using a composite phoneme score consisting of the percentage of responses correct. The low phoneme awareness group had a mean pretest phoneme score of 5.07 \( (n = 15) \), the average phoneme awareness group had a mean pretest score of 21.93 \( (n = 27) \), and the high phoneme awareness group had a mean pretest score of 43.09 \( (n = 22) \). There were no significant differences between the phoneme awareness groups on any of the word measures. These results indicate that letter knowledge contributes to word learning and the use of phonological recoding.
Table 19: Mean percentage of error types in reading trained words and generalisation words for letter-name and letter-sound ability groups

<table>
<thead>
<tr>
<th></th>
<th>Letter-name ability groups</th>
<th></th>
<th>Letter-sound ability groups</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LLN ($n = 18$)</td>
<td>ALN ($n = 52$)</td>
<td>HLN ($n = 10$)</td>
<td>LLS ($n = 52$)</td>
</tr>
<tr>
<td></td>
<td>$F(2, 77)$</td>
<td>$F(2, 77)$</td>
<td>$F(2, 77)$</td>
<td>$F(2, 77)$</td>
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<tr>
<td>Trained</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sublexical</td>
<td>13.19 (28.27)</td>
<td>17.98 (34.62)</td>
<td>27.42 (40.80)</td>
<td>17.85 (35.31)</td>
</tr>
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<td>23.91 (34.10)</td>
<td>26.45 (40.19)</td>
<td>30.00 (48.30)</td>
<td>24.14 (39.39)</td>
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<tr>
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<td>62.90 (40.98)</td>
<td>55.56 (45.50)</td>
<td>42.58 (46.59)</td>
<td>58.01 (45.12)</td>
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<td>Refusals</td>
<td></td>
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</tr>
<tr>
<td>Totals</td>
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<tr>
<td>Generalisation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sublexical</td>
<td>25.00 (41.35)</td>
<td>18.51 (36.92)</td>
<td>25.00 (40.82)</td>
<td>21.63 (40.08)</td>
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<td>Word sub</td>
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<td>31.49 (42.69)</td>
<td>28.75 (40.42)</td>
<td>30.53 (43.12)</td>
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<td>Refusals</td>
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<td>50.00 (46.64)</td>
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<td>47.84 (47.47)</td>
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<td>Totals</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Table 20: Mean percentage of error types in spelling trained and generalisation words for letter-name and letter-sound ability groups

<table>
<thead>
<tr>
<th></th>
<th>Letter-name ability groups</th>
<th></th>
<th>Letter-sound ability groups</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LLN (n = 18)</td>
<td>ALN (n = 52)</td>
<td>HLN (n = 10)</td>
<td>LLS (n = 52)</td>
</tr>
<tr>
<td>Trained Letters</td>
<td></td>
<td></td>
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<td>F(2, 77)</td>
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<tr>
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<td>17.66 (19.13)</td>
<td>31.37 (26.33)</td>
<td>46.25 (42.92)</td>
<td>27.55 (26.97)</td>
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<td></td>
<td>5.06 (11.05)</td>
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<td>15.92 (27.49)</td>
<td>7.08 (14.67)</td>
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<td>77.28 (25.76)</td>
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<td>37.83 (41.12)</td>
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<tr>
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<tr>
<td>Totals</td>
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<tr>
<td>Generalisation</td>
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<td>Letters</td>
<td>15.28 (17.45)</td>
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<td>2.08 (4.79)</td>
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<td>42.50 (40.48)</td>
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<tr>
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<td>100</td>
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</table>

*p < .05, **p < .01, ***p < .001
Error analysis

The errors made by children during the reading and spelling of the trained and generalisation words were analysed. The average percentage of error types as a proportion of total errors in TWR and GWR are shown in Table 19. The reading errors in TWR and GWR were classified as sublexical errors (which were the provision of letter-names, the provision of letter-sounds or sounding-out with no correct whole-word response), word level errors (substitution of trained word or other read words), and refusal errors (no response or don’t know responses). The average percentage of errors types as a proportion of total errors in TWS and GWS are shown in Table 20. Spelling errors for TWS and GWS were classified similar to the reading errors with letter-level errors (correct representation of one or more letters but not spelling the word correctly), word level errors (substitution of trained or other real words), and refusal errors (no response or don’t know responses).

Error analyses for letter-name groupings

Analysis of variance was carried out on the individual error types for the letter-name groups. There were no significant differences on any of the reading errors but there were significant differences between groups in spelling errors. There were significant differences between LLN and HLN on every spelling error type except word substitutions in TWS. The HLN group made more sublexical level errors in the spelling of both the trained and generalisation words and made more word substitution in GWS. They also had significantly less refusal errors than LLN in the trained words, and significantly refusal errors than both LLN and ALN groups in the generalisation words.

Error analyses for letter-sound groupings

Analysis of variance was carried out on the individual error types for the letter-sound groups. The same pattern of results was found for the letter-sound groupings as was found for the letter-name groupings. There were no differences between the groups on any of the reading errors, but there were for the spelling errors. The HLS group made significantly less refusal errors than the LLS group in TWS and significantly less refusal errors than both LLS and ALS in GWS. In the word substitution errors the HLS group made significantly more than the LLS group in the
generalisation words, but the ALS group made significantly more than the LLS group in the trained words. Finally, the HLS group made significantly more letter-level errors in the generalisation words, but the same pattern did not reach significance in the trained words.

**Summary**

Different levels of letter-name or letter-sound knowledge did not make any difference to the types of errors made when reading the trained or generalisation words. Levels of letter-name and/or letter-sound knowledge did have an effect on the types of errors in spelling trained or generalisation words. Children with good letter-name and/or good letter-sound knowledge made more accurate attempts at spelling, with more word substitutions and less refusal errors than children with low letter-name and/or letter-sound knowledge. Among the even more unfamiliar generalisation words they also made more attempts the children with average letter-knowledge, evidenced by their lower number of refusal errors.

**Relationships among measures**

Correlations among the pretest variables and the posttest letter-knowledge, reading and spelling measures are shown in Table 21. Several points of interest arise from these correlations. The first is that the correlation between pretest and posttest letter-sound knowledge is relatively low compared to the correlation between pretest and posttest letter-name knowledge. This might suggest that letter-sound knowledge is less stable than letter-name knowledge. A second finding is that there are no significant correlations between TWS and GWR measures. This could suggest that the knowledge used to spell the trained words and to read the unfamiliar generalisation words was very different. Finally, there were no significant correlations between pretest coda identity and all other variables, highlighting the difficulty children had with this task. The negative correlations in the spelling measures reflect the drop in the mean correct score in the two spelling conditions.
Table 21: Intercorrelations between letter knowledge, pretest phonological awareness, and word reading and spelling measures

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Note. LN = letter-names, LS = letter-sounds, Onset id = onset identity, Coda id = final phoneme identity, Rime id = rime identity, Syll blend = syllable blending, O-R blend = onset-rime blending, Phon blend = phoneme blending, RP = rhyme production, pre = pretest, post = posttest.

*p < .05, **p < .01
Summary

This chapter provides the results of the tests of the hypotheses for Part 2. The first set of hypotheses were regarding the learning of phonological awareness abilities as a result of the intervention. There was little evidence of learning except for the LSR condition who learnt phoneme blending, the explicit phoneme awareness ability measured in posttests, as part of the intervention. The first set of hypotheses were also regarding the development of phonological awareness independently of the intervention. In this case phoneme awareness also appeared to develop independently of literacy intervention, when controlling for learning but rime awareness increases seemed restricted to the experimental conditions. Additionally, it was confirmed that letter-sound knowledge and rime awareness contributed to phoneme awareness.

