

THE UNIVERSITY OF HULL

An examination of the effects of reading instruction
and gender differences on children's reading.

being a Thesis submitted for the Degree of
Doctor of Philosophy
in the University of Hull

by

Sarah Logan

MA (Hons) Psychology, The University of Aberdeen

MRes Psychology, The University of Aberdeen

January 2008

ABSTRACT

The aim of this thesis is to explore a number of areas relating to children's reading. The experimental studies were designed to investigate reading strategies, attitudes to reading and underlying cognitive processes. However the focus within each of them is to examine the effects of reading instruction and gender. The results from all gender comparison studies illustrate that the significant gender differences perceived to exist in reading ability are actually relatively small in terms of statistical significance. However greater gender differences can be found in measures of planning and attention, attitude to school, attitude to reading and frequency of reading. The studies also investigated the effects of two different reading programmes; synthetic phonics and Progression in Phonics (the National Literacy Strategy's analytic phonics based programme). The results of this thesis support the value of teaching synthetic phonics, as more children taught by this method become independent readers early on, become better readers later on, and there are fewer underachievers when taught by this method. Synthetic phonics provided children with better phonological reading skills, which boosted their ability to read irregular as well as regular words and is therefore suitable for opaque languages like English. In addition, no differences in reading attitudes were found according to type of reading instruction. Finally, the way in which children are taught to read appears to change the cognitive substrate underpinning reading, and may also develop skills beyond the reading system.

For my parents

For always being there for me and supporting me throughout.

I know I don't say it often enough, thank you.

ACKNOWLEDGEMENTS

I would like to thank Professor Rhona Johnston for her guidance throughout the last three years. Your expertise in this area of research was invaluable and I would like to thank you for sharing it with me. You have introduced me to an area of research that I enjoy so much, and I am very grateful for that. I would also like to thank Dr. Michal Lavidor for always offering to help if the need should ever arise.

I am grateful to all the teachers and children who participated in these studies, both in Hull and Clackmannanshire. In particular, I would like to thank Jo Hebden, who has always been very accommodating. I have appreciated this very much!

Also to all the friends I have made throughout the course of my PhD who have made my time in Hull so much fun, especially Chiara, Matt, Lisa and Guja! There are two in particular I would like to thank. First of all, Gastón, I can't imagine the PhD experience without you! You are a great friend and I am sure that we will keep in touch! And of course, Inga, what can I say? I couldn't have asked for a better friend!

Finally, and of course, thank you Will. Thank you for everything! You have always been there for me and have kept me smiling throughout! I'm looking forward to all the adventures we have coming our way....

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CHAPTER 1: INTRODUCTION (THEORY)

Being able to read is vital to educational achievement. It provides children with the skill to understand and enjoy a wide range of subjects both within and out of school. Beyond school, it plays an important role in our everyday lives, determining the choices available for work and further education. Children deserve the best teaching possible, therefore research regarding the teaching of reading is crucial.

The purpose of the research in this thesis is to investigate some of the factors involved in reading acquisition and development, and to examine their relationship to reading. The studies within this thesis explore the effects of reading instruction and gender differences on reading ability, reading strategies, attitude to reading and underlying cognitive processes. Reading ability refers to both single word reading and reading comprehension, and is measured using standardised tests. Reading strategies refer to the approach a child takes to reading, in other words, the strategies they use for working out unfamiliar words. Attitudes to reading examine the relationship between reading ability, frequency of reading and attitude to reading. In addition, attitudes to school and competency beliefs are also examined. Finally, underlying cognitive processes refer to the cognitive skills which underpin reading, and how these relate to reading achievement. These areas were studied as it is possible that they may be affected by the way in which a child is taught to read and may reflect possible sources of gender differences in reading. In addition, they represented distinctly different domains of reading research, highlighting the multi-faceted nature of research into reading. A comprehensive review of each of these areas will be presented in the introduction to

each experimental chapter. The main introduction for this thesis is split into three chapters; 1) models of reading, reading acquisition and development (theory), 2) types of reading instruction within schools (practice) and 3) an overview of the thesis, providing the aims for each study.

Models of reading, reading acquisition and development: theory

In order to explain how reading skill is acquired, develops and how words are processed by skilled readers, a number of models of reading have been proposed. These usually focus on one of two aims: to explain how words are read by proficient readers (models of skilled word reading, e.g., dual route and connectionist models), or to explain how reading is acquired and developed in the earlier stages of learning to read (models of reading development, typically stage theories). Initially models of skilled reading will be discussed, so that comparisons between models of reading development can be made with reference to models of skilled reading.

Models of skilled reading

Models of skilled reading represent frameworks designed to explain the reading of proficient readers, and how different types of word (regular and irregular) and familiarity (high and low frequency) affect reading. Regular words are those which follow regular letter sound correspondences, that is, they can be read accurately by blending the sequence of phonemes (e.g., best, stop). In addition, there are two types of irregular words; exception words and strange words. The former refers to words which have regular spelling patterns, but irregular letter sound correspondences (e.g., have, pint), whilst the latter refers to words which have both unusual spelling patterns and

irregular letter sound correspondences (e.g., aisle, yacht). Whether a word is high or low frequency will depend on the reading level of the person. High frequency words refer to those words which a person will have had a lot of exposure to, whereas low frequency words refer to those words which are less familiar.

There are a number of models of skilled word reading, one of the earliest being the dual route model (Coltheart, 1978), where it is suggested that there are two separate and distinct routes for reading based on word regularity and familiarity. However more recently there has been a move towards computational models¹ of word reading (in particular connectionist models), which take into account the quasi-regularity of the English language (i.e., the partial regularities within irregular words) to propose a single route for word reading. A number of versions of these have been proposed; Seidenberg & McClelland's parallel distributed processing model (1989), was the first to suggest a single route for word reading, however its poor performance on nonword reading lead to criticisms. This was succeeded by Plaut, McClelland, Seidenberg & Patterson (1996), who developed a single route successor to the previous Seidenberg & McClelland model; this performed well on nonword reading, giving added plausibility to the single-route theory. However, whilst these models had focused on the translation from print to sound, Harm & Seidenberg (2004), considered reading for meaning, with two pathways; from orthography to semantics, or orthography to phonology to semantics. This model still accounted for the quasi-regularity of the English language however. In response to these single route connectionist models, a computational account of the dual route model has recently been proposed; Coltheart, Rastle, Perry, Langdon & Ziegler's Dual Route Cascaded model (2001), with three routes proposed. In addition, others have

¹ Computational models refer to a computer program which is capable of performing the cognitive task being studied, and does so by using exactly the same information processing procedures as are specified in a theory of how people carry out this cognitive activity (Coltheart et al., 2001)

attempted to combine the dual route and connectionist models (Bjællid, Høien, & Lundberg, 1997). Below is a brief description of some of these models.

Dual route model

This is a very influential model outlining word recognition in skilled readers created by Coltheart (1978). Known as the dual route model of skilled reading, it has, to this day, remained as a comprehensive and extensively cited account of word reading in skilled readers. According to this model, there are two ways in which a word can be read. Firstly, a word may be read via a direct (visual/orthographic) route which maps stored representations of whole written words (word recognition units) onto spoken representations of these written words. This may or may not involve access to semantics (knowledge/meaning of the word). However, since a crucial aspect of reading is understanding what is being read, this activation of the semantic system is important. Words are processed as wholes by the direct route, and all familiar words are read via this route as it is quicker and more efficient. Through increased reading and exposure to print, more word recognition units will be created and connections will be formed between these units and the representations of meanings and pronunciation. Skilled readers will read predominately via this route and access the phonological route only for unfamiliar words. The indirect phonological route converts graphemes (letters) directly into phonemes (sounds) through letter sound rules so that a word can be read accurately. Due to the irregular nature of letter sound correspondences in irregular words, only regular words may be read accurately via this route. This route is also used to read nonwords.

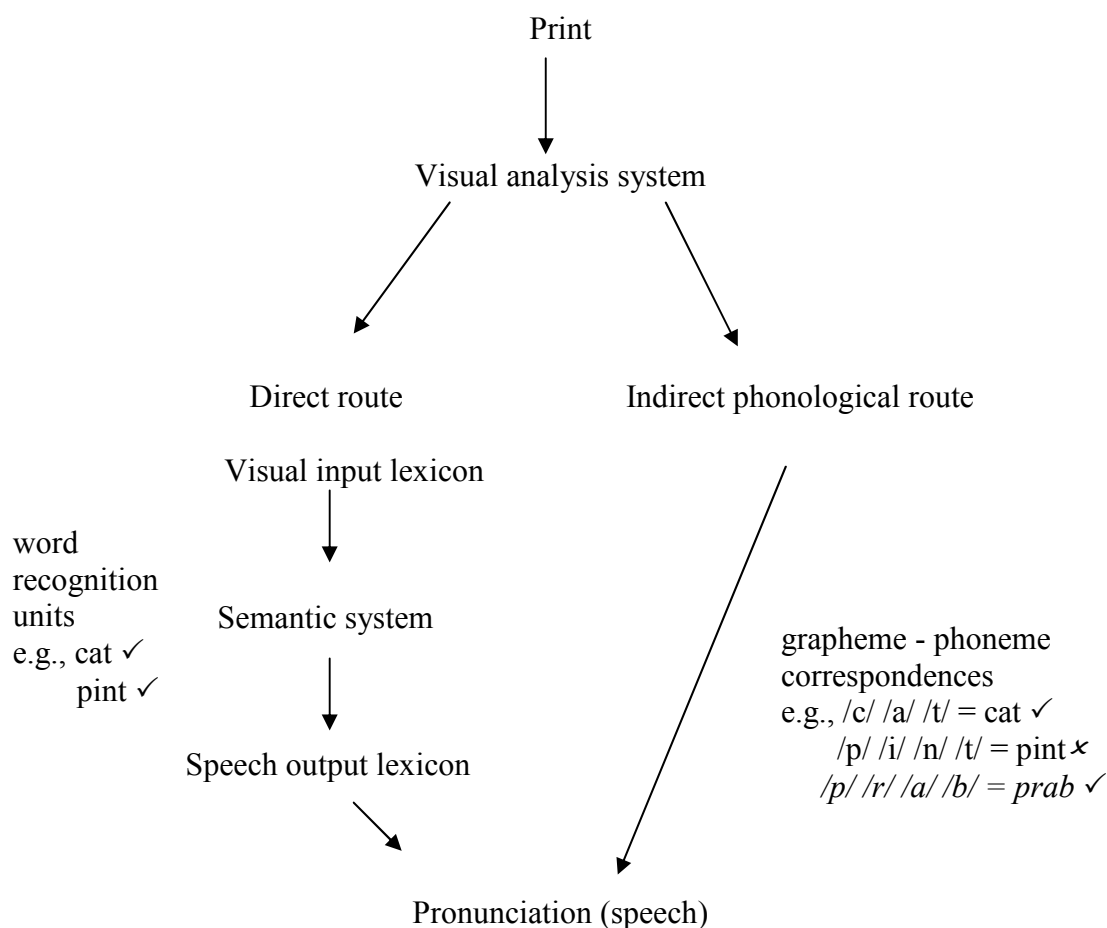


Fig 1.1: Dual route model of reading (Coltheart, 1978).

Note: The diagram above illustrates that whilst regular and irregular words can be accurately read via the direct route (where words are processed as visual wholes through word recognition units), only regular words and nonwords can be read accurately via the indirect phonological route, where grapheme-phoneme correspondences must be regular for a word to be pronounced correctly.

A revised version of the dual route model has been more recently proposed (Coltheart et al., 2001). Known as the dual route cascaded model it is a computational model of word reading, however the model's architecture was developed by theory (hand-wired) and then tested via computational modelling, rather than previous computational models in which the model's architecture was learned (e.g., Seidenberg & McClelland, 1989). The dual route cascaded model proposes three routes for word reading. Cascade refers

to the flow of activation within the model; as soon as there is even the slightest activation in an earlier module, this flows on to later modules. The lexical non-semantic route (middle route in the diagram below) processes words through the activation of word letter units (the letters in the printed word are processed in parallel), which then activate the word's entry in the orthographic lexicon. This activation spreads to the phonological lexicon, and that word's entry in the phonological lexicon then activates the word's phonemes (again in parallel across all phoneme positions). A second route, the lexical semantic route (left route in the diagram below), additionally accesses the meaning of the word. Finally, the third route, the grapheme-phoneme conversion route (right route in the diagram below) has the same function as that in the previous dual route model (Coltheart, 1978), where grapheme-phoneme conversions are made for the correct pronunciation of regular words and nonwords.

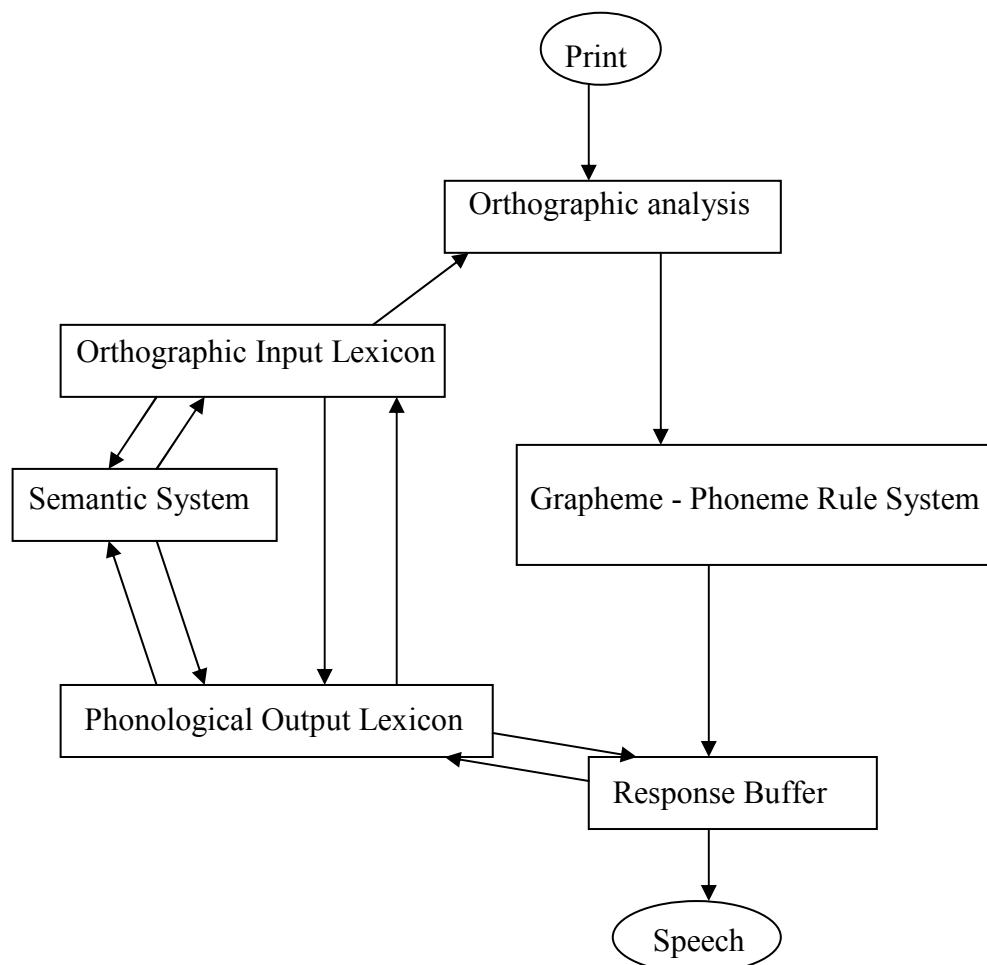


Fig 1.2: Basic architecture of the dual-route cascaded model of visual word recognition and reading aloud (Coltheart et al., 2001).