The second set of hypotheses were regarding word-learning. No word-learning occurred specifically as a result of the intervention except for the LSS condition. This condition were taught letter-sounds and then to spell using these sounds. Compared to the other conditions they appeared to be better equipped to make letter-level attempts at spelling the trained words. The hypotheses also referred to the role of letter-knowledge in acquiring word reading and spelling abilities, thus the focus then moved to the role of letter-name and letter-sound knowledge in the development of early word reading and spelling ability. Children’s letter-name knowledge has a relationship with the development of orthographic representations of whole words. It did not seem to have a relationship with making accurate but incomplete attempts at reading or spelling on the unfamiliar generalisation words, especially with the reading of the generalisation words. This pattern held even though the control group were included in these analyses. In comparison, letter-sound knowledge appears to play a role in children’s accurate but incomplete attempts in reading and spelling words, especially in the unfamiliar generalisation words.
Chapter 9: Discussion

The purpose of this study was to examine the development of phonological awareness and phoneme awareness in beginning readers who are experiencing literacy instruction for the first time. It was expected that the study would provide support for a proposed model of phonological awareness development (see Figure 13). The main aim of the study was to examine the learning and development of phonological awareness over a short intervention phase. Two hypotheses were formulated to address this aim. The first hypothesis was that rime awareness will develop across time for all children. The second hypothesis was that pretest letter-sound knowledge and rime awareness will continue to contribute to phoneme awareness. Two additional hypotheses examined the influence of different methods of reading and spelling instruction on the development of phoneme awareness. It was first hypothesised that receiving explicit letter-sound instruction would lead to larger gains in phoneme awareness. The second hypothesis was that when no letter-sound instruction is received learning to spell would increase phoneme awareness.

A secondary aim of the study was to examine the influence of different methods of instruction in reading and spelling have on initial word learning. Three hypotheses were formulated to examine the influence of instruction. It was first hypothesised that receiving explicit letter-sound instruction will provide the knowledge to use explicit recoding for new words. The second hypothesis was that literacy intervention groups without letter-sound instruction would need to develop orthographic representations of words before they could use any form of recoding. Thirdly it was hypothesised that learning to spell strengthens orthographic representations and allows children to use those representations in reading as well as spelling.

The present study differs from the existing literature on the research in phonological awareness and word-learning in two important ways. The first difference is that this study provided an intervention in literacy instruction to children who have had no formal instruction, not even in letter knowledge. The second difference is the most important. By teaching children how to either read or to spell, but not both, this study removes the confounding influence of receiving instruction in learning to read and to spell at the same time. Thus the individual influences of learning to read and learning to spell can be examined. The individual influences can be
examined in terms of the development of phonological awareness and of word-learning. This study also contributes to existing literature by providing more research on the development and nature of phonological awareness. It also contributes to our knowledge of the early stages of word learning in beginning readers.

Development of phonological awareness

The results partially supported the hypothesis that rime awareness would continue to develop over time. As predicted by the proposed model of phonological awareness (see Figure 13) children in the current study increased in rime awareness, largely independent of the type of literacy intervention they received. Although not statistically substantiated the control group made little to no gains in rime awareness. Chapter 5 provides evidence that vocabulary could be a key contributor to rime awareness development, and so the literacy intervention may have influenced this by the incidental learning of new words into the listening vocabulary. Anthony et al. (2002) suggest that rime awareness continues to develop into the first year of school, and Lonigan et al. (1998) also found evidence that phonological sensitivity, such as rime sensitivity, shows strong developmental trends prior to beginning school.

Blaiklock (2004) also found that children who were just learning to read in a non-phonics environment continued to develop their rime awareness over the first two years of formal instruction, when mean scores on a rhyme identification task reached ceiling. Once children have begun school, between the ages of 5 and 6, their vocabulary lexicons grow further from between 2500 - 3000 at 4 years of age to 7000 - 10000 in first-grade (Walley, 1993). As a result the segmentation of words for the storage of phonological representations continues at the onset-rime level until it reaches a point at which phoneme segmentation of the lexicon is required, according to the lexical restructuring hypothesis (Walley, 1993; Walley et al., 2003). It is at this time that it would be expected that performance on rime awareness measures would be at ceiling.

Another important finding for the proposed model of phonological awareness development was support of the hypothesis regarding the contribution of letter-sound knowledge and rime awareness to phoneme awareness. The contribution of intervention condition was not significant even though two conditions also received letter-sound instruction. The possible reason for this was that the instruction was ineffective in teaching children new letter-sounds. These findings
provide further support for the finding in Part 1 that rime awareness contributes to phoneme awareness. The contribution of rime awareness to phoneme awareness supports the proposed model of phonological awareness development in which rime awareness and phoneme awareness together form the latent variable of phonological awareness (Anthony & Lonigan, 2004; Anthony et al., 2002). In addition, it also supports the model of phonological awareness development in which rime awareness contributes to phoneme awareness, even after controlling for phoneme awareness. It does not support the proposed distinction of phoneme sensitivity and explicit phoneme manipulation as the coda identity task, intended as a measure of phoneme sensitivity remained the most difficult task.

It was expected that children who receive literacy intervention in conjunction with letter-sound instruction would increase in phoneme awareness compared to children who received literacy intervention in conjunction with letter-name knowledge. The final expectation was that if children didn’t receive letter-sound instruction then learning to spell would contribute to increased phoneme awareness at posttest. The latter was not supported, and it may that they lack of word-learning, discussed in the next section, is an explanation for this. The former was only partially supported as all conditions made gains in their phoneme awareness, including the control condition. It was anticipated that the expected gains would be due to greater letter-sound knowledge from the instruction in letter-sounds. As there was no learning of letter-sounds specific to these conditions this was not supported. However, the LSR condition did make significant gains in the phoneme blending task which was taken to indicate early explicit phoneme manipulation abilities.

The LSR condition was taught blending to read words and thus it is task learning rather than phoneme awareness. This is especially relevant as they did not learn to read any words by the end of the intervention. They also increased slightly more in the onset-rime blending task, although only significantly more than the LSS condition, suggesting that it is task-specific to blending. Although it was expected that this method of reading instruction would be especially potent in developing phoneme manipulation it was expected that learning to spell with the same letter-sound instruction combined with letter manipulation would also show raised development of phoneme manipulation. Meta-analyses of phoneme awareness training has clearly found that letter-sound instruction with letters aids in phoneme awareness development (Bus & van
Ijzendoorn, 1999; National Reading Panel, 2000). This was not the case in the current study as only the LSR condition made significantly larger gains than the other conditions.

The implication here is that the phoneme manipulation measure did not measure latent phoneme manipulation, but was only a measure of what children had learnt. Learning to read may be a better aid in phoneme awareness if the reading instruction method requires the analysis of words as individual sounds, and the blending of those sounds together again, which is the hallmark of systematic phonics instruction (National Reading Panel, 2000). Although phoneme blending is one of the easier phoneme manipulation measures for use in pre-readers and beginning readers phoneme blending may best reflect a set of learnt skills rather than phoneme awareness. These learnt skills may not be particularly relevant even for learning to read. Castles and Coltheart (2004) also question whether phonological awareness can be measured as a latent variable or if it is simply a taught skill. They suggest that phoneme awareness cannot be derived from learning to read or spell but the tasks used to measure phoneme awareness actually measure what children are taught while they are learning to read or spell. In the current study, the manipulation measure of phoneme awareness was very similar to what children in the LSR condition had been taught to do.

**Summary**

The explicit teaching of phoneme awareness may bypass the associated requirement of letter-sound knowledge. Instruction in letter-sounds was not enough to trigger the development of phoneme awareness on its own. Learning of a phonological awareness ability did seem to occur in the LSR condition due to the task-specific nature of their posttest advantages. Hulme, Caravolas, Malkova, and Brigstocke (2005) also found that children could have phoneme awareness without having knowledge of the specific letter-sound correspondences. Phonological awareness of both rime and phoneme awareness did develop over time with phoneme awareness being predicted by pretest rime awareness and letter-sound knowledge as well as by prior letter-sound knowledge. Rime awareness also appeared to increase across all conditions but closer inspection reveals that the rime awareness of the control condition did not develop. One possibility is that vocabulary contributed to this as the children in the experimental conditions learnt what were possibly new words during the intervention.
Word-learning and the early development of reading and spelling ability

The last set of hypotheses were derived to examine what children learnt about written words through learning to read or learning to spell. It was first hypothesised that explicit letter-sound instruction would aid in the use of explicit phonological recoding and spelling. Both phonological recoding and phoneme-grapheme correspondences learnt from spelling would contribute to a general knowledge base for recoding. This hypothesis was only partially supported by the LSS condition being better able to attempt spelling the trained words than all other conditions. This condition was the only one to show evidence of word-learning. However, children with high pre-existing letter-sound knowledge did show evidence of better phoneme and letter-level attempts at reading and spelling, especially on the unfamiliar generalisation words.

The next hypothesis was that contextual-based instruction would not have explicit phonological recoding available but they would show evidence of orthographic storage of word representations. This was not supported but there was evidence of a link between letter-name knowledge and the storage of orthographic representations. This was indicated by the ability of children with high letter-name knowledge to read and spell the trained words. Finally it was hypothesised that learning to spell would provide greater opportunities for the storage of orthographic representations which would be shown in the transfer of word knowledge from spelling to reading. This was not supported due to the very low levels of learning across conditions.

Word-learning

There was little evidence of word-learning in the experimental conditions. Although research suggests that four presentations are enough to learn a word most of these studies were conducted on children who were already reading and spelling (Carnine, 1977; Levy, Bourassa, & Horn, 1999; Reitsma, 1983). The difficulty in teaching preschool children to read and spell has also recently been reported by Coltheart and Castles (2007). The only condition to show evidence of learning compared to the control condition was the spelling condition that also received letter-sound instruction. They were able to spell more of the trained words correctly compared to the control and CR conditions. They also correctly represented more sounds in words than all conditions other than the other spelling condition. Although the CS condition didn’t differ from
the other conditions, neither did they differ from the LSS condition, suggesting that they were learning, but possibly at a slower rate. They too were exposed to letter-sounds, but only to link the phonemes in the word to letter-names and were not explicitly discussed.

The words that children learnt were regular CVC words and thus can be spelt using alphabetic knowledge or by using stored orthographic representations (Martinet, Valdois, & Fayol, 2004). The step-wise literacy acquisition theory of Frith (1985; 1986) could also explain the current finding as it is alphabetic spelling that develops first and drives alphabetic reading. Thus it would be expected that children who learnt to spell the trained words would learn them faster. Although not significant, the other spelling condition did appear to learn to spell faster than the other conditions were learning to read words. The current results suggest that it was an alphabetic approach that the spelling conditions were using as it was in the letter-level measure that the spelling condition of LSS was significantly better than all other conditions other than the CS spelling condition. If it was the orthographic approach they would have been better at spelling the words correctly than the LSR condition as well as CR and the control conditions.

**Early development of word reading and spelling ability**

As there was little evidence of learning other than for the LSS condition the role of letter-knowledge was examined. The examination of letter-knowledge and the development of early word reading and spelling ability was conducted because even the children in the control condition were able to make accurate attempts at reading and spelling. Although the control condition did not receive any word-training the labels of trained and generalisation words are retained. As the hypotheses on word-learning also specified the role of letter-name and letter-sound knowledge in the intervention conditions these analyses examined it further.

*The role of letter-name knowledge*

The current findings suggest there is a role of letter-name knowledge in the acquisition of word reading and spelling ability. It was hypothesised that contextually-based conditions (i.e., CR and CS) would develop orthographic representations of words as they did not have explicit letter-sound instruction to provide them with an alphabetic strategy to read or spell. The contextually-
based conditions did receive letter-name instruction, but the level of word-learning was so low that it could not be examined. The role of pre-existing letter-name knowledge could be examined instead. This could be a proxy for contextual-based instruction by controlling for letter-sound knowledge. Thus, it would be expected that children with better letter-name knowledge would begin storing orthographic representations compared to children with little letter-name knowledge.

The current findings found that children with high letter-name knowledge were better at reading and spelling the trained words at posttest. They were also better, as would be expected, on the phoneme and letter-level measures of these words. In addition they were better than the average letter-name group on the spelling of the generalisation words. The first of these findings suggest that children with good letter-name knowledge are particularly better at storing orthographic representations of taught words, reflected by their significantly better performance on the spelling and reading of these words. That they were then also better able to attempt spelling the generalisation words may suggest that they may be using traces of the stored orthographic representations to attempt the spelling of unfamiliar words.

Previous research has also found that children begin to store orthographic representations early in beginning to read and to spell (Fletcher-Flinn & Thompson, 2000; 2004; Martinet et al., 2004; Reitsma, 1983). No research has linked it specifically to the level of letter-name knowledge that children have. Letter-name knowledge has been suggested to provide a link to phonemic sensitivity, and through this play a role in literacy acquisition (Noel Foulin, 2005). Others have suggested that children need instruction in letter-sound knowledge before they can begin to develop orthographic representations (Ehri & Snowling, 2004; Share, 1995). However, Share and Gur (1999) have suggested that there may be early word phase in which orthographic representations of words may be stored using memory of all the letters, even when there is little letter knowledge. The current findings suggest that perhaps the level of letter-name knowledge does influence the learning of words, but that until more letter-name knowledge is gained the orthographic representations are traces rather than complete representation, as illustrated by the proportion of word substitutions made by all letter-name ability groups in reading.

Share and Gur (1999) go on to suggest that it is related to writing or spelling because attention needs to be paid to all letters in a spelt word. This is true of the children in the current study
although children with higher letter-name and letter-sound knowledge learnt more of the taught words. The nature of spelling instruction forces attention to all letters in a word string, which may influence the acquisition of sight words in the orthographic lexicon, which could explain why only the spelling conditions, LSS specifically, learnt any words during the intervention. The greater number of word substitutions and letter-level errors, and less refusals, by children with high letter-name knowledge in spelling indicates that greater letter-name knowledge is better. The current study also suggests that the visuographic phase of Share and Gur does occur but that it also goes across the boundaries of reading and spelling. Thus children may begin to establish an orthographic lexicon of word representations but need more experience with those representations before they are able to apply the representations in any lexicalised recoding for new words. This is an area that can not be examined in the current study.

The role of letter-sound knowledge

It was hypothesised that receiving explicit letter-sound instruction would encourage the use of explicit recoding but it was not supported. A possible explanation for this is that the children who received letter-sound instruction did not increase in their letter-sound knowledge. This is likely to be because the instruction was not long enough and was too abstract for the children’s pre-existing letter-name knowledge (Share, 2004). To examine the role of letter-sound knowledge outside the literacy intervention children were grouped according to their letter-sound knowledge and the influence of letter-name knowledge controlled for as a covariate.

When controlling for letter-name knowledge the relationships between letter-sound knowledge and the ability to read and spell words were different to those of letter-name knowledge. There were no differences between letter-sound ability groups on the reading and spelling of the trained words. There was only one significant main effect of group on attempts at reading the trained words. What the children with good letter-sound knowledge could do was make more attempts at reading and spelling the generalisation words. This is in contrast to the lack of relationship between letter-name ability and attempts at the generalisation words. Children with relatively high letter-sound knowledge also made more letter-level errors in spelling, more word substitutions and less refusals. This suggests that they are developing both traces of orthographic representations and the use of an alphabetic strategy, particularly in the spelling of words.
This combined use of alphabetic knowledge and orthographic lexicon in spelling has also been found in French first-graders, with orthographic lexical knowledge demonstrated in the first 3 months of reading instruction (Martinet et al., 2004). They also found that alphabetic use was more evident after 9 months of school reading instruction. The current findings suggest that it could be level of letter-sound knowledge and not school reading instruction in of itself that influences how early alphabetic strategies are used, particularly in spelling unfamiliar words. Ehri (1995) and Share (1995) emphasise the alphabetic strategy in early reading, but don’t account for letter-sound knowledge developing without explicit instruction.