Note: The diagram above illustrates that in two routes, adjacent layers of the model communicate fully in both directions. This can happen in one of two ways. Through inhibition (where activation of a unit makes it more difficult for the activation of other units to arise), and through excitation (where activation of a unit contributes to the activation of other units). However, this is not the case for the grapheme-phoneme conversion route, where processing proceeds in one direction, through excitatory links from graphemes to phonemes.

Connectionist models

Connectionist models are created via computational models of the way in which a skilled reader identifies words. These models take into account the quasi-regularity of the English language, arguing that irregular words contain regular components and therefore any model of word reading should account for this. Seidenberg & McClelland (1989) proposed a parallel distributed processing model stating that children initially learn mappings between orthography (letters) and phonology (sounds), and later between orthography, phonology and semantics (meaning). The model is represented via two types of units; input and output units, connected by a set of intermediate or hidden units (which increase the computational capacity of the network). The input units are responsible for coding the letters present in printed words (orthographic/written units), and the output units for coding the pronunciation of words (phonological/spoken units). The connections between the input, hidden and output units were suggested to strengthen through practice and training. This model proposes one route for word reading, although an additional route to semantics is needed to

access meaning (necessary to read homographs)² or to explain cases of phonological dyslexia (deficits in phonological skills). According to the one route theories, it is the relative consistency of the letter sequence to letter sound rules which determines how accurately and quickly a word can be read. According to this view, once children learn to associate many input patterns (written words) with output patterns (spoken words), they are able to generalise to words which they have not explicitly been taught.

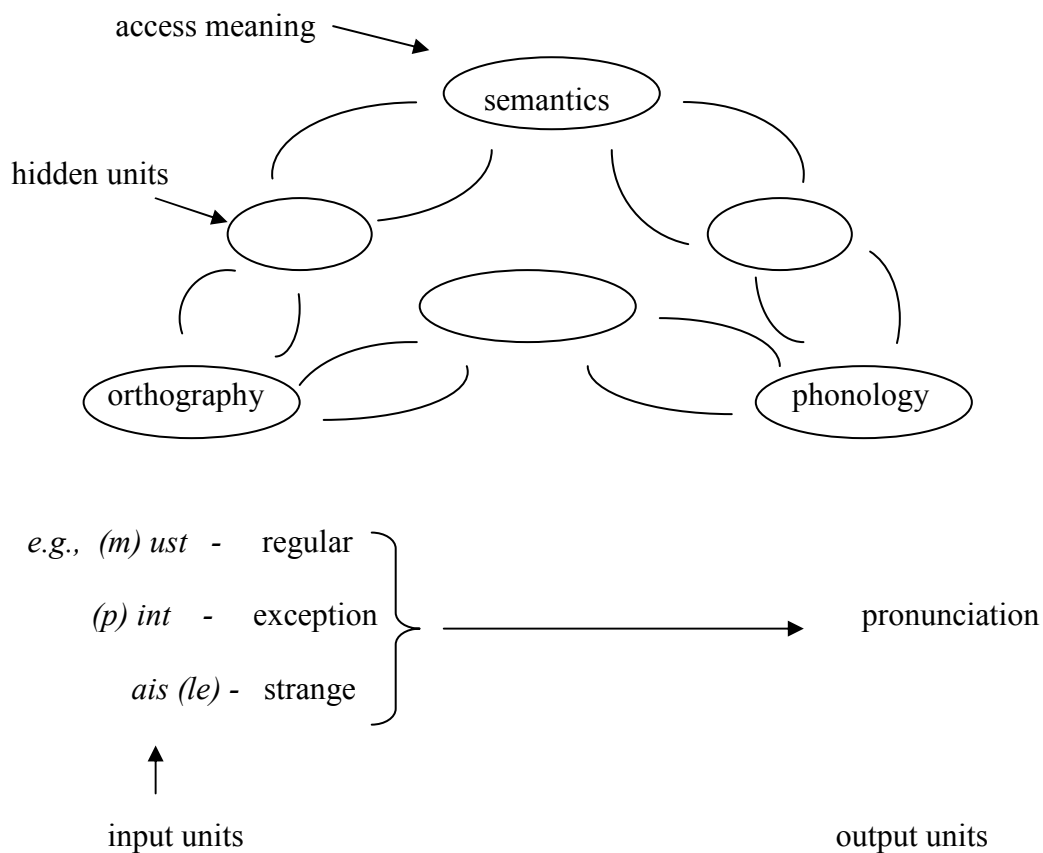


Fig 1.3: Connectionist model of reading (Seidenberg & McClelland, 1989).

Note: The diagram above illustrates that generally all words are read via one route, through input of orthography to the output (pronunciation), where the familiarity and consistency of the letter sequence determines the ease and speed at which a word will be read.

² Words which are spelt the same but have a different pronunciation based on context, e.g., the word 'tear' can refer to 'tears' from crying or a 'tear' in a dress, where the correct pronunciation of a word depends on the context.

A comparison between dual route and connectionist models of word reading.

There are a number of clear differences between dual route and connectionist models of reading. Whilst dual route models treat regular and irregular words as distinctly different word types, connectionist models take into account the regularity within irregular words, and also the consistency of the letter sound pattern for accuracy and speed of reading. In addition, the dual route models make no distinction between strange and exception words, both being classed as 'irregular' words. However, as connectionist models take into account the relative consistency of the spelling pattern, exception words will be read more accurately and faster than strange words due to their more familiar and consistent letter sequences.

These models offer different explanations for skilled reading and will be explained in more detail later (Chapter 4). However, it is important to go back to the earlier stages of learning to read and examine models of reading acquisition and development.

Models of reading development

Stage theories

In order to explain reading acquisition and development, stage theories outline a number of stages that a child will pass through sequentially in order to become a competent reader.

Chall (1983), outlined a six stage framework, describing pre-reading (the development of oral language and awareness of literacy) as the initial stage, followed by the second stage of learning to read, where a child starts to use letter sound associations to read

words. Following from this, a child was said to extend their early reading, developing the skills they have learnt and using them with accessible texts. Later, children are said to be reading to learn, in order to gain information and extend their vocabulary. Subsequently, children start reading using multiple viewpoints and are able to analyse what they have read and react critically towards it. The final stage is construction and reconstruction, in other words, where people read selectively and form opinions about what they have read. Chall (1983) argued that each of these stages was distinguishable. However, this model arguably makes presumptions about the purpose of text reading in skilled readers, and perhaps does not focus enough on the early stages of reading development.

Marsh, Freidman, Welch & Desberg (1981) outlined a four stage model to explain a child's reading acquisition and development with more focus on the beginning stages of reading acquisition. Firstly, children are said to process or read words as wholes via rote-learning. This is often observed in classrooms where children are taught high frequency familiar words from their first reading books as visual wholes. Secondly, 'discrimination net' learning, refers to a stage when a child reads a new word and its graphemic features (i.e., the letter sequences) are compared with those in the lexicon. If the word appears to be similar to, but different from a stored word, discrimination net guessing is used for further discrimination. Following this stage, children place more emphasis on letter sound rules, using left to right grapheme (letter) to phoneme (sound) correspondences to read new words. The final stage describes the process where children are able to make use of complex rules and analogies for word reading.

Following from this, a more commonly cited model by Frith (1985) proposes a three stage model, each phase being associated with a particular type of skill. Initially

children are at a 'logographic' stage of reading, where they recognise words based on a sight approach and process these words as wholes. Again, it is likely that these words would be high frequency familiar words taught to children as visual wholes. At this stage of reading, phonological information is not used. However, with the right teaching and support, children progress to the second 'alphabetic' stage, where they learn about the relationship between letters and sounds. At this stage of development, knowledge of the alphabet and of letter sound (grapheme-phoneme) correspondences is crucial. Children use these and phonological awareness skills to read new words. Finally, the 'orthographic' stage describes the period where children are more familiar and confident with the language system and show a more rapid recognition of words. Children will not need to depend on letter sound rules for reading all words, only those that are unfamiliar. Rather they process words as wholes or using morphemes, the smallest meaningful units of language (e.g., 'talked' contains two morphemes 'talk' and 'ed').

Ehri (1995) distinguished four phases in the development of sight word reading to characterise the degree of involvement of the alphabetic system at each point. The phases were named to reflect the predominant type of connection between the written form of the word to the pronunciation or meaning. The four phases distinguished were pre-alphabetic, partial alphabetic, full alphabetic and consolidated alphabetic. The pre-alphabetic phase reflects the point at which children use salient visual cues within words in order to remember them and pair these cues to the appropriate pronunciation or meaning (e.g., the 'oo' in look). In contrast to all subsequent phases, letter sound relationships are not involved in forming the connections between the written and spoken form. It is in the second stage that children attempt to read words by forming connections between some of the letters in the written form with their corresponding

sounds. In order to do this, children will need to have some letter sound knowledge, and will often use the first or last letters as clues as these are particularly salient to them. Later, children read words by forming complete connections between letters and sounds (full alphabetic phase), by reading a word from left to right. Their better letter sound knowledge leads to more accurate word reading. Finally, knowledge of letter sound information is consolidated (consolidated alphabet phase), and children start to recognise letter sequences that occur across different words, and retain this information in memory to allow faster and more accurate word reading.

One limitation of stage theories is that they are quite rigid frameworks, assuming that all children successively pass through one stage and then on to the next, with very little overlap. They also ignore the fact that the way a child is taught to read will affect their literacy development. For example, a child who learns to read through a systematic synthetic phonics method of instruction, which emphasises letter sound correspondences and sounding and blending as the principal and initial strategy, will likely spend no or very little time in Frith's logographic stage, Marsh et al's first whole word stage or Ehri's pre-alphabetic stage. In addition, Ehri's model focuses on the alphabetic nature of the English language, however, for children taught via a whole word approach, their knowledge of letter sound associations may be very poor.

The models of reading development also differ in terms of their focus. For example, Chall (1983) outlines phases of development from acquisition to proficiency, and suggests later phases involving different uses of reading for information. However others (i.e., Ehri, 1995) focus more specifically on acquisition to skilled reading within the context of the alphabetic system rather than covering reading comprehension or the purpose of reading. The models of reading acquisition and development can also be

compared to models of skilled word reading, with regards to the way in which they explain the transition to skilled reading. Frith's model can be likened to the dual route model, as it does not consider recognition of word parts or familiar letter sequences for word reading, rather reading is carried out through recognition of visual wholes (direct visual/orthographic route) or mapping of letter sound correspondences (indirect phonological route). For example, words are recognised as visual wholes in the 'logographic' stage of reading and therefore processed by the direct visual route. The 'alphabetic' stage focuses on the indirect phonological route as a method of reading new unfamiliar words by using letter sound correspondences, whilst the final 'orthographic' stage distinguishes between depending on letter sound rules for reading unfamiliar words (phonological route), but processing familiar words as wholes or using morpheme segments (direct route) for rapid recognition of familiar words.

Ehri's model of reading development on the other hand can be likened more to connectionist models. This model highlights the use of partial segments of words throughout reading acquisition and development. Initially, partial segments of words are used in the pre-alphabetic phase, where those features of words that have most salience to the unskilled reader are used as a cue for reading. Letter sound correspondences are not known until later when connections are formed between some letters in the written form and their corresponding sounds, but again it is the most salient that the reader uses (often initial letter sounds). When letter sound knowledge is better developed, children will use it for reading more accurately. Finally, when this information is consolidated, readers make use of letter sequences which occur across different words (partial segments), and retain this information in memory to transfer this knowledge to reading other words, this is an important feature of connectionist models.

Early reading acquisition

There are two skills regarded as very important for learning to read; letter knowledge and phonological awareness. This section on early reading acquisition will focus initially on the evidence concerning whether knowledge of large (rime) or small (phoneme) word segments are most important for reading to develop, and also which are most useful to teach in the context of reading. Following this, phonological awareness (sensitivity to the sound structure of words) will be explained, with studies investigating the role of phoneme analysis and synthesis in both phonological awareness studies (as a precursor to reading) and phonics studies (where these skills are taught in conjunction with the teaching of reading). Finally, the importance of letter knowledge will be discussed.