Summary

The current study finds that in the earliest stages of early word reading and spelling ability letter-name knowledge and letter-sound knowledge each make important contributions to the developing orthographic lexicon and to the use of an alphabetic strategy in reading and spelling unfamiliar words. Letter-name knowledge and not just letter-sounds allow them to start acquiring traces of sight words, similar to the visuographic strategy of Share and Gur (1999). However, letter-sound knowledge then contributes to the use of an alphabetic strategy, without the need for explicit letter-sound instruction. As letter-sound knowledge develops out of letter-name knowledge (e.g., Treiman et al., 1998) the two continue to develop simultaneously, suggesting that both alphabetic strategies and the use of orthographic representations each develop simultaneously for both reading and spelling.

Conclusions and implications

The current findings partially supported the proposed model of phonological awareness development with regard to the role of phoneme awareness and word-learning. As previously discussed formal literacy instruction did influence phoneme manipulation ability, but only as a taught skill. It was found in the present study that prior phoneme awareness ability had no influence on word-learning. Instead it was letter-name knowledge that potentially influences the development of orthographic storage of sight words, and letter-sound knowledge that influences the development of alphabetic strategies for explicit recoding. The role of letter-name and letter-sound knowledge was predicted in the model of phonological awareness development. The
model illustrated in Figure 13 does not provide for spelling knowledge but it may be that the box labelled ‘reading’ needs to be changed to ‘reading and spelling’.

The current study adds to the body of literature on the development of phonological awareness. In particular it provides further evidence for the single factor developmental nature of phonological awareness which includes rime and phoneme awareness. The findings are limited by the number of subjects and length of the study. It would be preferable to have a larger number of subjects and a longer time span, perhaps with additional delayed posttests to use structural path analysis. The intervention design of the study with children who have received no formal literacy instruction adds to the literature. An advantage of the study is that the intervention provided an examination of the individual influence of reading and spelling instruction on the development of phoneme awareness. Many studies are disadvantaged by the confounding influence of children receiving both reading and spelling instruction at the same time. The spelling of words necessitates the reading of words once they are spelt although attempts were made to minimise the time available for this. This also allowed for the examination of word acquisition from the individual instruction in either reading or spelling. It also attempted to control the print vocabulary to which the experimental conditions were exposed for the literacy intervention by restricting it to eight words and seven letters.

**Implications**

The current findings have theoretical implications for reading and spelling acquisition. Spelling acquisition has usually been described as a set of stages which may be independent of reading acquisition (Morris & Perney, 1984). The predominant theories on reading acquisition are similar to stage theories, although take a phase approach. Some, such as that of Ehri (2000; 2005), aim to also explain spelling acquisition and development though the development of shared knowledge in the orthographic lexicon. Such theories suggest that reading begins as a logographically, then makes use of partial alphabetic cues, followed by full alphabetic and then orthographic representations.

The current study has implications for the emerging theories in which alphabetic strategies and lexical orthographic knowledge can develop at the same time, and which are considerably more item-based than stage-based. The current findings found that the item-based orthographic
representations developed as a function of letter-name knowledge and not as a result of intervention. Alphabetic strategies developed as a function of letter-sound knowledge and partially as a result of spelling instruction. The requirement of a letter-by-letter output for spelling lends itself to such a strategy (Fletcher-Flinn, Shankweiler, & Frost, 2004; Frith, 1985; 1986). This may be why spelling has been found to contribute to reading during the first year of school (Caravolas et al., 2001; Cataldo & Ellis, 1988; Mommers, 1987). There are also practical implications for the classroom teaching of reading and spelling. Learning to spell is an influence on the development of alphabetic strategies, along with letter-sound knowledge. In the whole-language or implicit phonics classroom situation spelling and writing is taught in conjunction with reading instruction so children receiving reading instruction in this philosophy will develop orthographic representations of words by developing letter-name knowledge and alphabetic strategies through learning to spell and through letter-sound knowledge that may be induced through letter-sound knowledge. Children who receive reading instruction with more letter-sound instruction and ongoing word-analysis instruction are forced to confront the structure of words and so use both explicit phonological recoding and orthographic representations.

At the very early stages of reading acquisition phoneme awareness may develop alongside learning to read when word analysis instruction is provided but the results of the current study suggest that it does not aid in learning to read. Thus teaching phoneme manipulation skills increased phoneme manipulation but didn’t contribute to reading in the LSR condition. Krashen (1999a; 1999b; 2002) has suggested that teaching phoneme awareness leads to better phoneme awareness but does not contribute to reading. However, it may be that at this current time it could be that the tasks used to measure phonological awareness are not good measures of the type of phonological knowledge that is necessary in learning to read and spell (Treiman, Pennington, Shriberg, & Boada, in press).

**Limitations**

There were several methodological limitations in the present study that may have implications for the results. One is the influence of experimenter bias as the same experimenter carried out both the training sessions and the posttesting. Experimenter bias may have influenced the interaction
between children and experimenter and their expected posttest results. Also the measurement of
the spelling task meant that there was an element of chance in selecting the right letters for the
spelling of words. Although this was true there was a low probability, less than 15%, that a child
could choose any more than one letter correct in a word. In addition the children in the spelling
condition were better at spelling the whole word and made more whole word substitution errors
in spelling. This indicates that although the performance of the reading conditions on the spelling
of generalisation phonemes was high it was likely to be due to guessing but the performance of
the spelling conditions in the spelling task was due to word-learning and not guessing.

Another methodological issue is the low accuracy levels and small effect of intervention for all
participants. This may be a reflection of the use of a set number of trials rather than a criterion
for the training phase of the study. Over the training sessions the children were presented with
each trained word 24 times. Reitsma (1983) suggested that words could be learnt in as few as
four trials, however this was for readers in first and second grades who had already had up to six
months of formal literacy instruction. Stuart et al. (2000) found that 5 year old non-readers did
not develop high levels of word-learning after 36 exposures to words. A problem in comparing
that study with the current study is that they were all complex words that were taught, e.g.,
‘haddock’. In addition, Ehri and Wilce (1987) found that children without any prior spelling
instruction learnt very few words after 7 trials which were stopped earlier if a child reached a
criterion of a word correct twice. Richgels (1995) found that children who were poor spellers did
not reach the criterion of words correct twice over seven trials.

Although the children in the current study had more than twice as many presentations as the
children in the studies of Ehri and Wilce (1987) and Richgels (1995) did, even with more
presentations the children in the current study performed poorly. Although using a criterion may
have been preferable there would have been problems with it in the current study. Firstly, it is
possible that children of this age would have lost interest if they had been subjected to too many
trials. Secondly, the CR condition learnt the least of all conditions based on posttest results but if
a criterion had been in place they would have stopped the intervention sooner than all other
conditions as they quickly learnt to remember the context in which the words were provided in.
The children in the CR condition were able to remember the words when they were confronted
with the context in which they learnt them after only one presentation. However they were
unable to carry through with their good ability in remembering the trained words in context to
reading them out of context. This is similar to the findings of Gough (1993) who found that beginning readers could remember words by paying attention to the context, which in that study was a fingerprint on the corner of the card the word was presented on. In the current study the context was pictorial.

**Future directions**

Further research could be conducted by also separating out the confounding influence of learning to read and learning to spell at the same time. Such research could be strengthened by additional measures of phoneme manipulation and by a greater number of subjects so that more reliable analyses can be conducted. It may also be desirable to replicate this research but with fewer words so that words are easier to learn and accuracy rates are higher. This would be best in conjunction with increased letter instruction. The low accuracy rates influence the reliability of the current results. Additionally, replications would require that the experimenter be blind to experimental group membership.