Onset-rime versus phoneme skills

The orthographic and phonological structure of words can be broken down to their smallest units, known as phonemes, as well as larger units such as rimes and syllables (see Fig 1.4). Knowledge of these units can be taught prior to reading (within spoken words) or in conjunction with later reading (with written words). There has been much controversy (see Muter, Hulme, Snowling & Taylor, 1998; Bryant, 1998; Hulme, Muter & Snowling, 1998) concerning which sound segments are the most important to teach a child to read, whether smaller (phonemes) or larger (onset-rime) units are more beneficial to reading acquisition. There is evidence that rhyme and phoneme skills represent very distinct skills prior to formal literacy instruction as they load distinctly onto two different factors (Muter et al., 1998). However abilities on both skills appear to become more closely associated during the first two years of school, although they

still load onto two separate factors (Muter et al., 1998). This distinction between rhyme and phoneme skills is consistent with Foy & Mann (2001) who found that phoneme awareness and rhyme awareness tasks were differentially associated with a number of other variables being measured, and is also consistent with Carroll, Snowling, Hulme & Stevenson (2003) who found a strong distinction between phoneme and onset-rime awareness compared to onset-rime and syllable awareness. The concept of phonological sensitivity has been proposed (Stanovich, 1992, cited in Stainthorp & Hughes, 1998), with sensitivity lying on a continuum from shallow to deep. Shallow levels refer to being sensitive to the larger phonological units (i.e., rimes) within spoken words, whilst deeper levels of sensitivity refer to being aware of the smallest phonological units (i.e., phonemes). Alternatively, the differences between phoneme and rhyme awareness are seen as quite distinct, and are referred to as small unit (phoneme) versus large unit (rhyme) theories (Duncan, Seymour & Hill, 1997). Stainthorp & Hughes (1998) examined phonological sensitivity with precocious readers and argued that shallow levels of phonological awareness appear to be necessary for reading to progress, whilst deeper levels develop later and have a more reciprocal relationship to progress in reading. Indeed, Bryant et al. (1990) found a developmental path from early sensitivity to rhyme to later tests of phoneme awareness, which was then strongly related to later reading (even after controlling for IQ and social background). Finally, Maclean, Bryant & Bradley (1987) found that children as young as three possess shallow levels of phonological awareness (rhyme) and that there is a strong association between this ability and later phonological ability (even after controlling for IQ and family background). The following example illustrates the differences between the larger (onset-rime) and smallest (phoneme) units.

syllable	hand			
onset-rime	/h/	/and/		
phoneme	/h/	/a/	/n/	/d/

Fig 1.4: Onset-rime and phoneme units

Onset-rime awareness

Goswami, Bryant and colleagues (Bryant, 1998; Goswami, 1999; Goswami & Bryant, 1990) advocate that the rime is the most important phonological unit in learning to read. They argue that the teaching of rime is developmentally more appropriate in the initial stages of learning to read as awareness of rime segments naturally arises through nursery rhymes and rhyming games. Indeed, Stuart (1993) found that, prior to literacy instruction, 60 - 67% of children could perform well on rhyming tasks (depending on the nature of the task) compared to 20 - 26% of the same children who could score well on phoneme tasks. Also, Hulme, Hatcher, Nation, Brown, Adams & Stuart (2002) tested children in the early stages of learning to read (5 - 6 years old) and found that children were better at onset-rime tasks than phoneme tasks, even when the same stimuli were used for the assessment. This is consistent with Carroll et al. (2003) who found that nursery aged children (3 years & 10 months - 4 years & 9 months) had significantly better awareness of rhyme than phoneme units of sound. Another advantage of teaching at the rime level is that the spelling system is more regular at this level of segmentation. Onset-rime teaching draws children's attention to common endings of words, for example; 'cat', 'mat', 'bat' or 'hall', 'ball', 'call', and can be likened to the teaching of 'word families' in print. Those who propose that awareness of rhyme is more important for reading to develop cite studies which have found a link

between awareness of rhyme and later reading achievement (Bradley & Bryant, 1983; Bryant, Maclean, Bradley & Crossland, 1990; Ellis & Large, 1987; Maclean et al., 1987). For example, Maclean et al. (1987) found that early rhyming skills (at aged 3) predicted beginning reading. In addition, Greany, Tunmer & Chapman (1997) found that the ability to transfer knowledge of onset-rime segmentation skills to word reading distinguished normal from disabled readers. Similarly, Ellis & Large (1987) found that the ability that best distinguished children with reading problems from their reading skilled peers was rhyme. Finally, Bryant et al. (1990) found a direct connection between rhyme and later reading, independent of phoneme awareness. It should be noted however, that in this study the onset-rime and phoneme awareness measures were taken at different times, therefore it is not possible to make any direct comparison regarding the predictive power of these different types of tasks. Indeed, those studies that have found evidence of a link between rhyme and later reading rarely pit phoneme awareness and rhyme awareness against each other.

Phoneme awareness

Others argue that knowledge of phonemes, rather than rhyme, is the best predictor of later reading and spelling (Foy & Mann, 2006; Hulme, 2002; Hulme et al., 2002; Muter et al., 1998). For example, Muter et al. (1998) carried out a longitudinal study examining the predictive power of phonological skills (rhyme versus phoneme) on later reading. It was found that phoneme segmentation skills were a far better predictor of later reading, and were also concurrently more strongly correlated with reading. In addition, Hulme et al. (2002) found that phoneme awareness was the best concurrent and longitudinal predictor of later reading, with onset-rime skills explaining no extra variance in reading after accounting for phonemic skills. This was a very tightly

controlled experiment, as the same stimuli were used in both onset-rime and phonemic awareness tasks. Research has shown that young children can learn to read very well through teaching at the phoneme level when they first start school, counteracting the claim that it is developmentally inappropriate (Johnston & Watson, 2004a; 2004b; Watson & Johnston, 1998). However it is vital that teachers are able to understand and teach at the phoneme level of segmentation (Stainthorp, 2004). Duncan et al., (1997) found that children relied on letter sound (grapheme-phoneme) knowledge for reading nonwords, rather than making analogies based on familiar rhyme units, suggesting that children naturally attempt to read words using the phoneme unit rather than onset-rime. In addition, whilst children may have naturally learnt onset-rime awareness from nursery rhymes etc prior to school, this does not mean that their teaching must be focused on this. Indeed, Duncan et al. (1997) found that even children with excellent rhyming skills had poor explicit awareness of onset-rime units, highlighting the fact that knowledge of one does not necessarily transfer to knowledge of the other. Castles & Coltheart (2004) conducted a review of seventeen longitudinal studies and reported that the level of phonological awareness most likely to influence reading and spelling acquisition is the ability to perceive and manipulate the smaller sound units (phonemes).

Onset-rime versus phoneme awareness for teaching reading

The following examples illustrate how one-syllable words are broken down into onset-rimes or phonemes for teaching reading.

Onset-rime			Phoneme		
c-at	c-all	t-each	c-a-t	c-a-ll	t-ea-ch
b-at	b-all	b-each	b-a-t	b-a-ll	b-ea-ch
m-at	sm-all	r-each	m-a-t	s-m-a-ll	r-ea-ch
f-at	f-all	p-each	f-a-t	f-a-ll	p-ea-ch

Fig 1.5: Onset-rime and phoneme units for teaching

Whilst the onset-rime level of segmentation might appear to be the most simple method of teaching reading, phoneme level teaching uses the smallest unit of sound, allowing knowledge of phonemes to be transferred more accurately to other words. For example, using the ‘cat’ example above, children taught at the phoneme level will be able to use their knowledge of the letter sound relationship for ‘a’ and ‘t’ to read other words containing these letters (e.g., trap, attack, pot, cap). However those taught at the onset-rime level will not explicitly have been taught to distinguish between the two final sounds ‘at’, therefore will not be able to transfer their knowledge to situations where these letters are apart (e.g., trap, pot, cap). In addition, phoneme level teaching teaches children that these sounds appear in all positions of the word, preparing the children for reading in this way. However, a child taught by rhyme, e.g., ‘at’, may not recognise when the same two letters appear within a word but in a different position (i.e., at the beginning of a word, e.g., attack, or in the middle of a word, e.g., battle).

The studies reviewed highlight the controversy that has occurred within the past two decades regarding whether teaching should be focused on the rime or phoneme unit. This has both theoretical and practical implications, however the evidence in favour of teaching at the phoneme level appears to be stronger. Another, equally contentious area to examine is the way in which phoneme awareness should be taught, by analysis or

synthesis, and how it should be taught in the context of reading, by either analytic or synthetic phonics.

Phonological awareness

Phonological awareness refers to the ability to be sensitive to the sound units within spoken words, and to be able to manipulate and process those sounds. Phonological awareness helps children see the linkages between letters and sounds and is often a precursor to phonics (the method used to teach children to read based on letter sound information). Phonological awareness can be measured in a number of different ways, for example, phoneme deletion, phoneme substitution, phoneme counting, syllable segmentation and rhyme judgement tasks etc. All of these tasks involve demonstrating knowledge of parts of the sound structure of words (whether rime or phoneme), however they vary in terms of difficulty and cognitive demands (Torneus, 1984). It is vital that age appropriate tests of phonological awareness are given to prevent floor or ceiling effects, as these may reduce the accuracy of these measures. It is well documented in the literature that phonological awareness is important for reading to develop (Bryant et al., 1990; Castles & Coltheart, 2004; Muter & Snowling, 1998; Muter et al., 1998; Share, 1995; Waters, Seidenberg, & Bruck, 1984). It has also been suggested that the causal relationship may run the other way, that the process of reading itself fosters more awareness of phonological segments (Castles & Coltheart, 2004). It is also possible however, that a third factor which is independent of both processes could be responsible for the correlation between phonological awareness and reading ability, through influencing the development of both (Castles & Coltheart 2004). The previous section highlighted the evidence to support teaching at the level of the phoneme, however phonological awareness at this level can be taught through two different methods; analysis and synthesis.

Phoneme analysis versus synthesis

Phonological awareness encompasses a wide range of abilities and phonological awareness tasks at the level of the phoneme require at least two different sub processes. Firstly, to be able to segment whole words into their constituent sounds (analysis), and secondly, to be able to combine/blend these sounds together to form whole words (synthesis) (Castles & Coltheart, 2004). According to Wagner, Torgesen, Laughon, Simmons & Rashotte (1993) phonological synthesis and phonological analysis show enough unique variance such that they can be conceptualised as distinct aspects of phonological awareness. In addition, Perfetti, Beck, Bell & Hughes (1987) refer to phonological synthesis and phonological analysis as two separate aspects of phonological awareness which have different roles in reading development. However, analysis and synthesis skills have been found to be highly correlated (Castles & Coltheart 2004; Wagner, Torgesen & Rashotte, 1994) and performance on both variables has been found to correlate with the acquisition of early reading skills (Wagner & Torgesen, 1987). However, no study as yet has provided unequivocal evidence that either analysis or synthesis skills are the predominant causal factor in reading acquisition (Castles & Coltheart, 2004). Analysis (segmentation) and synthesis (blending) skills can be taught before children have been introduced to letters, through training these skills in the context of spoken words (phonological awareness), or they can be taught in conjunction with word reading by using analysis and synthesis skills in written words to teach reading (phonics).

Analysis and synthesis in phonological awareness studies refers to using analysis or synthesis teaching within *spoken* words (i.e., prior to teaching word reading).

A number of training studies have been carried out to examine the effects of training analysis skills alone (Fox & Routh, 1984) or synthesis skills alone (Torgesen, Morgan & Davis, 1992) and comparing these with combined teaching of analysis and synthesis skills (Fox & Routh, 1984; Torgesen et al., 1992). One observation made consistently is that synthesis skills are much easier to teach than analysis skills (Torgesen, Wagner & Rashotte, 1994; Torgesen, et al., 1992).

Fox & Routh (1984, developed from a previous study by Fox & Routh, 1976) investigated the effects of training analysis and synthesis skills to decoding by assigning children to one of three groups; training in segmenting, training in segmenting and blending or no training. Children were trained in these skills in the context of spoken words and training took place in small groups (5-6 pupils). It was found that those children who received segmenting and blending performed better at word decoding than those who received phonemic segmenting alone. They concluded from this study that it would have been beneficial to have included a blending only condition, to investigate the effects of this skill when not coupled with segmenting.

In response to this, Torgesen et al. (1992) carried out training in phonological synthesis (blending) skills and compared this with training in phonological synthesis and analysis (segmenting) skills, and also a language experience control group. This intervention study was carried out with children who had poor phonological awareness, and teaching

was carried out in the context of spoken words, in groups of 3-5 pupils. Those trained in synthesis and analysis skills received an extra week of teaching (8 compared to 7), due to the difficulties in teaching analysis skills. It was found that children who received teaching in both synthesis and analysis skills improved significantly on both types of skills, whereas those taught synthesis skills improved only on blending skills.

A following study by Torgeson, et al. (1994) further investigated the relationship between these skills and later word reading and found that phonological analysis had a unique influence on first grade reading. However, phonological synthesis was found to have a stronger causal relationship than analysis for second grade reading. One of the main aims of the study was to explore the effects of phonological awareness training, as all children taking part in the study were from schools which used the whole language approach. The authors recommended that training in phonological awareness be included in teaching, particularly for those at risk of reading difficulties, or with reading disabilities.

Lie (1991) compared two different ways of teaching phonemic awareness skills; positional (i.e., to identify phonemes in the initial, medial, or final position, which can be likened to analysis) or analysis and synthesis (i.e., to identifying phonemes in a word in the correct sequence in order to blend them, which can be likened to synthesis). Children were taught to do so in the context of spoken words. However they were later introduced to reading books which they read with their teacher. These books contained words and pictures corresponding to the story, and children were encouraged to use their new skills throughout the reading of books with their teacher. This study therefore was not a pure measure of comparing analysis and synthesis skills without the context of print, rather these skills preceded the introduction to print and results were taken after

children were able to read and spell. The final differences between the two groups were modest, the analysis and synthesis group had the highest means in first and second grade on reading, but these differences were not significant. At the end of Grade 2 however, the analysis and synthesis group had better spelling. It was suggested however that the differences between the two groups may have been underestimated due to ceiling effects.

Share (1995) reviewed a number of laboratory-style and classroom studies which had investigated the effects of training synthesis or analysis skills on later reading. Whilst the aim was to examine the effects of phonological awareness on later reading, many of these studies contained letter sound training (laboratory-style studies) or children were taught letter sound knowledge out with the context of phonological awareness training (classroom studies). The inclusion of letters makes these studies comparable to phonics studies, however they do not include enough letter sound training to warrant them as phonics studies, and therefore this review will act as a lead into analysis and synthesis in phonics studies. Share's review (1995) found that when phonemic awareness training includes a blending component (in addition to some letter sound training), trained groups consistently outperform controls (Haddock, 1976; Treiman & Baron, 1983). However when segmentation is trained (even in conjunction with symbol-sound knowledge), findings were consistently negative (Hohn & Ehri, 1983; Treiman & Baron, 1983). However, Vellutino & Scanlon (1987) have found that training in phonemic segmentation has beneficial effects on the acquisition of word reading. In longer-term field studies, positive results have been found when blending skills are taught (and likely letter sound knowledge was concurrently being taught in the classroom) (Cunningham, 1990; Lie, 1991). However, mixed results in field studies where analysis

skills were trained, lead the author to argue that the role of phonemic analysis in reading acquisition is uncertain.

Analysis and synthesis in phonics studies

Analysis and synthesis in phonics studies refer to using analysis or synthesis teaching in the context of *written* words (i.e., in conjunction with teaching word reading).

The example below illustrates how single word reading would be taught by a teacher to their pupil, using analysis (segmenting) or synthesis (blending) skills in the context of words for reading.

Analytic Phonics		Synthetic Phonics	
Teacher	Pupil	Teacher	Pupil
Points to word ‘cat’		Points to word ‘cat’	
Here is the word ‘cat’		What are the sounds?	/c/ /a/ /t/
Break it into its sounds	/c/ /a/ /t/	Blend them together	c-a-t
What does it say?	cat	What does it say?	cat

Fig 1.6: Analytic and synthetic phonics method of teaching word reading.

Note: This example highlights how analytic phonics starts at the whole word level and focuses on segmenting whole words into their sounds for reading, whilst synthetic phonics starts with the smallest units, by blending sounds to read whole words. One important point to note is that in synthetic phonics teaching, children are being asked to read more independently as they are not told what the word is before they are asked to read it.

One large scale study (n=304) compared the effects of synthetic phonics (n=117) with analytic phonics (109) and analytic phonics with additional phonological awareness training (n=78) (Johnston & Watson, 2004a, experiment 1). The study was designed to examine the effects of phonological awareness training with and without letters, however due to it's faster pace of teaching letter sounds, the synthetic phonics condition had more letter sounds taught. It was found that synthetic phonics was far more effective at teaching children to read than both analytic phonics and analytic phonics with addition phonological training, as children taught by this method had better reading, spelling and phonemic awareness (after 16 weeks and later after 15 months). Whilst analytic phonics with phonological training produced better phonemic awareness than analytic phonics alone, this did not transfer to better reading and spelling skill. Even after speed of letter learning was controlled for, synthetic phonics children still read and spelt better than those taught by analytic phonics (Johnston & Watson, 2004a, experiment 2). In addition, when children were taught by synthetic phonics, there were no significant differences in word reading between children from disadvantaged and advantaged homes, throughout every year in Primary school, and only a significant difference emerged in Primary 7 for spelling ability, those from advantaged homes performing significantly better (Johnston & Watson, 2004b).

In addition, the faster speed at which letter sounds are taught with synthetic phonics is very beneficial to those who arrive at school with very poor letter knowledge and literacy skills. Teaching children letter sounds early on puts them on a similar level to their peers who may have been taught many more letters of the alphabet before attending school (usually those from more advantaged homes). Rather than large differences appearing and widening in literacy between those who have received no instruction prior to primary school and those who have received a lot, the first and fast

method of teaching letter sounds early on and using them for reading narrows these gaps in ability and continues to do so throughout the rest of Primary school. This can be likened to the ‘Matthew effect in reading’ (Stanovich, 1986), whereby individuals who have better early educational experiences can get more out of their new educational experiences, therefore good early achievement generates faster rates of subsequent achievement. The ‘Matthew effect’ (previously coined by Merton, 1968), refers to the Gospel according to Matthew “For unto every one that hath shall be given, and he shall have abundance: but to him that hath not shall be taken away even that which he hath” (XXV:29). With synthetic phonics, as well as allowing those children previously disadvantaged through no home literacy instruction a better method of teaching, this will also make classroom teaching more inclusive, as there will be a narrower span of attainment, allowing more children in the classroom to be involved in the same class activities requiring the same level of ability.

Share (1995) proposed that whilst phoneme synthesis may be critical for reading (sounding and blending letter sound correspondences independently to read), phoneme analysis may be critical for spelling (segmenting a spoken word given into its corresponding sounds). These methods of teaching will be discussed further in Chapter 2.

Combining phonological skills with reading instruction

Applying analysis and synthesis skills in phonics studies highlights the importance of combining phonological awareness (whether at the level of phoneme or onset-rime) to the context of reading. Studies have found better results when phonological skills are trained in the context of reading, (Cunningham, 1990; Ehri, Nunes, Willows, Schuster,

Yaghoub-Zadeh & Shanahan, 2001). In addition, reading instruction can be improved by combining it with phonology instruction than just teaching reading alone (Hatcher, Hulme & Ellis, 1994; Hatcher, Hulme & Snowling, 2004).

Cunningham (1990) compared two different forms of instruction in phonemic awareness; 'skill and drill' (taught how to segment and blend the sounds of words but not how to apply this to reading) and 'metalevel' (taught to segment and blend the sounds of words and when, where, how and why to use this within the reading context). Whilst there were no differences between the groups in kindergarten for reading, in first grade, those that were taught to use their phonemic awareness knowledge and apply it to reading (metalevel) performed better on the reading achievement test. The results showed that phoneme awareness accounted for a substantial amount of variance in reading achievement, highlighting the importance of its role in reading (Hulme et al., 2002; Muter et al., 1998).

Further evidence for combining phonological skills with reading instruction comes from a study by Hatcher et al. (1994). They found that gains in reading ability were due to a combination of phonology instruction (including, analysis, synthesis and rhyming) and reading instruction, rather than just reading or phonology instruction alone. The group that received only phonology instruction made the most progress on the phonological tasks but the group that received both phonology and reading instruction made the most progress in reading. In addition, the group that received only reading instruction was not as effective as either of the other groups in phonological or reading skills.

Finally, there is further evidence that instruction in reading alone does not provide such significant gains in reading compared to when it is combined with the teaching of

phonological awareness skills. Hatcher et al. (2004) compared the effects of four different programmes: reading with rhyme, reading with phoneme, reading with rhyme and phoneme, and reading alone (n = 410). In each of these conditions the reading element contained a strong phonic component. No differences in reading ability were found between the four instruction conditions for normally developing children. However, for children at risk of reading failure, it was only those children who were explicitly taught to link phonemes to print (reading with phoneme and reading with rhyme and phoneme groups) that made significant gains in word reading, although the differences between all the groups were modest. It should be noted that although the method of teaching reading was described as synthetic phonics in this paper, in fact it was of the analytic phonics type (Snowling, personal communication). Nevertheless, these results provide significant evidence that phonological training is most effective when used in conjunction with reading and/or letter instruction.

Alphabet knowledge

Whilst phonological skills have proven to be very important in learning to read, knowledge of the alphabet is also a vital factor known to influence reading acquisition (Adams, 1990; Foy & Mann, 2006; Muter, 1994). Letter knowledge is a very good predictor of first-grade reading skill (Evans, Bell, Shaw, Moretti & Page, 2006; Wagner et al., 1994). Indeed, letter knowledge and phonological awareness are seen as the two critical variables for learning to read (Adams, 1990; Muter, 1994; Share, 1995). A distinction should be made however between knowledge of letter names and knowledge of letter sounds. Letter sounds have a much closer relationship to the phonemes they represent and are therefore more useful to teach for reading acquisition (Foy & Mann, 2006; Treiman, Tincoff, Rodriguez, Mouzaki & Francis, 1998). Treiman and colleagues (Treiman et al., 1998) have carried out a number of studies investigating the

relationship between knowledge of letter names and letter sounds and have found that an important factor that determines knowledge of letter sounds is whether the sound occurs in the name of the letter (e.g., P - p, but not W - w). If the sound does appear, it is learnt more easily if it is at the beginning of the letter name (e.g., P - p), than at the end, (e.g., F - f). This suggests that children can use their knowledge of letter names, which typically precedes letter sound knowledge in our culture (Foy & Mann, 2006), to learn and remember letter sounds. This categorisation of letter sounds was used later by Foy & Mann (2006) who found that knowledge of letter sounds, regardless of whether they contained a phonological component (e.g., F - f or P - p) or not (e.g., W - w), predicted later phoneme manipulation skills. However only those letter sounds that contained a phonological component (e.g., F - f) predicted later rhyming skills, suggesting that these categories of letter sounds show a differential relationship to later awareness of rhyme. Muller (1973) investigated the effect of phonic blend training on word decoding performance of first grade children. Children were either taught letter sounds or letter names, and whilst there was no difference between these groups on word decoding if they had not been taught to blend, for those who did receive training in blending, those taught letter sounds performed significantly better in word decoding than those taught letter names. A more recent study (Stainthorp & Hughes, 1998) tested children who were fluent at reading before they attended school and compared them with children matched on verbal intelligence but who were not yet reading. Those fluent at reading showed significantly higher levels of phonological sensitivity (particularly at the shallow and intermediate levels) and also significantly greater alphabet knowledge. It was concluded that the ability to integrate phonological skills and knowledge of the alphabet are important tools in learning to read.

Further skills involved in reading acquisition and development

Oral language skills

During later reading development, other skills, for example broader language skills, will be important in reading development (Hulme, Snowling, Caravolas & Carroll, 2005; Nation & Snowling, 2004). Although phonological skills help children to decode new words, there is more to reading than decoding, as children need to understand what they have read, and therefore vocabulary and listening comprehension are important for word recognition and reading comprehension to develop. Nation & Snowling (2004) emphasised the importance of recognising broader language skills, and not only phonological skills in reading development. Children aged 8½, were administered a range of tests relating to reading, oral language, phonological skills and nonverbal ability, and then re-tested at age 13. The authors found that oral language skills (vocabulary, listening comprehension and semantic skills) predicted reading comprehension, and that even after controlling for the effects of decoding and phonological skills, individual differences among children in language skills were related to individual differences in word recognition. They found that both expressive vocabulary and listening comprehension were better longitudinal predictors of word recognition than semantic skills. Language skills were argued to be particularly important in reading irregular words (words which do not have regular letter sound correspondences), as greater language skill may allow children to read words more accurately through better understanding of word context or word recognition. Children with better oral skills, richer vocabularies and better syntactic skills, will be more accurate at using context and knowledge of grammar to resolve situations where word decoding leads to ambiguous pronunciations (i.e., with some irregular words). Consistent with this argument, one study has shown that oral vocabulary skills predicted

concurrent reading comprehension and exception word reading, but not text reading accuracy, nonword reading or regular word reading (Ricketts, Nation & Bishop, 2007). This suggests that oral vocabulary skills are particularly important for understanding meaning (which is necessary for good reading comprehension) and for resolving any ambiguities in pronunciation for irregular words.

The combination of phonological and language skills for reading is highlighted in the simple view of reading (Gough & Tunmer, 1986) which states that there are two chief elements that are equally important for reading comprehension (R). The first is decoding skills (D), the second is linguistic comprehension (C). The equation $R = D \times C$ highlights this simple view towards reading which argues that in order to understand what you have read, you must be able to decode the words and then make sense of them. If a person cannot decode words, they will not be able to achieve reading comprehension, however decoding alone does not guarantee reading comprehension. This simple view of reading is commonly cited, but arguably might be too simple to account for reading comprehension. For example, Cain et al. (2004a) found that working memory and component skills of comprehension (inference skills, comprehension monitoring and story structure knowledge) predict unique variance in reading comprehension (R), even after word reading ability (D), vocabulary and verbal ability (C) have been controlled for.

Use of context for reading

The way in which children are taught to read and their reading ability will impact on their use of context for reading. Use of context is often a factor that can distinguish good from poor readers. Context can be used for two different processes; to facilitate

word reading or to facilitate comprehension, and there is often some confusion between these two processes. Whilst it has been found that good readers use context, this has often been inappropriately generalised to the word recognition level (Stanovich & Stanovich, 1995). Rather, the evidence shows that good readers are better able to use contextual information to facilitate their comprehension (Baker & Brown, 1984), however, poor readers have consistently been found to rely more on context for word reading (Bruck, 1990; West & Stanovich, 1978; Stanovich & Stanovich, 1995; Perfetti, 1995). This is likely to be a compensatory strategy as they lack the decoding skills for word reading. As poor readers are often more inexperienced readers, and lack the vocabulary and understanding of grammatical and contextual knowledge in order to make as an informed guess as better readers, their dependence on context is not a good strategy. In addition, whilst these poorer readers are using context to ‘guess’ the words, they are paying very little attention to the orthographic structure of the word itself, providing less time for processing this word, resulting in poorer recognition when encountered again. The assumption that good readers gloss over passages, focusing on a small number of words and using context to guide reading is not supported and evidence suggests the contrary. Studies measuring eye fixations show that readers’ ability to answer comprehension questions is generally limited to the text locations that they have actually fixated (Just, Carpenter & Woolley, 1982) suggesting that individual words must be read and processed for accurate comprehension. Studies investigating the ability to use context to aid word reading have found that even where children are provided with the preceding text before the word, the initial letter of the word and the word’s length, they still make many errors when ‘guessing’ the word. The proportion of errors is higher for content words which provide more information (i.e., adjectives, nouns & verbs; proportion of errors = 0.60) compared to function words (i.e., articles, conjunctions, prepositions, auxiliary verbs and pronouns; proportion of errors = 0.31)

(Gough & Wren, 1999). This result has been found across a variety of subject populations and texts, where a readers' probability of correctly predicting the next word in a passage is usually between 0.20 and 0.35 (Stanovich & Stanovich, 1995). This highlights the drawbacks of relying on context for reading. Phonics tuition therefore may provide a strong foundation for word reading from which reading comprehension can develop. Indeed, learning to read individual words is highly correlated and a good predictor of reading comprehension (Dally, 2006; de Jong & van der Leij, 2002; Muter & Snowling, 1998).

Underlying cognitive processes

Up until now, reading has largely been considered as if it is a modular system, not affected by other cognitive processes. However associations with reading have been found with various cognitive skills in non-reading tasks. A particular focus of this thesis will be on the relationship between word reading and PASS (planning, attention, simultaneous and successive) cognitive processes (Das, 1999; Das, Naglieri & Kirby, 1994; Naglieri, 1999, Naglieri & Das, 1990). PASS theory is based on the neuropsychological work of Luria (1970) who identified three operational units that are important to understanding mental functioning; arousal/attention, simultaneous & successive skills, and planning. Planning refers to the ability to choose, select and then use the most appropriate strategy in order to solve a problem or complete a task. Planning provides intentionality and impulse control. Attention is important so that individuals can focus on particular information and be able to inhibit distracting and useless information. Simultaneous processing allows a person to deal with many pieces of information at the same time, integrating information or stimuli into a coherent whole in order to make sense of it. Finally, successive processing involves working with

information in a specific serial order, allowing a person to perceive and work with stimuli in sequence. In particular, performance on simultaneous (necessary for integration of information into a whole) and successive (coding information in a serial order for processing) tasks has been linked to word reading skill (Das, Parrila & Papadopoulos, 2000). There is ample evidence that simultaneous and successive processes correlate with both reading comprehension (Das et al., 2000; Das, Janzen & Georgiou, 2007; Kirby & Das, 1977; Naglieri, 1999; Naglieri & Das, 1990) and reading decoding (Das et al., 2000; Joseph, McCachran & Naglieri, 2003; Naglieri, 1999; Naglieri & Das, 1990). In addition, phonological memory has been found to be highly correlated with successive processes (Joseph et al., 2003). However, no cognitive task requires only one of these processes, rather it is a matter of differences of emphasis based on task demands. For example, planning and attention skills will be drawn upon when task demands are high. This theory has been used to explain gender differences in cognitive performance (Naglieri & Rojahn, 2001; Warrick & Naglieri, 1993), with girls performing better on planning and attention scales.

Attitudes to reading

Attitudes to reading have also been found to be closely related to reading skill (McKenna, Kear & Ellsworth, 1995a) and frequency of reading (Sainsbury & Schagen, 2004), although the direction of causality is undetermined. In addition, girls have been found to have more positive attitudes to reading (Askov & Fishback, 1973; Coles & Hall, 2002; Kush & Watkins, 1996; McKenna et al., 1995a; Sainsbury & Schagen, 2004, Smith, 1990), read more frequently (Coles & Hull, 2002) and have better reading ability (NLS statistics, 2007; PIRLS, 2001). Attitudes to reading represent a consistent source of differences between boys and girls and are an area which can be studied in order to examine their association with frequency of reading and reading skill. In addition, the

effect of reading instruction on attitudes to reading is an area which is in need of more research, although previous large scale studies have found no differences in attitudes to reading, even when children are taught by very different methods (McKenna, Stratton, Grindler and Jenkins, 1995b; Stahl, McKenna and Pagnucco, 1994). These different methods examined are either whole language approaches (where teaching is tailored around the students ability and students have more control over their teaching, with no systematic reading instruction) or basal (phonics orientated) approaches (which introduces reading skills gradually and sequentially, and links phonics knowledge to reading). Whilst these approaches to teaching appear to be either student orientated (whole language) or skill orientated (phonics), no differences in attitudes to reading have been found.