**Summary**

The purpose of the current study was to examine the influence of different literacy instruction methods on the development of phoneme awareness, and on word-learning. This provided an opportunity to test the predictive nature of different literacy instruction methods on phoneme sensitivity and phoneme manipulation. The results found that literacy instruction in general led to increases in rime awareness, but not to phoneme awareness. Explicit phoneme manipulation ability increased most when reading instruction taught the same skill, thus phoneme awareness gains in this case were task specific. Additionally, this increase in phoneme manipulation did not have any influence on word-learning as there was little to no learning across intervention conditions. It was found that pre-existing letter-name and letter-sound knowledge had different relationships to the early acquisition of word reading and spelling ability, with letter-name knowledge associated with whole-word orthographic representations and letter-sound knowledge associated with the use of alphabetic strategies. It is suggested that the separate influences of reading and spelling and letter-name and letter-sound knowledge on both phoneme awareness and word-learning requires further study.
Chapter 10: General discussion

The first goal of this thesis was to examine the nature of phonological awareness in four-year-old preschool children. The second goal was to examine some possible drivers for the development of more advanced levels of phonological awareness. This first goal was addressed in a correlational study of 110 preschool children with varying degrees of pre-literacy skill. This study provided a snapshot of phonological awareness in preschool children who had received no formal literacy instruction. The second goal was addressed in an intervention study designed to examine the effects of learning to read or spell on the development of phonological awareness, and phoneme awareness in particular. The first study, in Part 1, adds to the existing literature on early phonological awareness by examining the relationship between phonological awareness and pre-literacy skills. There is a plethora of studies studying the relationship between reading and phonological awareness, but not as many have studied the relationship between phonological awareness and pre-literacy skills.

The second study differs from much of the existing literature on phonological awareness and literacy in that it is an intervention that separates reading and spelling instruction so that the relationship between each literacy skill and phonological awareness could be studied. The semi-longitudinal nature of the study meant that the influence of earlier phonological awareness and other pre-literacy skills could be tested and controlled for. The second study also adds to the existing literature in that it provides comparisons between instruction methods that differ in philosophical stance, that is, context-based versus explicit instruction. Although such comparisons have been made, the current study is distinct in that it also separates spelling and reading instruction. This is important for examining the relationship between phoneme awareness and reading instruction without the confounding influence of learning to spell, and vice versa. The second study also adds to the existing literature because it assesses the relationships between phonological awareness and controlled word learning.

The nature of phonological awareness

To clarify the goals of the thesis a model of phonological awareness development was proposed (see Figure 13). The model proposed potential precursors to phonological awareness. To examine the precursors to phonological awareness it was necessary to test the nature of
phonological awareness. It was anticipated that phonological awareness consisted of two main subtypes, namely rime awareness and phoneme awareness. A check of the data using exploratory factor analysis supported the supposition that phonological awareness is comprised of both rime and phoneme awareness. A confirmatory factor analysis was used to test the theoretical hypothesis that rime and phoneme awareness were two subtypes of phonological awareness. The best fit of the concurrent correlational data supported the hypothesis that phonological awareness is comprised of two latent subtypes: rime awareness and phoneme awareness.

**The development of phonological awareness**

Using the results of the confirmatory factor analysis as the measurement model a number of potential precursors were tested. Rime awareness and phoneme awareness were hypothesised to have different precursors. Current research indicates that some threshold of rime awareness is necessary for phoneme awareness. For this reason the two levels of phonological awareness were separated and individually entered into regression analyses as dependent variables. Of the potential precursors receptive vocabulary was found to be the biggest concurrent contributor to rime awareness, with a small contribution of letter-name knowledge and own name spelling ability. Letter-name knowledge and own name spelling ability partialled each other out which indicates that they were possibly measuring the same thing.

Rime awareness continued to develop over the literacy intervention phase independent of the type of intervention received, although the control condition showed little evidence of increasing rime awareness. This development of rime awareness for the experimental conditions may be an effect of the children in the experimental conditions receiving intensive instruction in eight vocabulary items. This can be further explained if it is receptive vocabulary that best predicts the ongoing development of rime awareness (see also Carroll et al., 2003). The phonological segmentation theories of Fowler (1991) and Walley et al. (2003) provide a framework for understanding the influence of vocabulary on rime awareness. As receptive vocabularies increase during childhood the way the phonological representations are stored will change due to the increasing number of entries. The phonological representations of words become increasingly segmented after initially being stored as holistic word representations. Thus it is likely that preschool children have vocabularies that are being segmented at the rime level which in turn aids in the developing sensitivity to rimes in rime awareness tasks.
The phoneme awareness measures were difficult for preschool aged children. However, it was found that the main precursors to phoneme awareness were rime awareness and letter-sound knowledge. There were small contributions of letter-name knowledge and of reading, but both were partialled out by letter-sound knowledge. The contribution of rime awareness to phoneme awareness was expected as they both contributed to the latent variable of phonological awareness, and this has been documented previously (Bryant et al., 1990; Lonigan et al., 2000; Schatschneider et al., 1999).

**Word-reading and spelling**

There was little to no word learning that occurred as a result of the intervention for the experimental condition. The spelling conditions did learn a little compared to the other conditions, although it was only significant for the condition that also received explicit letter-sound instruction. The greatest effect was for attempts made at spelling rather than whole-word accuracy, suggesting that learning to spell provides a pathway to developing alphabetic strategies. The view that phoneme awareness contributes to reading was challenged by the finding that although phoneme manipulation increased after literacy instruction there was no relationship between phoneme manipulation and word learning. Rather than phoneme awareness having a role in word reading and spelling it was letter knowledge that had the greatest influence.

Both letter-name and letter-sound knowledge had a relationship with word reading and spelling. There was an association between letter-name knowledge and early word reading and spelling, which is in line with previous research findings (Burgess & Lonigan, 1998; Roberts, 2003; Stuart & Coltheart, 1988). Evans, Bell, Shaw, Moretti, and Page (in press) found that letter-name knowledge in kindergarten independently predicted word identification in Grade 1. Children given instruction in letter-names also find it easier to learn to read simplified phonetic spellings (Roberts, 2003). Children may utilise letter-name knowledge in their word-learning by remembering the letters in the words they are learning. It is possible that learning to spell aids in the storage of words into the orthographic lexicon. The current findings suggest that letter-name knowledge is specific to the development of orthographic representations.

Letter-sound knowledge was also found to be important for word reading and spelling. Once children have better letter-sound knowledge they seem able to use explicit alphabetic strategies.
for words that they are unfamiliar with. If children receive comprehensive letter-sound instruction, which in the current study was too limited, it is likely that this will occur early in the acquisition of reading and spelling ability. As letter-name knowledge usually precedes the development of letter-sounds (Levin, Shatil-Carmon, & Asif-Rave, 2006; Share, 2004; Treiman et al., in press) it is likely that very early word reading and spelling will make use of stored orthographic representations or traces of these representations and alphabetic strategies.

**Theoretical implications**

There are few theories on the development of phonological awareness that have proposed precursors or drivers of different levels of phonological awareness. Tunmer and Chapman (2007) suggest two models of phonological awareness development, the linguistic structure account and the phonological processing account. Both are described in Chapter 2 of this thesis. However, neither provides an explanation as to how children acquire awareness of different levels of phonological awareness. The current study proposes a potential model for the development of phonological awareness that describes possible precursors to the different levels of phonological awareness that act as drivers for development. The proposed nature of phonological awareness was tested and found in the current sample that phonological awareness is best represented by two latent variables of rime awareness and phoneme awareness.

Potential precursors or drivers of phonological awareness were found such as vocabulary for rime awareness. In turn, rime awareness and letter-sound knowledge were potential precursors or drivers of phoneme awareness. In the current study no distinction could be made between implicit, or sensitivity, and explicit, or manipulation, levels of rime awareness. A potential precursor to explicit phoneme awareness, indexed by phoneme blending in this non-reading preschool sample, is instruction in explicit phoneme manipulation skills. In Part 2 of this thesis it was found that children who were taught to read by blending sounds together made the greater gains in phoneme blending at posttest.