The purpose of reading

Word recognition versus reading comprehension

The purpose of reading will vary depending on what the reader wants to attain from the material. However, good comprehension, as shown by a good understanding of what they have read, is a clear goal for all readers. It is important to make a distinction therefore between word recognition and reading comprehension. Those researchers who support phonics instruction for reading have been criticised for arguing that word recognition (i.e., correct pronunciation) amounts to reading, but this point is clearly misunderstood (Stanovich & Stanovich, 1995). Those who support phonics instruction emphasise the importance of word recognition in reading, however they do not deny that the ultimate purpose of reading is comprehension. Good word reading skill underlies good comprehension. A child cannot have good comprehension without

adequate word reading skill. Indeed, word recognition skill has been found to be the single best predictor of reading comprehension (Vellutino, 1991) and many studies have found word reading to be highly correlated or a good predictor of later reading (Curtis, 1980; Dally, 2006; de Jong & van der Leij, 2002; Muter & Snowling, 1998). However a child's word reading skill does not always generalise to good comprehension. Instead it may be deficits in working memory (the ability to store and process information), integration (of information in the text to establish coherence) or inference skills (Cain & Oakhill, 1999; Cain, Oakhill & Bryant, 2004a) that cause problems with comprehension. Despite this, a large number of studies have found that training in decoding skills and phonological sensitivity transfers onto positive effects in reading comprehension or text reading (Cunningham, 1990; Evans & Carr, 1985; Hatcher et al., 1994; 2004; Lie, 1991; Tunmer & Nesdale, 1985). These studies illustrate that the positive effects of teaching decoding skills generalise to reading comprehension (likely through better word reading skill). Combined, these studies provide powerful evidence that word recognition is important (but not sufficient) for good reading comprehension.

In addition to decoding, language skills, working memory, integration and inference skills, one study has found that a child's reading strategies (based on the way in which they have been taught to read) can produce differences in reading comprehension (Connelly et al., 2001). This study compared the effects of reading instruction on reading comprehension using two very different approaches to reading instruction; phonics and the 'book experience' approach (which encourages children to use context to aid word recognition). Whilst it was expected that the children taught via the book experience approach would have better reading comprehension, due to its focus on reading within context, the group taught by phonics had better reading comprehension, despite both groups being matched on reading accuracy (word recognition), indicating

that word recognition alone does not predict reading comprehension (Connelly et al., 2001). One possible explanation is that the phonics taught children were slower readers, and were more likely to attempt to read unknown words compared to the non-phonics counterparts. It was suggested that perhaps their method of reading encouraged them to think more about the story as they read it, to check their responses matched the context. This extra rehearsal whilst reading was proposed to lead to better reading comprehension.

Benefits from reading: vocabulary acquisition

Written text is an important source of vocabulary acquisition (Cunningham & Stanovich, 1991, 1998; Echols, West, Stanovich & Zehr, 1996) once children become fluent readers. Stanovich (1986) proposed that most vocabulary growth occurs through learning meanings of unknown words in oral or written language, rather than being a product of direct instruction. Children are exposed to new words within text and can often learn the meaning of words through the context in which they are presented. In this way, reading can act as a self-teaching mechanism for vocabulary (although inferences of meaning will not always be correct). Naturally, a child who has better reading skill will be able to read a larger variety and greater difficulty of texts, thereby being exposed to a wider range of vocabulary. A five stage process has been proposed to explain the acquisition of new words from print (Cain, 2007). Firstly, children encode the phonological representation of the word and then infer the meaning from context. Next children link the meaning with the phonological and orthographic representation, store this new knowledge and finally integrate it with existing knowledge. This process highlights the importance of paying attention to the phonological and orthographic information from the word and integrating this with its

context in order to acquire new vocabulary. Children who do not have a method of decoding the word and pay little attention to its orthographic structure (relying instead on context for reading), will ‘gloss over’ the actual word, and therefore be less likely to process it and acquire the vocabulary for future reading and writing. In addition to vocabulary, exposure to written text has been found to be related to, or highly predictive of general knowledge and information in children (Cunningham & Stanovich, 1991; Echols et al., 1996) and adults (Stanovich & Cunningham, 1993; Stanovich, West & Harrison, 1995).

CHAPTER 2: INTRODUCTION (PRACTICE)

The following chapter reviews a number of methods of reading instruction which emphasise different skills for reading acquisition and development. There are numerous ways to teach reading, and methods tend to differ in terms of focus on initial skills as precursors for reading (e.g., phoneme versus rime awareness), and also in further teaching where different strategies are taught for reading words (e.g., phonics (analytic versus synthetic), contextual information, whole word teaching etc).

The alphabetic method

Pre-twentieth century methods of reading used an alphabetic method, which in essence meant teaching children the letters of the alphabet (letter names; ay, bee, cee) and then using this knowledge to decode words (Hannon, 2000). One obvious limitation of this method is that the letter names do not map easily onto words. However, it is likely that this basic alphabetic method was supplemented by teaching further letter sound associations (e.g., ah, buh, cuh) which have clearer mappings to letters.

The whole word approach

The ‘whole word’ or ‘look and say’ method encourages children to learn and recognise words as visual wholes (Harris & Coltheart, 1986). No reference is made to the individual letters making up that word, or to the relationship between letters and sounds. This method may be taught using flash cards with single words written on them, by having name cards attached to objects in the classroom, or pointing to the words within

a book. However, research has found that children learn sight vocabulary better and faster if presented on flashcards, than if presented in a book or using a combined method of flashcards and books (Stuart, Masterson & Dixon, 2000). This approach is often used initially for teaching children words which they will come across frequently, for example words or character names that will appear in their first books. This has been observed in schools using the Oxford Reading Tree reading scheme where children are taught to read as whole words, the characters in their first books such as ‘Chip’, ‘Biff’ and ‘Floppy’. This type of teaching can be likened to Frith’s (1985) ‘logographic’ stage of reading development, and also Marsh et al’s (1981) first stage of reading development if the children are not taught letter sounds. Children are tested on these words through rote memorisation and rehearsal. The children need to learn to read the words as wholes and so may look for distinctive cues within the words and associate them with the spoken word. Such techniques may include using the first letter, the word length, or other distinctive features of the word (e.g., double letters). A very important drawback of this method is that it relies very heavily on visual memory, and therefore there is only a limited amount of words which can be learnt in this way, as words look very similar. Interestingly, Stuart et al. (2000) found that children with poor alphabet knowledge and phonological skills relied more heavily on visual memory for recognition of sight vocabulary ($r = 0.79$) compared to children with good alphabet knowledge and phonological skills ($r = -0.11$) who were likely using other strategies for remembering the words. Teaching children to read words as wholes gives them no techniques for deciphering new words, as the words learnt cannot be generalised to others. Also, children may be confused between words which share similar patterns, for example, ‘fine’ and ‘fire’, or between words which share similar distinctive cues within them, for example the double l ‘ll’ in ‘collect’ and ‘yellow’. Finally, even after repeated exposures to words (whether on flash cards or within reading books), children find it

very difficult to remember words by sight. Stuart et al. (2000) found that even after children had been shown words on flashcards 36 times, only an average of five out of sixteen words could be recalled, with two children not being able to recall any. In the first term of school, Stuart et al. (2000) found that the average number of different words that children encounter is 125.9 (57.9 S.D), therefore other strategies need to be in place for children to learn to read. Analysis of the word stock of printed school materials reveals that from Grade 3 - Grade 9, printed school English contains about 88,500 distinct word families³, with upwards of 100,000 distinct meanings (Nagy & Herman, 1991). Nagy & Herman (1991) suggested that the average fifth grader encounters almost 10,000 new words a year, and that for a student with a smaller than average vocabulary, the number of unfamiliar words would be even higher. Therefore this method alone cannot possibly provide children with the ability to become skilled readers. In addition, Stuart et al. (2000) found that children are much more successful in learning sight words if they have good phonological awareness and alphabet knowledge, highlighting the importance of these skills not only for use in phonics approaches (i.e., through recoding of the letter sound string), but also in influencing the success in learning sight vocabulary.

Language based approaches

This is a common approach to teaching used in other English speaking countries (in particular, New Zealand, Australia, and some parts of the U.S and Canada) but will be summarised briefly in order to make comparisons to phonics methods clearer. The main principle underlying the whole language approach is that learning to read and write is natural, and that children can learn to read as they learnt to speak; through exposure to a literate environment. It is argued that there is no special key to reading

³ A word family consists of a set of words for which there is a transparent, predictable relationship in both form and meaning, e.g., persecute, persecution, persecutor, persecuted, persecutions.

and writing, and no explicit skills that need to be taught. Rather, it is argued that children learn to read and write best when they are doing so for authentic purposes and that through social interactions with books and text, children will become good readers. Indeed, teachers create children's learning experiences around their actual uncontrolled language and vocabulary (McKenna et al., 1995b). The basic tenet being that "kids learn when they are in control of their learning and know that they are in control" (Goodman & Goodman, 1990, p. 226). However, this approach assumes that children are naturally in environments which are stimulating and rich with conversation and varied vocabulary. However children from low socioeconomic status (SES) backgrounds often do not have this stimulation, and very often arrive at school with little or no knowledge about the English language's written system and with poor vocabulary. These children are likely to suffer with a programme which is based on their knowledge for learning to develop. In addition, whilst children will learn the letters of the alphabet, they will not be taught the link between letter sound correspondences, which is something that children often do not learn implicitly (Masonheimer, Drum & Ehri, 1984). However this is a factor consistently found to be important (although not necessary) for reading to develop (Castles & Coltheart, 2004).

Phonics

Phonics is a method of teaching reading that focuses on letter sound relationships. It is used predominately in the earlier stages of learning to read, and stresses the fact that there is a predictable relationship between graphemes (the letters and spellings in the written language) and phonemes (the sounds which represent the letters in the spoken language). To teach using phonics, letter sound correspondences are taught to children, who are then taught to break whole printed words down into letters and their constituent sounds (analytic phonics), or instructed to sound and blend the sounds to read the word

(synthetic phonics). Initially children are taught regular words (which follow regular and simple letter sound correspondences), and later on more complex letter sound correspondences are taught, alongside words which have irregular spellings. One very important point about the use of phonics for reading is that it provides a self-teaching mechanism, allowing children to independently teach themselves new words once they have learnt the letter sound correspondences (Share, 1995).

Over the years, with an increase in research, the knowledge, resources and understanding of the teaching of reading is beyond what it has ever been before. Reading programmes are developed in order to make learning to read as easy as possible, so that children may achieve higher standards in reading, and feel more successful and confident in their abilities. The teaching of reading however is a highly political subject, with many differences in opinion. The rest of the introduction provides a summary of some of the main programmes currently used to teach reading in Britain.

The National Literacy Strategy

In 1997, the newly elected Labour government put forward a 'National Literacy Strategy' for England. This strategy was to affect 20,000 schools, 190,000 teachers and 3 million pupils. The strategy identified the literacy problem to be tackled; the Literacy Task Force focused on underachieving schools, poor teaching methods and poor teacher training. The goal set by the National Literacy Strategy was that by 2002, 80% of all 11 year olds would reach the standards expected of their age in English (i.e., Level 4), in the Key Stage 2 National Curriculum tests. In previous years the number had fallen short of this goal; in 1997 it was 63%, in 1998, 65% had achieved this level and in 1999, 70% had (Hannon, 2000). The introduction of the National Literacy Hour and the

Framework for Teaching represented two of the main steps towards achieving this goal. The National Literacy Hour was a daily lesson consisting of four parts; group or individual activities, whole class work with shared text, whole class word or sentence work and whole class review, sharing and evaluating (Stainthorp, 2002). The Framework for Teaching specified in considerable detail each term of every year's programme to be carried out, in relation to three levels of work – word (phonics, word-recognition, graphic knowledge, spelling, vocabulary and handwriting); sentence (grammatical awareness, sentence construction and punctuation); and text (composition and comprehension, through a variety of text-types) (Huxford, 2000). These three strands built with increasing complexity through each term of every primary school year. The Framework for Teaching also indicated word lists to be learnt and planning and monitoring procedures. The Framework for Teaching, although not statutory, was clearly expected to be used in all schools in England. According to the strategy the teaching of reading was proposed to be more successful if it was taught by multiple approaches. A searchlight model was proposed where children are encouraged to use a range of strategies to read.

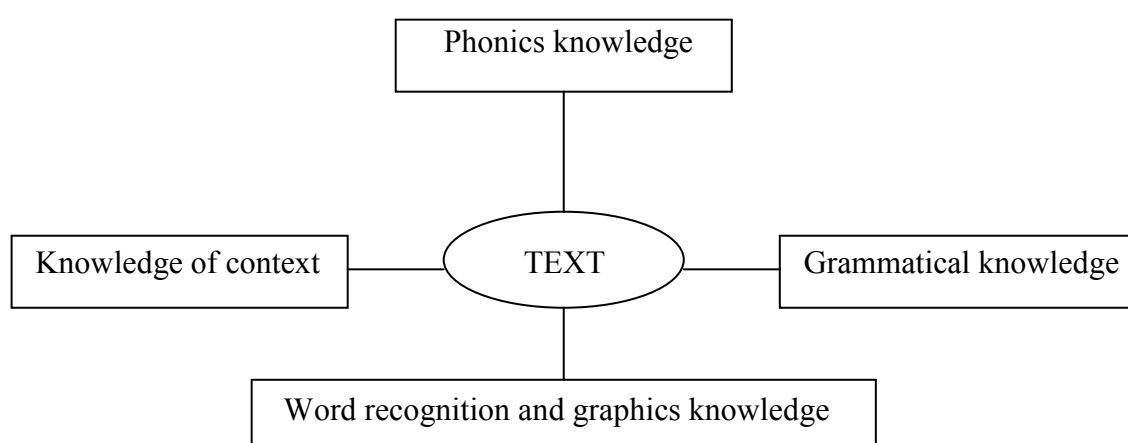


Fig 1.7: National Literacy Strategy searchlight model

Note: Phonics knowledge refers to the use of letter sound correspondences to aid reading. Word recognition applies to using the recognition of words or word parts (in particular morphemic segments; e.g., ‘talk’ and ‘ed’ in talked) for accurate reading. Knowledge of context and grammatical knowledge refer to ‘guessing’ what the word is based on the text or pictures, by drawing on the spoken language to predict what type of word will come next and using grammatical and contextual information for a more informed guess.

Using this approach, children are encouraged to orchestrate these strategies, to use at times two or more at once depending on the level of their skills/abilities and the difficulty of the text. However one problem is that children may become reliant on some techniques at the expense of others and may not have a sound enough knowledge of phonics to learn new words themselves. As previously mentioned, the use of context for guessing or predicting an unfamiliar word is not a particularly accurate method of reading, and may undermine the use of a phonics approach.

Since the introduction of the National Literacy Strategy, a more phonics approach has been introduced in response to evidence of its importance in reading acquisition. School inspection reports prior to the National Literacy Strategy had consistently criticised schools for the lack of effective phonics training, (e.g., HMI 1991, 1992; OFSTED 1996). Progression in Phonics was therefore introduced in 1999; it was an interactive play-based approach to teaching phonics, using an analytic phonics (see below) scheme combined with phonological awareness training and segmentation for spelling. Using Progression in Phonics, children were encouraged to take part in alliterative and rhyming games and were initially taught letter sounds in the initial positions of words (DfES, 1999). They then learnt about letter sounds in the final position of words, and then in the medial position of words. Children were then taught

to segment to spell CVC⁴ words and then blend to read CVC words. This was done after children had been taught approximately 25 grapheme-phoneme correspondences. The approach involved telling children the whole word, then to break it into its sounds before blending them back together again (i.e., full circle game). This is an analytic phonics approach. In 2004, *Playing with Sounds* (a supplement to *Progression in Phonics*) was introduced, which was more like synthetic phonics because of its accelerated speed. Segmentation for spelling and sounding and blending were taught, however the programme's primary focus was not towards sounding and blending. Some of the studies within this thesis will compare the effects of the National Literacy Strategy programme and synthetic phonics. It should be noted that all children who learnt to read by the National Literacy Strategy approach, learnt with *Progression in Phonics* (with the exception of Chapter 10, who learnt phonics via *Playing with Sounds*).

Analytic Phonics

Analytic phonics is generally taught in parallel with or after reading books are introduced. Children are taught one letter sound a week, therefore the rate of teaching letter sounds is relatively slow, and they are often introduced to a series of alliterative pictures and words which use that letter sound (e.g., cat, cup, cake). When the 26 initial letter sounds are taught, children are introduced to final sounds in words (e.g., nap, cup, top), middle sounds (e.g., cat bag, man), and then initial constant blends (e.g., bl, cr), and final consonant blends (e.g., nt, ng), and finally, vowel and consonant diagraphs (e.g., ee, ch) (Johnston & Watson, 2004a). In analytic phonics, once children have been taught letter sound correspondences in all positions of the word, word reading is taught by telling the child what word they are reading, then asking them to segment the word into its constituent sounds before blending them back together to read

⁴ Consonant - vowel - consonant (e.g., cat)

the word. This technique does not foster independent reading as children have already been told what the word is and so do not need to master sounding and blending in order to pronounce the word correctly. As this approach takes a long time to teach all the letter sounds, in all positions of the word, children initially have poor phonic knowledge and so will use other techniques in order to help them to read, such as picture cues, word recognition, or guessing, either from context, initial letter sound, distinctive features within the word or word length. With analytic phonics children will receive some whole word teaching for high frequency words within their reading books in order to start them with reading. This method does not typically include segmenting for spelling. Some experts may support this method as phonics teaching is spread out more evenly throughout the year giving children a gentler introduction to it. This may be argued to be developmentally more appropriate. In addition, teaching initial letter sounds first could also be deemed as most appropriate as these are the most obvious to the child and can be taught through alliterative games.

Synthetic Phonics

The principles behind analytic phonics are quite different to those of synthetic phonics. The main principle of synthetic phonics is that it must be taught first and fast so that children have a method to read independently very early on (Johnston & Watson, 2004b). It is important that words are not taught through the whole word approach, so that sounding and blending for reading is uppermost in the children's minds. Ideally, synthetic phonics is taught before children are introduced to books or reading. It involves teaching letter sounds very rapidly (the letter sounds which are initially taught are those which combine to make the greatest number of words). These letters sounds are taught in all positions of the word right from the start. This allows the child a method of decoding new words, through sounding and blending the constituent sounds.

At the same time, spelling may be taught by segmenting the words, this reinforces using the letter sound correspondences of the word, but a synthetic phonics scheme may not include this. Children are taught all the letter sounds very quickly, and are then taught consonant and vowel digraphs. Children can be introduced to reading books with a method of reading new words and will use the strategy of sounding and blending for reading, however it is important to stress that whilst words are decoded in this way, the children are also taught to read for meaning. Throughout the teaching of synthetic phonics it is important that teachers do not promote reading strategies which conflict with the approach, for example, guessing words from pictures, context or initial letter cues. Irregular words, which cannot be taught through simple letter sound correspondences, are taught separately, although attention is always drawn to the parts of irregular words which follow consistent letter sound correspondences. This reinforces the importance of letter sounds and the strategy of sounding and blending. It is thought that by teaching the letter sound correspondences very early on, this reduces the gap between those children who have started school with a very good knowledge of the alphabet (taught by their parents or older siblings), and those children who are greatly disadvantaged by starting school with no knowledge or very little knowledge of the alphabet. Right from the beginning of school, as children are involved in literacy experiences in the classroom (i.e., big books, shared reading, words and letters on the classroom wall), those children who were disadvantaged before have been taught early on about the alphabetic principle. This allows them to gain much more from these literacy experiences, which otherwise would have more greatly benefited those with a better knowledge of the alphabet.

These two methods of teaching will be compared as they have been used in all reading programme comparisons throughout the studies for this thesis. Recently, the National Literacy Strategy has placed more emphasis on phonic methods in response to evidence of its importance in reading acquisition, and this approach was well established in the classes in England where the studies were carried out. However, whilst synthetic phonics teaches only one strategy for reading (using letter sound correspondences to sound and blend), the National Literacy Strategy taught four different strategies to read words: grammatical knowledge, word recognition and graphic knowledge, knowledge of context and phonics. Children are encouraged to use a combination of these techniques in order to read unfamiliar words. Another important difference is that synthetic phonics encourages children to read new words independently by blending the phonemes and working the word out for themselves. This is in comparison to the NLS in which the teacher tells the child the word and then gets them to convert the letters into sounds and then blend the sounds back together (a primarily analytic phonics approach). The National Literacy Strategy expects children to read books from the start, even though they may understand very little of the text, on the other hand, teachers of synthetic phonics do not give children books until they are ready and able to use phonics to work out many of words. Another important difference is that the NLS initially uses a whole word approach to teaching high frequency words so that children are able to recognise these words from sight. On the other hand, whilst high frequency irregular words cannot be taught through straightforward sounding and blending, synthetic phonics will also draw children's attention to the parts of the irregular words which are more regular, thereby reinforcing the strategy of sounding and blending. A final important difference is the time-scale used to teach letter sound correspondences.

With synthetic phonics, the major letter sound correspondences can be taught in about 12-16 weeks. This is important, as this is the only method children have in which to read new words. On the other hand, as children are taught to use a variety of strategies to identify new words under the NLS scheme, the use of letter sound correspondences all through the word is not viewed as being essential and it is usually a few terms before these are all taught.

Final note

It is important to note that a child's success in school may depend on the reading programme which is implemented in the classroom. However it is crucial to realise a further variable which can have an enormous impact on a child's progress. This factor to be considered is the child's teacher. From observations in children's classrooms it is clear that the success of a reading programme, or the skills taught to children will depend on the teacher's ability to engage the child within the classroom. Chall (1967) recognised that vast differences in the children's responsiveness to their reading lessons and the mood of the classroom appeared to be independent of the philosophy or objective behind a particular program or materials. It did not appear to be the content of the materials, the emphasis on phonics rules or the class size or organisation which was the most influential factor in reading. Rather it was the environment created by the class teacher. There is also accumulating evidence that teachers' credentials, experience, and years of education may make a difference in children's achievement (Darling-Hammod & Youngs, 2002). In addition, teacher expectations, responsiveness, praise and pace and quantity of instruction have been related to student outcomes (Brophy & Good, 1986). Finally, their ability to manage and control behaviour (Brophy & Good, 1986), and to be responsive to student questions and interests whilst providing a

positive emotional climate in the classroom has been linked to better student outcomes (McDonald-Connor, Morrison & Katch, 2004a; McDonald-Connor, Morrison & Petrella, 2004b).

CHAPTER 3: THESIS OVERVIEW

The previous two chapters were intended to provide an introduction to the thesis, by outlining models of reading, reviewing some of the past literature on reading research and describing different practices for teaching reading. The purpose of the studies in this thesis are to examine reading strategies, attitudes to reading and underlying cognitive processes, focussing on the effects of different types of reading instruction and gender differences.

Aim

The aim of this thesis is to investigate the factors which may affect children's reading achievement and to look at the influence of reading instruction and gender differences.

Reading strategies

Chapter 4 outlines the effect of reading instruction on reading strategies ($n = 64$, average age = 10 years & 7 months (0.35 S.D)) and a discussion follows on how the results can be explained in the context of models of skilled reading.

Chapter 5 reviews gender differences in reading strategies ($n = 82$, average age = 10 years & 5 months (0.36 S.D)) and possible suggestions are given for these differences; whether a result of naturally inherent differences or stage of maturation in reading development.

Attitudes to reading

Chapter 6 outlines gender differences in attitudes to reading, school, competency beliefs and support networks (n= 232, average age = 10 years & 7 months (0.35 S.D)) and how these relate to reading achievement and frequency of reading.

Chapter 7 summarises the effect of type of reading instruction on attitudes to reading and reading ability (n = 168, average age = 10 years & 7 months (0.34 S.D)) and highlights the need for further research to be carried out in this area.

Cognitive processes

Chapter 8 examines gender differences in planning, attention, simultaneous and successive skills (PASS underlying cognitive processes) and their associations with reading ability (n = 141, average age = 10 years & 7 months (0.36 S.D)),

Chapter 9 outlines the effect of reading instruction on underlying cognitive processes, reading ability and phonological skills (n = 51, average age = 10 years & 6 months (0.33 S.D)) and assesses whether reading instruction can develop skills beyond the reading system.

Chapter 10 summarises a longitudinal intervention study (n = 37, initial average age = 4 years & 11 months (0.16 S.D)), examining the effects of different types of reading instruction on children's early reading skills. It also investigates whether type of reading instruction influences the role of different cognitive skills in early reading development.

General discussion and conclusions

Chapter 11 summarises the results of all studies, bringing together the literature from all areas and integrating it into a discussion regarding the influences and factors involved in reading acquisition and development.

General hypotheses

The focus of the thesis is therefore on two different areas: gender differences and the effect of different types of reading instruction.

With regards to gender differences it is hypothesised that:

Girls will be better at reading, have more positive attitudes to reading and perform better on measures of planning and attention (underlying cognitive processes) compared to boys. No predictions are made regarding their strategies for reading.

Regarding the effects of different types of reading instruction it is predicted that:

Those taught by synthetic phonics will be better at reading, have a more phonological approach to reading, and will perform better on measures of simultaneous and successive skills (underlying cognitive processes) compared to those taught by analytic phonics. It is predicted that there will be no effect of reading instruction on attitudes to reading.

CHAPTER 4: READING STRATEGIES

THE EFFECT OF READING PROGRAMME

Introduction

In order to understand the processes involved in reading words, it is important to consider the way in which printed words map onto speech. In alphabetic languages (such as English), understanding the link between orthography (written symbol) and phonology (the sound) is crucial in learning to read. Some alphabetic languages (such as Italian and Spanish) follow the alphabetic principle almost perfectly, with each letter representing one (and only one) phoneme. Therefore words can be pronounced accurately every time by sounding and blending the phonemes for reading. English however does not have a pure alphabetic system, for example the sound /k/ can be spelt with a 'c' or a 'k' or a 'ck'. Alternatively, the letter 'c' can be pronounced as /k/ in 'car' or /s/ in 'city'. Finally, vowel digraphs such as 'ea' have very variable pronunciations. In addition two different words with different spellings (i.e., homophones, e.g., one and won) are pronounced the same way, whereas two different words with the same spellings (i.e., homographs, e.g., tear (cry) and tear (rip)), are pronounced differently. Although these examples highlight the complexities of the English language, it does not undermine the importance of the alphabetic principle. For example, the sound /k/ would never be spelt with a 'm', and the letter 'c' would never be pronounced as a /r/. In addition 'bave' could rhyme with 'cave' or 'have' but would never rhyme with 'gad'. Whilst there are some irregular words in the English language, there are often regular sound-spellings underlying them (for example in 'pint', the /p/ and /nt/ are regular).

Despite the irregularities in English spelling, it is widely accepted that understanding the link between orthography and phonology is very important in learning to read (Castles & Coltheart, 2004).

As previously highlighted, a number of different models have been proposed in order to explain the way in which words are read, and to account for the complexities within the English language. These complexities refer to the irregularities found in the letter sound correspondences of some words. As discussed in Chapter 1, words can be categorised under two separate headings; regular and irregular (strange & exception), the difference between regular and irregular words lying in the relationship between orthography and phonology. The two models of word reading summarised below have been previously outlined (see Chapter 1), however more detail is given regarding the alternative explanations of how words are read in both models.

The dual route model (Coltheart, 1978) has been the most dominant framework for modelling skilled reading throughout the past 25 years and proposes two ways in which a word can be read. Firstly, word reading via the direct route occurs from the visual analysis system (which identifies the string of letters) to the visual input lexicon, responsible for identifying letter strings as familiar words. This lexicon contains word recognition units, and through learning and reading experience, more word recognition units are created. By this method, words are processed holistically, and therefore all words, whether regular or irregular can be processed in this way. Nonwords cannot be processed in this way as no orthographic representation of these word types exists in memory. Beyond the visual input lexicon there are two outputs, an output to the semantic system, to access the meaning of the word being read, and to the speech output lexicon, which provides knowledge on how to pronounce the word. The second indirect

(phonological/nonlexical) route, converts the graphemes into phonemes to allow correct pronunciation. As previously mentioned, regular words can be read in this way, as there is a direct relationship between the printed letters (graphemes) and sounds (phonemes) and therefore the words follow simple spelling-sound rules. Nonwords (letter sequences which do not exist in English but which follow regular spelling-to-sound correspondences) can only be read via this route. However, irregular words, with their irregular mapping of grapheme-phoneme correspondences will be pronounced wrongly (i.e., 'pint' will be pronounced to rhyme with 'mint'). This model explains regularity effects on the basis that irregular words can only be read through one route (from memory of the word in the lexical store), however regular words can be read through both routes (the indirect phonological/nonlexical route mapping graphemes to phonemes, and from memory of word in the lexical store). Therefore regular words will be read more quickly and accurately as both routes produce the same pronunciation, however if irregular words are processed by both routes, this will produce conflicting pronunciations.