Several theories of reading acquisition agree that letter-sound knowledge plays a role in developing orthographic representations (Ehri, 2005; Ehri & Snowling, 2004; Share, 1995). The current study also provides some evidence for this, although it was letter-name knowledge that specifically played a role in the storage of orthographic representations or orthographic traces. It
is suggested that the visuographic stage of word acquisition described by Share and Gur (1999) is a legitimate phase in the early development of orthographic representations if there is not yet any letter-sounds. This storage allows even children who don’t have a high level of letter-sound knowledge to develop sight words and to transfer that knowledge from one literacy skill to another. This storage of first words into the orthographic lexicon can allow for the beginning of implicit lexicalised recoding or self-teaching in reading or spelling new or unfamiliar words (Fletcher-Flinn & Thompson, 2004; Gough & Hillinger, 1980; Share, 1995; 1999; Thompson et al., 1996; Thompson & Fletcher-Flinn, 2007). The current study did not examine this.

The role of letter-sound knowledge was specific to attempts at more unfamiliar words. This finding, along with that of the role of letter-name knowledge suggests that, as long as beginning readers and spellers have both letter-name and letter-sound knowledge, early reading and spelling can make use of both orthographic representations and alphabetic strategies. This is in contrast to the most predominant theories which are phases or stages (Ehri, 1995). The current findings have more in common with item-based theories or theories that allow for multiple sources of information to read and spell familiar and unfamiliar words (e.g., Thompson & Fletcher-Flinn, 2007).

**Limitations**

A limitation of the first study is that the findings are essentially correlational and cannot be assumed to be causal. Future experimental designs to test the proposed model of phonological awareness development can help to overcome this limitation. A second limitation is that the sample was restricted in socio-economic status. It may be that the homes that the current sample was drawn from provide richer literacy experiences than do less privileged homes. The current findings may not be generalisable to all populations. However, children in this study ranged in level of preschool literacy knowledge suggesting that the sample was indicative of the general population of preschool children in New Zealand.

A limitation of the second study is that children showed very little evidence of learning in both the letter-training and word-training phases. The current study used a design with a fixed number of trials. Although this number of trials has worked in other studies, their samples consisted of children who were already learning to read and spell (Carnine, 1977; Levy et al., 1999; Reitsma,
1983). The younger age of the current sample and low level of initial letter-knowledge may have
required a greater number of trials. A problem with the use of a performance criterion rather than
a set number of trials is that the condition that was least able to read the trained words in the
posttest was the CR condition. In this condition children were able to remember the trained
words from one trial to another because the same sentence and pictorial context was used across
trials. This condition would have stopped the intervention first but gained the least from it. In
future research this could be remedied for the CR condition by using different contexts in each
training session during the intervention along with criterion-based extinction of training.

**Practical implications**

There are some practical implications for the teaching of pre-literacy skills in preschool
institutions and for beginning reading instruction in school classrooms. The potential precursors
to the development of phonological awareness can be used as early diagnosis indicators of
reading difficulties. Although the current study found little influencing relationship between
phoneme awareness and word-learning the reciprocal nature of phonological awareness and
reading in children from first grade and beyond has been well documented (Adams, 1990; Aidinis
& Nunes, 2001; Castles & Coltheart, 2004). Thus interventions can be provided to young
children who have difficulty with the precursor skills. They can receive help before they begin
formal instruction in school classrooms. In early childhood classes and institutions it is suggested
that one of the most important pre-literacy skills to teach is to teach children the names of the
alphabet letters. This can be begun by encouraging children to spell and to write their own names
as frequently as possible. Children’s ownership of their names encourages attention to letters
more than environmental print (Blair & Savage, in press). In addition, the role of vocabulary in
the development of rime awareness, as a beginning stage of phonological awareness, supports the
importance of engaging in conversation with younger children. Vocabulary development can
also be promoted through the reading of story books to children. This has its greatest effect on
younger children, especially those aged from 3 years of age onwards (Aram, 2006).

When children do begin receiving formal literacy instruction the teaching of letter-names can
help to facilitate early reading and spelling. The teaching of reading and writing from school
entry can, along with letter-name knowledge, begin to facilitate the first entries into the
orthographic lexicon. Extending letter-name knowledge into teaching the sounds of letters,
especially for those letters whose sounds are difficult to induce from their letter names, is also important for beginning readers and spellers. Letter-sound knowledge is important as it provides a second mechanism for reading new words through explicit phonological recoding. Although the current research did not find any relationship between phoneme awareness and word-learning it may be that this is because the children were at such an early stage of reading and spelling. The teaching of letter names, sounds, and phonological awareness skills is a direct way to help children who have difficulty with implicit phonological recoding or self-teaching. Another practical application is that reading and spelling instruction be combined rather than taught as individual subjects. Reading and spelling use the same print and linguistic knowledge base and at the very early stages it may be that learning to spell contributes to reading as much or more than reading contributes to spelling.

**Future directions**

Future research is necessary to test further the role of vocabulary and letter-name and letter-sound knowledge as possible precursors to phonological awareness. Such research would need to be experimental in design to complement the present correlational findings. The validity of using vocabulary, letter-knowledge and even own-name knowledge as potential indicators of phonological awareness deficits is also an area of future research. Phonological awareness deficits are considered as an underlying cause of dyslexia so it is important that early childhood indicators are identified to ameliorate potential problems in learning to read and spell before they have begun formal literacy instruction. The model of phonological awareness acquisition suggested in this thesis provides a framework for future research on the development of phonological awareness and its relationship with pre-literacy skills.

Some interesting questions about the relationship between letter-name knowledge and very early word reading and spelling have arisen from these two studies. Future research into the nature of the relationship between early reading and spelling and letter-name knowledge are recommended. Recent research suggests that the letter knowledge of four-year-olds is related to word-learning especially if the words to be learnt are based on letter-names (Treiman et al., 2001b). A study of the process by which letter-name knowledge influences the learning of words that do not contain letter-name associations is another recommended area of research. Since there is a strong relationship between the ability to read or write one’s own name and letter-name knowledge this
is also worth future study. The search for drivers of alphabet acquisition is attracting increasing examination (Evans et al., in press; Levin et al., 2006; Noel Foulin, 2005; Share, 2004; Treiman & Kessler, 2003).

**Summary**

The results of the present correlational and training studies suggest that the acquisition of phonological awareness follows the model proposed in Figure 13. This model proposes a development of phonological awareness along a continuum of increasing explicitness and linguistic unit size. The acquisition sequence appears to begin with rime awareness followed by implicit phoneme sensitivity and ending with explicit phoneme manipulation. The findings of the current investigation are in line with the definition of Anthony and Francis (2005) that phonological awareness is “heterotypically continuous” (p. 256). This means that phonological awareness is a single latent variable that manifests itself in different ways depending on the individual’s level of literacy development. The current investigation has provided evidence of potential precursors to the development of literacy level appropriate levels of phonological awareness. Vocabulary has an association with the development of rime awareness. Phoneme awareness, and phoneme manipulation skills in particular, are apparent in normally developing children once they have begun receiving literacy instruction in an alphabetic script (Anthony & Francis, 2005). This suggests that learning letter-sounds and explicit phoneme awareness skills through bottom-up reading instruction have associations with the development of phoneme awareness.

In the current investigation bottom-up reading instruction and the corresponding growth in phoneme awareness did not promote word-learning. Word-learning only occurred in the spelling instruction conditions, specifically the one that had explicit letter-sound instruction rather than incidental letter-sound experiences. The current findings suggest that phoneme awareness plays very little role in learning to read and spell but it may be that the effects of phoneme awareness on reading and spelling are evident beyond the very beginning stages of reading and spelling. Beginning reading and spelling of words may not utilise phonemic awareness skills because it is not necessary. Instead, it is possible that letter-name knowledge initially contributes to the development of orthographic representations. Improvements in letter-sound knowledge among
beginning readers may mean that the development of orthographic representations are supplemented by the use of alphabetic strategies for more unfamiliar words.

**Concluding statement**

The findings of these two studies add to our knowledge on the nature and development of phonological awareness. It contributes to the body of literature on the nature of phonological awareness which suggests that phonological awareness is a single ability. It also contributes to the literature in attempting to explain the development of the different manifestations of phonological awareness. It manifests itself in different ways that depend on the pre-literacy and literacy knowledge of individuals. The level of receptive vocabulary appears to contribute to the development of rime awareness. The level of phoneme awareness manifested appears to depend on pre-existing rime awareness and on the knowledge of letter-sounds. Once formal literacy instruction has begun then explicit phoneme awareness then begins to appear as a form of phonological awareness but not before. Reading instruction that incorporates phoneme awareness and letter-sound instruction promotes explicit phoneme awareness more than contextual-based reading instruction and more than spelling instruction. Children’s letter-name knowledge contributed to the storage of orthographic representations while letter-sound knowledge contributed to alphabetic strategies used for unfamiliar words.
Appendices
Appendix A

The phonemes of English (from Treiman, 1993).
# The Phonemes of English

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</tr>
<tr>
<td>/n/</td>
<td><em>noon</em></td>
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<tr>
<td>/ŋ/</td>
<td><em>sing</em></td>
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<td><em>pup</em></td>
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<td>/r/</td>
<td><em>roar</em></td>
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<td><em>sassy</em></td>
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<td>/ʃ/</td>
<td><em>show</em></td>
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<td><em>toot</em></td>
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<tr>
<td>/θ/</td>
<td><em>church</em></td>
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<td>/v/</td>
<td><em>verve</em></td>
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<td>/w/</td>
<td><em>wish</em></td>
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<td>/z/</td>
<td><em>zoo</em></td>
</tr>
<tr>
<td>/ʒ/</td>
<td><em>measure</em></td>
</tr>
<tr>
<td>/θ/</td>
<td><em>think</em></td>
</tr>
</tbody>
</table>
Appendix B

Participant information sheets and consent forms
The influence of teaching on the development of phonological awareness

Dear [Name],

My name is Alison Arrow, and I am a doctoral student enrolled for a PhD degree in the Department of Psychology at the University of Auckland. I am conducting this research for my thesis on the influence of different reading and spelling instruction methods on the development of phonological awareness, the developing awareness that words are made up of different sounds.

I would like to invite Kindergarten to participate in this research, and I would appreciate any assistance you can offer me. I would like to work with children aged from 4 years 6 months to 4 years 10 months. These children will be randomly assigned to a group where they will either learn to read 8 words, learn to spell 8 words, or learn early math concepts. They will also play linguistic games and be tested for vocabulary level, reading, and spelling ability. I would be taking each child (with a signed consent form from their parent/guardian – see attached copy) out of the play area for approximately 16 short periods of time (10 minutes) over an approximately five week period.

Each child will need to be individually tested, and if at any point the child becomes too tired or does not wish to continue, all activities will stop. Most of the sessions will be audiotaped so as to ensure accurate record keeping. Because of the nature of the training sessions I will need a quiet place to teach the children.

If you do wish to participate please let me know by signing the attached consent form and sending it to me or phoning me on the number below during working hours or on 813-5110 after hours. All of the information will remain strictly confidential and only group results will be reported. The data collected may be further used in journal articles beyond use in my thesis. Please remember that you may withdraw your centre’s participation from the study at any time until 17 September, 2004. A research report will be made available to you when the research has been completed.

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more please phone me at home at the number given above or write to me at:

Department of Psychology
The University of Auckland
Private Bag 92019
Auckland

Tel. 373-7599 extn. 83044

The Head of Department is: Professor Dianne McCarthy
Department of Psychology
The University of Auckland
Private Bag 92019
For any enquires regarding ethical concerns please contact:
The Chair, The University of Auckland Human Subjects Ethics Committee, The University of Auckland, Research Office – Office of the Vice Chancellor, Private Bag 92019, Auckland.
Tel. 373-7999 extn. 8783

UNIVERSITY OF AUCKLAND
CONSENT TO PARTICIPATE IN RESEARCH
THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

Title of project: The influence of teaching on the development of phonological awareness.

Researcher: Alison Arrow, PhD student, University of Auckland.

I have been given and have understood an explanation of the research project and have been given an opportunity to ask questions and receive answers about it. I understand my centre’s participation is voluntary and that I may withdraw my consent at any time until 17 September, 2004 without having to give any reasons for it.

I understand that the children from my centre may be audio-taped.

Signed:

Name:
(Please print clearly)

Date:

The influence of teaching on the development of phonological awareness

Dear Parent/Guardian,

My name is Alison Arrow, and I am a doctoral student enrolled for a PhD degree in the Department of Psychology at the University of Auckland. I am conducting this research for my thesis on the influence of different reading and spelling instruction methods on the development of phonological awareness, the developing awareness that words are made up of different sounds.

I have permission from ______ to conduct this research at ______ Kindergarten. I would like to invite your child to participate in this research, and I would appreciate any assistance you can offer me. All children aged from four years six months to four years ten months who have signed consent forms from their parent or guardians will be able to participate, however, due to time constraints not all children may complete the entire project. Those participating will be randomly assigned to a group where they will either learn to read 8 words, learn to spell 8 words or learn early math concepts. They will also play linguistic games and be tested for their receptive vocabulary level, reading, and spelling ability. Each child will be individually tested and taught for 16 sessions over 4-6 weeks, and if at any point the child becomes too tired or does not wish to continue, all activities will stop. Most of the sessions will take about 10 minutes each and will be audiotaped so as to ensure accurate record keeping.

If you do wish for your child to participate please let me know by signing the attached consent form and returning it to your kindergarten or phoning me on the number below during working hours or on 813-5110 after hours. To help with the structure of the first session it would be appreciated if you could please note on the consent form any words that your child may be able to read or spell. All of the information will remain strictly confidential and only group results will be reported. The data collected may be further used by myself, in journal articles beyond use in my thesis. Please remember that you may withdraw your child from the study at any time until September 17, 2004.

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more please phone me at home at the number given above or write to me at:

Department of Psychology
The University of Auckland
Private Bag 92019
Auckland

Tel. 373-7999 extn. 83044

The Head of Department is: Professor Dianne McCarthy
Department of Psychology
The University of Auckland
Private Bag 92019
Auckland

Tel. 373-7999 extn. 88516/88555
For any enquires regarding ethical concerns please contact:
The Chair, The University of Auckland Human Subjects Ethics Committee, The University of Auckland, Research Office – Office of the Vice Chancellor, Private Bag 92019, Auckland.
Tel. 373-7999 extn. 87830.

Title of project: The influence of teaching on the development of phonological awareness.

Researcher: Alison Arrow, PhD student, University of Auckland.

I have been given and have understood an explanation of the research project and have been given an opportunity to ask questions and receive answers about it.

I understand that I may withdraw my child from the project, or any information traceable to my child up to September 17, 2004 without giving a reason.

I understand, and agree that some of the sessions with my child will be audio-taped.

I agree that ………………………………… who is under my guardianship may participate in this research.