Connectionist models (Seidenberg & McClelland, 1989) offer an alternative account of word reading and have gained in popularity in recent years. The main difference between this type of model and the dual route model of reading is that rather than proposing two separate and distinct pathways (dual route), one main pathway (with many connections) is used to explain the reading of all words. Representations of connectionist models are shown by networks composed of separate groups (or layers); each group in turn is made up of units. There are variations in the models of word reading proposed, some of which focus solely on orthography-phonology mappings, others which focus on orthography-phonology-semantics mappings. Either way, the orthography group (or layer) will contain a finite set of units representing a very large

set of letters and letter patterns and the phonology group (or layer) will contain a finite set of units representing a very large set of sounds and sound patterns. In addition, there may be a semantics (meaning) group (or layer), with its own units within it. These groups (or layers) are connected together, but between them there is usually a layer of hidden units that allow the network to learn and represent more complex mappings. The connections between the input, hidden and output units are proposed to strengthen through practice and training. The model can explain reading through a simple feed-forward network, in which a word's spelling will activate the units corresponding to the letters in the word (within orthography) and via connections between them, allow activation to pass to the output units, (within phonology) to allow pronunciation of the word. Connectionist models explain regular and irregular word reading through similar mechanisms as all words are read in the same way, through input of spelling and output of pronunciation. The model represents both rule-governed cases (regular words) and exceptions (irregular words), and it is through certain weights applied between input (spelling patterns) and output (pronunciation) that words are read correctly. These weights are adjusted after each exposure to the word, bigger changes being made to weights that have led to inaccurate performance. Performance on any given word is affected by knowledge of other words (e.g., training on 'find' and 'hide' will help performance on 'hind' through weight adjustments). Once children learn to associate many input patterns (written words) with output patterns (spoken words), they are able to generalise to words which they have not explicitly been taught. According to this model, the ease with which a word is pronounced will depend on the relative consistency of the pronunciation of the letter patterns in the word (i.e., regularity). For example, words with letter patterns that are always pronounced in the same way (e.g., 'ust' in 'dust' and 'must') will be read more quickly than words with letter patterns that are pronounced differently in different words (e.g., 'int' in 'mint' and 'pint'). The less

typical the letter pattern and pronunciation, the greater the difficulty (i.e., exception and in particular strange words).

The dual route model has been criticised by advocates of connectionist models, as the dual route model states that regular and irregular words are read in different ways, through different pathways, regular words through spelling-sound rules (if the word is unfamiliar) and irregular words through memory, thereby ignoring any partial regularities within irregular words. The dual route model would predict that learning to correctly pronounce the words 'pant' and 'pine' would have no impact on learning 'pint', (Seidenberg, 2005).

What results would be expected to provide support for the connectionist and dual route models of reading? Both would expect that high frequency words are read more accurately and faster than low frequency words. The connectionist model would achieve this through stronger connections between letter patterns and pronunciations, as they are accessed more frequently. The dual route model would achieve this through word recognition units within the visual input lexicon, where the more frequent the word, the easier and faster it is recognised. The dual route model would propose that regular words are read more accurately and faster than irregular words (as they can be accessed through both routes), but that both strange and exception words would have conflicting information from both routes so would be less accurate and also take longer. According to the dual route model, there should be no differences between strange and exception words as both are read via one route only. However, high frequency irregular words should be recognised faster and more accurately than their low frequency counterparts. According to the connectionist model, regular words will be read faster and more accurately based on the consistency of the pronunciation of the letter patterns

in the word. Exception words should be read faster and more accurately than strange words, as there is more consistency within the letter patterns, whereas strange words, which have few regular elements and are characterised as having unusual letter patterns, should be read less accurately, and take longer. In both models, there should be a greater regularity effect⁵ amongst low frequency words, due to a greater dependence on links between orthography and phonology.

The ability to read nonwords and the reading of regular and irregular words represents an efficient method of measuring the approach or strategy a child takes when reading. If a child takes a phonological approach to reading, the phonological route is functioning in addition to the visual route. These children are likely to be good at reading regular words and nonwords compared to irregular words. However, they may also try to utilise the regular components of irregular words in order to read these too. Those children who take a less phonological approach to reading (i.e., are more visual readers), are likely to be poor at nonword reading, and the reading of regular and irregular words is likely to be carried out based on whole word recognition, context, or using initial letter sounds to work out the rest of the word. This would lead to similar performance on regular and irregular words.

Metsala, Stanovich & Brown (1998) carried out a meta-analysis examining regularity effects in reading disabled and normal readers. Only the latter will be discussed here as they are of most relevance to this study. Regularity effects were found in all seventeen studies (containing a total of 580 normally achieving readers), with a mean weighted effect size of $d = 0.68$ (unweighted effect size = 0.85). This would be considered relatively large, as an effect size of 0.20 is considered small, 0.50 is considered medium

⁵ Regularity effects refer to the size of the discrepancy between accuracy of reading regular versus irregular words.

and 0.80 large, according to Cohen's d (Cohen, 1992). Variability in effect sizes was examined and it was found that age of participant did not predict variability in effect size, however year of publication did, with the more recent publications reporting larger effect sizes (it was suggested that this may be due to improved methodology, and better control of confounding variables such as word frequency and length). Interestingly, when the studies were split in two by regular word frequency (i.e., half the studies using the highest mean frequency versus half using the lowest mean frequency), the regularity effect size for the high frequency words was smaller ($d = 0.39$) compared to low frequency words ($d = 0.94$). This greater discrepancy between regular and irregular word reading in low frequency words suggests more emphasis on the phonological components for word reading.

Waters et al. (1984) compared the reading strategies of young children (3rd grade), older children (5th grade) and adults (university students) on the reading of six word types; high and low frequency regular, strange and exception words. In the first experiment young children were split based on ability, and it was found that good readers were more accurate and faster at naming all words, that high frequency words were read faster than low frequency, and that a greater frequency effect was found amongst poor readers. Generally, most errors were made in reading exception words. A second experiment conducted with older children (not split on ability) found a regularity effect only with low frequency words. With low frequency words, again most mistakes were made in reading exception words. In a third experiment carried out with adults, there were still significant regularity effects with low frequency words. However, for low frequency words, most mistakes were made in reading strange words (rather than the greater level of exception errors found in both younger and older children). These results illustrate that the extent to which irregular spelling or spelling-sound

correspondences influence word recognition depends on the skill and age of the reader and the familiarity (i.e., frequency) of the words. Overall, younger less skilled readers show regularity effects with high and low frequency words, whereas older children, and even more so adults, regularity effects are limited more to low frequency words. The pattern of results provides convincing evidence that there is a greater involvement of phonological information in the early stages of learning to read than in later skilled reading where regularity effects are limited to only low frequency words (consistent with Metsala et al., 1998). This is also consistent with studies carried out with skilled adult readers (Jorm & Share, 1983; McCusker, Hillinger and Bias, 1981; Seidenberg, Waters, Barnes & Tanenhaus, 1984).

A further study investigating adults and children's reading strategies, compared reading-age matched adults (poor readers) and children on a range of reading and spelling tests; sight word reading task (consisting of 50 atypically spelt words), a nonword reading task, a spelling task and a rhyme word detection task (Greenberg, Ehri & Perin, 2002). It was found that adults were less likely to use phonological strategies and were more likely to rely on visual or orthographic processes; this was shown in how they read and spelt words. For example, adults were more likely to misread a word as another word, whereas children were more likely to make decoding errors in word reading. In addition, adults spelling errors contained fewer phonetic errors than children's, and they also had greater difficulty detecting rhyming pairs of words unless the words had similar spellings (e.g., 'nail' and 'sale' versus 'nail' and 'tail'), indicating a greater reliance on the orthographic element of words rather than the phonological. Adults also had poorer phonological decoding skills (nonword reading) and it was thought that this may have contributed to their problems in reading and spelling.

A number of studies have found that children use phonological information when reading all words initially but as words become more familiar they are identified on a visual basis (Backman, Bruck, Hebert & Seidenberg, 1984, Doctor & Coltheart, 1980; Waters et al., 1984). However others (Barron & Barron, 1977; Condry, McMahon-Rideout & Levy, 1979) found that young children used visual as opposed to phonological information for reading, with no evidence of a transition from a phonological to a visual stage. To reconcile these contrasting views, McCusker et al. (1981) and Jorm and Share (1983) suggest that children recognize words on a direct visual basis or through the use of phonological mediation depending on their strategy for performing the task, and that children are flexible in using both strategies depending on word frequency, length, difficulty of the text and reading skill. Indeed, whilst even young children have been found to use visual information to read words, these have been limited to studies using a restricted range of high frequency words (Share, 1995). In fact, it is likely that children were taught these words as visual wholes. This leads to the point that it is very possible that the way in which children were taught to read will impact on their strategies for reading.

Indeed, a study carried out by Johnston & Thompson (1989) compared the reading strategies of two groups of children; one taught via a systematic phonics method (where children are encouraged to sound out words to read them), the other via the book experience approach (where children are encouraged to predict what words are based on meaningful context and initial letter). Children were tested on their ability to classify real words, nonwords and pseudohomophones (nonwords that are phonetically identical to a real word, e.g., ‘coff’ instead of ‘cough’ or ‘poast’ instead of ‘post’) as either real or made-up words. Children taught via the book experience approach were more accurate at this task overall, as phonics-taught children were more likely to classify

pseudohomophones as real words due to their reliance on phonological information. Both groups were equally good at rejecting nonwords however, suggesting that the phonics groups classification of pseudohomophones as real words is based on the matched pronunciation of these words to real words, rather than poor identification of non-existent letter sequences.

A later study by Thompson and Johnston (2000) compared reading disabled children against reading level matched normal readers. Within the normal readers, there were two groups, a phonics and non-phonics group, and the comparisons between them are of interest in the current study. Those taught by phonics were significantly better at reading nonwords, indicating they had better phonological reading skill which was likely a result of their teaching. However there were no significant differences in phoneme awareness (phoneme deletion) or magnitude of the regularity effect (although this was almost significant). In addition, the non-phonics taught group tended to show a greater regularity effect due to a greater disparity between regular and irregular word reading. An analysis of the normal readers (Johnston, personal communication) shows that the phonics and non-phonics taught groups did not differ in the size of regularity effect for high frequency words. However, for low frequency words, the non-phonics group showed a significantly greater regularity effect. This pattern of results is opposite to what would be predicted by a programme which focuses on phonics. Phonics based programmes are often criticised as they focus on letter sound relationships when many words in English are actually irregular, leading these children to have good reading of regular words, but poor reading of irregular words. However, this study has shown that it was the non-phonics group which were significantly impaired on irregular word reading. This finding will be examined later in the discussion.

Earlier studies have been carried out comparing whole word and phonics approaches to teaching, and have found differences in the errors made in sight word reading. Barr (1972) found that those taught by a whole word method were more likely to make word reading errors which involved substituting different words learnt in the same time period as the stimulus word, with very few substitutions containing the same initial letter sound as the stimulus word and also fewer nonword substitutions. This was in contrast to the phonics group who made more errors substituting different nonwords or words with the same initial sound (e.g., bat for boy). Similarly, DeLawter (1970, unpublished PhD dissertation, cited in Barr, 1975) found that children taught via a phonics approach made errors in word reading more often by substituting nonwords which were similar in graphophonemic elements to the target word, compared to children taught via a sight-word meaning approach. Finally, Elder (1971), found that phonics taught children made fewer word recognition errors, including fewer word substitutions, but showed more nonword substitutions than a sight-word meaning taught group. The results of these three studies are consistent; children taught via a phonics method are more likely to make errors which show a correspondence between letters and phonemes, often producing nonwords containing similar graphophonemic elements rather than poorly matched real words. Sight word readers on the other hand are more likely to substitute the stimulus word with other real words, often with poor or no correspondences between letters and phonemes.

Barr (1975) reported that synthetic phonics taught children make most substitution errors which have high correspondences between letters and phonemes to the target word. This, it is suggested, is due to their strategy of blending phonemes for reading, and focusing on the letter unit of print for reading, rather than the word unit of print observed in whole-word approaches. In a study examining 32 first graders, children

were taught to read by either a phonics approach or a whole word approach. It was found that reading strategies were significantly influenced by class instruction, those taught by phonics producing more nonwords and showing little reading text word set constraint (this was taken as evidence of a phonics strategy by the testers). A sight word strategy was inferred if children produced only real words, of which 75 percent or above came for the reading text sample, and more children in the whole word taught group used this strategy. When individual children were examined it was found that there was some individual strategy deviation from the class method, and this was more common in the phonics group. However, despite these deviations to a more whole word approach when children initially started learning to read, at the end of their first year, children had changed their strategy back in accordance with the classroom method (i.e., phonics). It was suggested that when a child first learns to read they find the whole word approach more natural as each word relates to a meaningful unit of speech. However, a phonics approach requires children to learn new operations, to look at words in a different way, and the unit level at which they are taught does not refer specifically to a meaningful referent (i.e., phonemes).

Finally, Freppon (1991) asked first grade children taught by two different methods what strategies they would use for working out an unfamiliar word. One group of children was from a literature based classroom, which utilises “children’s literature and self-generated writing as reading materials, focusing both on reading as a meaning making process and on teaching a variety of reading strategies” (Freppon, 1991, p.143). The other group of children were taught in a skill based classroom, which was basal driven and exhibited a “strong emphasis on traditional, sequenced phonics and vocabulary curriculum and instruction” (Freppon, 1991, p. 143). The children from the literature group more frequently expressed multiple strategies for working out a word (such as

rereading, use of context, skipping words), whereas the skills readers stated one main strategy; sounding out words.

Several other studies have compared the effects of phonics teaching in comparison to other methods and have found that children receiving phonics teaching have better nonword reading (Connelly, Johnston & Thompson, 1999; Hatcher et al., 1994; Tunmer & Nesdale, 1985), better word reading, (Connelly et al., 1999; Foorman, Francis, Novy & Liberman, 1991; Hatcher et al, 1994) and show a greater regularity effect (Foorman et al., 1991). This last result runs counter to the results of Thompson and Johnston (2000).

However, Trieman (1984) found that children naturally adopt different strategies for reading, regardless of their method of teaching and used the term ‘phoenicians’ to categorise children who relied heavily on spelling-sound rules and ‘chinese’ for those who use specific associations (these terms were previously coined by Baron & Strawson, 1976). Interestingly, this distinction goes beyond reading to spelling, where rule use in spelling was found to be correlated with rule use in reading.

In addition to illustrating the effects of reading programme on reading strategies, these studies also highlight the different types of tests that can measure the approach a person takes when reading. Whilst nonword reading and phoneme awareness tasks represent an efficient way of measuring a person’s phonological skills, it is only through the natural process of reading that we can measure a persons’ natural strategy towards reading. Performance on reading and spelling tests can be analysed based on accuracy of regular versus irregular words, and likewise, incorrect responses given can be analysed by looking at the types of errors made (whether visual or phonological).