Signed:

Name: (Please print clearly)

Date:

Child’s birthdate:

Any words your child can read or spell:

Appendix C

Letter knowledge test card
Phonological awareness tasks and items
Rime identity task (from Byrne & Fielding-Barnsley, 1991)

Practice items:
1. pet: barn, net, hand
2. sat: hat, clock, bed

Test items:
1. star: leg, car, bike
2. mop: snake, kite, top
3. moon: cat, fly, spoon
4. plane: goat, train, sun
5. clown: town, stove, shoe
6. flash: trash, car, desk
7. cake: hat, snake, horse
8. jump: hump, book, flag
9. box: stool, jug, fox
10. peep: truck, sheep, frog

Onset identity task. (from Byrne & Fielding-Barnsley, 1991)

Practice items:
1. football: wardrobe, telephone, footpath
2. pencil: penguin, carrot, kitten
3. van: snail, tie, vase

Test items:
1. fish: fox, pot, dog
2. nose: night, broom, watch
3. key: lamp, king, mouse
4. ball: bow, fish, cake
5. foot: sheep, fence, brush
6. needle: spider, necklace, toaster
7. kangaroo: kettle, finger, table
8. bird: kite, book, sheep
9. fork: mouse, fire, doll
10. nail: bird, hat, net

Coda identity task. (from Byrne & Fielding-Barnsley, 1991)

Practice items:
1. snowman: traffic lights, beach ball, postman
2. pillow: yellow, tiger, mushroom
3. hive: snake, coat, glove

Test items:
1. hat: key, belt, brush
2. case: house, dog, watch
3. drum: horse, swim, kite
4. owl: ball, sheep, hat
5. skate: cat, frog, cow
6. glass: duck, dress, bow
7. jam: broom, sock, ant
8. camel: toaster, turtle, tiger
9. kite: sock, nose, boat
10. mouse: lock, door, bus

Blending task (Adapted from O’Connor, Jenkins & Slocum, 1995; Roper, 1984)

Practice items:
1. space-men
2. c-at
3. c-u-p

Syllable items:
1. gar-den
2. bull-doz-er
3. lo-li-pop
4. hos-pi-tal
5. he-li-cop-ter

Onset-rime items:
6. s-oap
7. d-og
8. f-ish
9. tr-ain
10. pl-ane

Phoneme items:
11. p-i-g
12. b-oo-k
13. r-a-ke
14. s-o-ck
15. sh-o-p

Rhyme Production Task

Practice items:
bear
shoe

Experimental items:
hop
cap
bat
plum
hen
Appendix D

Derivation of the words that training and generalisation words were taken from for Part 2
<table>
<thead>
<tr>
<th>Initial letter</th>
<th>Final letter</th>
<th>M</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
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<td>mam</td>
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<td>map</td>
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<td>mem</td>
<td>met</td>
<td>mep</td>
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<td>M</td>
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<td>pom</td>
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<td>pop</td>
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<td></td>
<td></td>
<td>pum</td>
<td>put</td>
<td>pup</td>
</tr>
</tbody>
</table>
Appendix E

Trained letters and their corresponding storylines for the letter sound instruction in Part 2 (adapted from Lloyd, 1992).
<table>
<thead>
<tr>
<th>Letter</th>
<th>Story</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Some children went on a picnic. When they start eating they feel tickling on their arms and say ‘a a a a a ants’ and jump up and leave the ants alone.</td>
<td>Wiggling fingers at the elbow as if ants were there saying ‘a a a a a’</td>
</tr>
<tr>
<td>E</td>
<td>Some children go to stay on a farm. On the farm are chickens. The children get to collect the chickens’ eggs. The eggs are cooked. They are cracked on the edge of a pan and the children say ‘e e e e egg’.</td>
<td>Pretending to crack egg on bowl with one hand then using both hands to open shell saying ‘e e e e egg’</td>
</tr>
<tr>
<td>I</td>
<td>A family gets a pet mouse and it gets out of its cage and knocks over an ink bottle. The mouse gets ink all over it and is called ‘Inky’. We can pretend to be ‘Inky’ by saying ‘i i i i’</td>
<td>Pretending to be ‘Inky’ by wriggling fingers at the end of the nose saying ‘i i i i’</td>
</tr>
<tr>
<td>O</td>
<td>A child gets their own bedroom and they can reach the light switch from their bed and turn it on and off saying ‘o o o o o on off’ till they get told off.</td>
<td>Point finger as if to turn switch on and off saying ‘o o o o o’</td>
</tr>
<tr>
<td>U</td>
<td>A family goes for a walk on a nice day and one child takes their umbrella with them, and everyone laughs. But it does rain so up goes the umbrella ‘ u u up up umbrella’ while everyone else gets wet.</td>
<td>Have two hands in front of them, and raise the other as if to push up umbrella saying ‘u u u u u’</td>
</tr>
<tr>
<td>M</td>
<td>My favourite meal is a hamburger ‘mmmmm’. What’s your favourite meal? Say ‘mmmmm’ when child says.</td>
<td>Rubbing tummy with hand at tasty food saying ‘mmmmm’.</td>
</tr>
<tr>
<td>P</td>
<td>It is a child’s birthday and they have a cake, but the candles are magic candles and when they try to puff the candles out – making a p sound - they light up again.</td>
<td>Hold up finger, imagining it is a candle and try to puff the trick candle out ‘p p p p p’</td>
</tr>
<tr>
<td>T</td>
<td>Children go to watch tennis being played and everytime the ball gets hit with a ‘t’ sound everyone turns their head, form side to side with every ‘t’ sound.</td>
<td>Turning the head from side to side saying ‘t t t t t’</td>
</tr>
</tbody>
</table>
Appendix F

The pages, and their copyright permissions, used for the whole-language and invented spelling training in Part 2.
He’ll feed the mouse,
and mop the moose!
Date: Fri, 9 Jun 2006 02:48:44 -0400
From: "Feldman, Sherri" <sfeldman@randomhouse.com>
To: a.arro@auckland.ac.nz
Subject: Michael Frith, I'LL TEACH MY DOG 100 WORDS

Dear Alison Arro:

We have no objection to your use of the above material in your dissertation, as requested in your letter, subject to the following conditions:

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2. Full acknowledgment of the title, author, copyright and publisher is given;

3. If your dissertation is ever considered for publication or broadcast, commercially or privately reproduced in any manner not specified in your request, you must reapply for permission.

Best wishes for the success of your paper.

Sincerely,

Sherri Feldman
Assistant, Copyright/Permissions
Random House, Inc.
1745 Broadway, 3rd floor
New York, NY 10018
Phone: 212 572 2506
Fax: 212 572 6066
Katie went on holiday with her mum and dad.
Greedy Cat sat
on a mat
by the fridge.
Meow, meow, meow!

Cowley, J. (1988). *Greedy Cat is hungry*. Wellington, NZ: Department of Education. (pg. 4)
3/6/2006

Dear Alison,

Cat Is Hungry; Lunch For Greedy Cat

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Yours sincerely,

[Signature]

[Title]

Signed on behalf of:

[Designation]

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Yours sincerely

We accept these terms


designation:

signed on behalf of:
Alien Arrow
Department of Psychology - Uni of Auckland
C/- Campus, University of Auckland
Private Bag 92019
Auckland

To: Alison

Enclosed

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Yours sincerely

We accept these terms

Liz Smith
Rights and Permissions

Signed on behalf of:

Designation:

P & P 3681
Alison

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The following acknowledgment is requested:


Please sign one copy of this letter and return to us indicating your acceptance of these terms.

Yours sincerely

[Signature]

[Designation]

[Date]
My mouse makes a good pet.

“Big, black clouds,” said Tom.

Grandpa laughed.
Mail :: Inbox: RE: Copyright permission

Date: Thu, 22 Jun 2006 12:32:36 +1000 [EST]
From: "Jared Dunn" jared_dunn@mccraw-hill.com
To: Allison Arrow <arrow@auckland.ac.nz>
Subject: RE: Copyright permission

Allison,

Thanks for your patience while we researched these titles. I am pleased to grant permission for you to include these double pages from each of the listed publications to be included as appendices to your thesis.


Best regards,
Jared

Jared Dunn
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Australia & New Zealand
Locked Bag 2233, North Ryde, NSW 1670
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---- Original Message ----
From: Allison Arrow [mailto:a.arrow@auckland.ac.nz]
Sent: Tuesday, 13 June 2006 12:45 PM
To: Jared, Jared
Subject: RE: Copyright permission

Hi Jared,

Thanks. In my research I taught children to read one word inserted into text. To be as natural as possible the text came from a page in a published book. To be as methodologically rigorous as possible I am including a scanned copy of the page or double page in my appendix. It is possible that my thesis will be available through digital dissertations as more than one or two copies will be available, hence the need to get copyright permission. The books and pages that I seek permission for are:


Thanks
Allison Arrow
References


Blair, R., & Savage, R. (in press). Name writing but not environmental print recognition is related to letter-sound knowledge and phonological awareness in pre-readers. *Reading and Writing: An interdisciplinary Journal*.


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