The following study was carried out to look at the effects of reading instruction on reading strategies. Whilst previous research has investigated this area (Johnston & Thompson, 1989; Thompson & Johnston, 2000), these studies had looked at younger children (aged 8 in the former study and aged 6 - 8 in the latter), where the effects of instructional practice were likely to be more prominent as children receive more time each day dedicated to formal literacy teaching. In the current study children were older, with an average age of 10 years and 7 months, therefore it was of interest whether instructional practice would still affect reading strategies later in school. Also, previous research tested two very different reading programmes (phonics versus non-phonics), however in this study both types of reading instruction contained a phonics element, however this differed in type and emphasis (synthetic phonics versus analytic phonics). Whilst synthetic phonics has an early and strong emphasis on phonics for reading, analytic phonics, as taught by the National Literacy Strategy, introduces children to phonics at a slower pace, and children are encouraged to use a variety of strategies for reading (searchlight model, see Chapter 2) in addition to phonics. For more information regarding the differences between these two programmes see main introduction (Chapter 2). It was of interest whether more subtle differences in reading instruction would affect reading strategies. Finally, due to current changes in the reading programmes used in England, the following study compared the method of teaching reading which has been used currently in England, with one which is similar to that being implemented this year (Letters and Sounds, DfES, 2007). This allows an insight into the way in which the new programme is going to effect reading strategies and abilities of new pupils in the forthcoming years.

It was predicted that high frequency words would be read more accurately and faster than low frequency words (frequency effect), and that regular words would be read more accurately and faster than irregular words (regularity effect) for both groups.

It was also predicted that due to the greater emphasis on sounding and blending for reading, children taught to read by synthetic phonics would be better at nonword reading.

Finally, it was predicted that the synthetic phonics taught group would show a smaller regularity effect than the analytic phonics taught group.

Method

Participants

Sixty four children took part in this study. Thirty one had been taught to read by synthetic phonics (14 male), and had an average age of 10 years and 8 months (0.28 S.D). Thirty-three had been taught in accordance with National Literacy Strategy (NLS) guidelines (20 male), and had an average age of 10 years and 6 months (0.41 S.D). There was one school in each group and these schools were matched carefully on socioeconomic status. Although the synthetic phonics taught children were tested in Clackmannanshire, these children were not in the experimental intervention (Johnston & Watson, 2004a). See Chapter 2 for further details regarding these two types of reading instruction.

Design

This was a mixed design as all children took part in both the regularity task and nonword reading task (within subjects) and comparisons were made across groups (between subjects).

Materials and Procedure

Regularity Test

High and low frequency regular, strange and exception words were presented individually in a quasi-random order in the centre of a computer. All words were one-syllable and were presented in white type (Times New Roman, font 48) on a black

background. In total there were 95 words (5 practice words and 15 examples of each word type). All words were taken from the Children's Printed Word Database (Masterson, Dixon & Stuart, 2002) in order to obtain frequencies per million, which were as follows; high frequency regular (770.80), high frequency strange (507.47), high frequency exception (2545.13), low frequency regular (5.80), low frequency strange (6.27) and low frequency exception (8.47). All children were tested individually and were instructed to pronounce each word as quickly and as accurately as possible into a microphone. Accuracy was recorded and the vocal reaction (mean response) times were calculated (milliseconds). See Appendix 1 for test stimuli.

Graded Nonword Reading Test, (Snowling, Stothard & McLean, 1996)

This test consists of 25 nonwords (5 practice, 10 one syllable words and 10 two syllable words) which were transferred to computer and presented individually in the centre of the computer. All words are presented in white type (Times New Roman, font 48), set against black background. During the practice stage it was ensured that children understood the task before undertaking the test. The children were tested individually and were instructed to pronounce each word as quickly and as accurately as possible into a microphone. Accuracy was recorded and the vocal reaction times were calculated.

Children also completed ability tests so that reading strategies and phonological skills could be considered within the context of ability. All children completed a test of word reading (WRAT), reading comprehension (GRT) and vocabulary knowledge (EPVT).

Single word reading: Wide Range Achievement Test, (Jastak Associates, 1993)

This is an individually administered test and consists of two sections: letter reading and word reading. Due to the children's age and level of reading ability, only the word

reading section was administered and full marks were automatically given for the letter reading section. The blue version of the word reading test was used, and children were asked to continue until they had made 10 consecutive errors. Children were allowed 10 seconds to respond to each word, after this time, they were asked to move onto the next word.

Reading comprehension: Group Reading Test II, (Macmillan Unit, 2000)

This is a group administered test consisting of 45 items to assess early reading skills in children aged 6-14. Sentence Completion Forms C and D were used to assess reading via sentence completion. To prevent copying, tests C and D were alternately given based on where the children were seated. The examiner read through the practice items with the children beforehand to ensure they understood the test. No time limit was imposed for completion of the test.

Vocabulary knowledge: English Picture Vocabulary Test (Brimer & Dunn, 1968)

This is a group administered test consisting of 40 items to measure vocabulary knowledge and level of listening vocabulary. The examiner read each word aloud and told the children to circle the picture which best fitted the word. The children had four picture options for each word and were told to guess if they were unsure. The examiner worked through the practice items with the children beforehand to ensure they understood the test. The following words were not read until the examiner felt all the children had completed the last item.

Results

The results are split into two sections; 1) the effect of reading programme on reading ability and reading strategies and 2) the effect of reading programme on phonological reading skill (nonword reading).

1) Effect of reading programme on reading ability and reading strategies

Table 4.1. Effect of reading programme on reading and vocabulary scores (mean and standard deviations).

	Synthetic Phonics		National Literacy Strategy	
	Mean	S.D	Mean	S.D
Word reading (WRAT)	107.00	12.67	99.15	14.22
Comprehension (GRT)	107.61	11.83	95.44	14.25
Vocabulary (EPVT)	99.71	13.13	88.53	11.21

Synthetic phonics taught children had better word reading; $F(1, 62) = 5.54$, $p < .05$ (partial eta squared effect size = 0.08), better reading comprehension; $F(1, 61) = 16.75$, $p < .001$ (effect size = 0.21) and better vocabulary; $F(1, 60) = 14.75$, $p < .001$ (effect size = 0.19). Throughout the remainder of this thesis, effect sizes will be reported for all significant ANOVA results. The effect size reported with ANOVA results is partial eta squared.

Following this, analysis was carried out on the regularity task data.

Accuracy

Table 4.2. Effect of reading programme on accuracy of reading high frequency and low frequency regular, strange and exception words (mean and standard deviations).

	Synthetic Phonics		National Literacy Strategy	
	Mean	S.D	Mean	S.D
HF regular	14.94	0.25	14.82	0.47
HF strange	14.58	0.81	14.48	0.80
HF exception	14.55	0.77	14.45	0.83
LF regular	14.68	0.70	13.97	1.59
LF strange	10.45	3.61	8.09	4.00
LF exception	11.84	2.07	10.24	3.06

A 2 x 3 x 2 (frequency x regularity x reading programme) analysis of variance was carried out and there was a main effect of frequency, $F(1, 62) = 153.85, p < .001$ (effect size = 0.72) with high frequency words read better, $M = 14.64$ (5.44 S.D), than low frequency words, $M = 11.55$ (2.32 S.D). There was also a main effect of regularity, $F(2, 124) = 117.35, p < .001$ (effect size = 0.65) with significant differences in the accuracy of reading these different word types. Regular words were read most accurately, $M = 14.60$ (6.88 S.D) followed by exception, $M = 12.77$ (1.60 S.D) then strange words, $M = 11.90$ (2.24 S.D). In addition, there was a main effect of reading programme, $F(1, 62)$

= 5.72, $p < .01$ (effect size = 0.09), with children taught to read by synthetic phonics reading better, $M = 13.51$ (2.00 S.D) than children taught by National Literacy Strategy guidelines, $M = 12.68$ (1.92 S.E). However, this difference was limited to only low frequency words, $F(1, 62) = 7.00$, $p = .01$ (effect size = 0.10), as groups were matched on high frequency word reading, $F(1, 62) = 0.56$, $p > .05$.

There was an interaction between frequency and regularity, $F(2, 124) = 126.23$, $p < .001$ (effect size = 0.67), between reading programme and frequency, $F(2, 62) = 8.49$, $p < .01$ (effect size = 0.12), but not between reading programme and regularity. However, there was a three way interaction between frequency, regularity and reading programme, $F(2, 124) = 2.57$, $p < .05$ (effect size = 0.06).

This three way interaction was examined further. Although there was a main effect of overall word reading ability, the two groups did not differ on their reading of high frequency words. Scheffe tests revealed that for low frequency items, the NLS taught children showed a greater regularity effect for strange, $p < .05$, but not exception words.

Errors made on the regularity task were recorded by the examiner during the testing session and were analysed in order to investigate whether the way in which the children had been taught to read influenced their reading strategies.

Table 4.3. Effect of reading programme on the type of reading errors made on all irregular words (high and low frequency strange & exception words).

Error Type	Synthetic Phonics (% of total errors)	National Literacy Strategy (% of total errors)
Regularisation	71.83%	66.43%
Visual error (real word)	17.86%	26.90%
Visual error (nonword)	3.99%	3.33%
No response	6.35%	3.33%

Words which were read phonetically (e.g., ‘pint’ to rhyme with ‘mint’) were scored as regularisation errors. Visual errors were words which were read as a visual whole but were either: substituted with a different real word (e.g., ‘board’ for broad) or substituted with a word that does not exist (e.g., ‘blad’ for ‘bald’). If the child gave no response to the word it was scored as such. Generally, children taught to read by synthetic phonics were more likely to ‘regularise’ the irregular words (i.e., make phonetic errors), and were less likely to make visual errors compared to the National Literacy Strategy taught group.

Following this, speed of reading on the regularity test was examined. Only times taken from correct responses were used in the analysis.

Reaction times

Table 4.4. Effect of reading programme on speed (in milliseconds) of reading high frequency and low frequency regular, strange and exception words (mean and standard deviations).

	Synthetic Phonics		National Literacy Strategy	
	Mean	S.D	Mean	S.D
HF regular	857.56	177.55	758.84	198.19
HF strange	877.37	205.05	799.89	215.06
HF exception	863.90	198.35	796.83	261.08
LF regular	994.02	324.93	916.12	421.60
LF strange	1219.79	469.91	1079.73	459.51
LF exception	1056.89	350.26	932.04	388.96

A 2 x 3 x 2 (frequency x regularity x reading programme) analysis of variance was carried out and there was a main effect of frequency, $F(1, 62) = 57.09$, $p < .001$ (effect size = 0.48), with high frequency words, $M = 825.74$, (25.00 S.E) being read faster than low frequency words, $M = 1033.10$, (46.91 S.E). There was also a main effect of regularity, $F(1, 62) = 21.61$, $p < .001$ (effect size = 0.26), with significant differences in the speed of reading these different word types. Regular words were read fastest, $M = 881.64$ (33.64 S.E), followed by exception, $M = 912.42$ (35.21 S.E) then strange words, $M = 994.20$ (41.19 S.E). There was no main effect of reading programme, those taught to read by synthetic phonics read as fast, $M = 978.26$ (50.25 S.E), as those taught by

National Literacy Strategy guidelines, $M = 880.58$ (48.70 S.E); $F(1, 62) = 1.95, p > .05$.

However the synthetic phonics group tended to read a little slower.

There was an interaction between frequency and regularity, $F(2, 124) = 10.83, p < .001$ (effect size = 0.15), but not between reading programme and frequency, $F(1, 62) = 0.37, p > .05$ or reading programme and regularity, $F(2, 124) = 0.17, p > .05$. In addition, the three way interaction between reading programme, frequency and regularity was not significant, $F(2, 124) = 0.73, p > .05$.

2) Effect of reading programme on phonological reading skill (nonword reading).

Analysis was then carried out to examine the effect of reading programme on phonological reading skill.

Accuracy

Table 4.5. Effect of reading programme on accuracy of reading one syllable and two syllable nonwords (mean and standard deviations).

	Synthetic Phonics		National Literacy Strategy	
	Mean	S.D	Mean	S.D
1 syllable nonwords	9.52	0.77	8.82	1.57
2 syllable nonwords	8.23	2.06	7.03	2.81

A 2 x 2 (syllable x reading programme) analysis of variance revealed a significant effect of reading programme on accuracy of nonword reading, $F(1, 62) = 5.27, p < .05$ (effect size = 0.08), with synthetic phonics children being superior on this task. There was also a significant effect of nonword length on accuracy of nonword reading, $F(1, 62) = 33.55, p < .001$ (effect size = 0.35), with one syllable nonwords being read more accurately than two syllable nonwords. Finally, there was no interaction between reading programme and nonword length on accuracy, $F(1, 62) = 0.87, p > .05$.

Reaction times

Table 4.6. Effect of reading programme on speed (in milliseconds) of reading one syllable and two syllable nonwords (mean and standard deviations).

	Synthetic Phonics		National Literacy Strategy	
	Mean	S.D	Mean	S.D
1 syllable nonwords	1475.50	908.32	1289.00	786.68
2 syllable nonwords	2328.89	1115.24	1984.64	1061.63

A 2 X 2 (syllable x reading programme) analysis of variance revealed a significant effect of nonword length on speed taken to read nonwords, $F(1, 62) = 77.43, p < .001$ (effect size = 0.56), with two syllable nonwords taking longer to read than their one-syllable counterparts. There was no effect of reading programme on speed of nonword reading, $F(1, 62) = 1.36, p > .05$. Finally, there was no interaction between nonword length and reading programme, $F(1, 62) = 0.80, p > .05$.

Discussion

Although the synthetic phonics children had better standardised word reading scores, they did not differ in their reading of high frequency words on the regularity task. With low frequency words they were found to show a smaller regularity effect than the NLS group on strange words. They also had better phonological reading skill (evidenced by superior nonword reading). Finally, consistent with the hypotheses, significant effects of frequency and regularity were found.

Firstly, as the synthetic phonics programme had a greater emphasis on phonics and sounding and blending for reading, it would be expected that these children would have better phonological skills as a result of more instruction and practice. Indeed, synthetic phonics taught children were significantly better at nonword reading, indicating that reading instruction has had a significant effect on these skills. This is consistent with other studies which have found that instruction which includes phonics or has greater emphasis on phonics, has a positive effect on nonword reading (Connelly et al., 1999; Hatcher et al., 1994; Thompson & Johnston, 2000; Tunmer & Nesdale, 1985). In terms of their approach towards word reading, synthetic phonics taught children had a more phonological approach to reading as shown by the analysis of errors made (fewer visual errors and more phonetic errors were made compared to National Literacy Strategy taught children).

Type of reading programme also had a considerable effect on reading ability and strategies for reading. Firstly, children taught to read by synthetic phonics performed better on standardised tests of word reading and reading comprehension (WRAT & GRT). This advantage must be on more complex words and reading comprehension, as

both groups were matched on one-syllable high frequency words. Whilst the two groups were matched on high frequency word reading in the regularity task, children taught to read by synthetic phonics were better at reading all low frequency words and, more importantly, National Literacy Strategy taught children had significantly greater difficulty reading strange words over regular words (as evidenced in a greater regularity effect with strange words). This is consistent with research in a previous study (Thompson & Johnston, 2000), which found that a non-phonics group of children showed a greater word regularity effect than those taught phonics. These results, however, are inconsistent with those found previously by Foorman et al. (1991). Indeed, the results of this study conflict with what is usually argued about phonics focused programmes - that they benefit regular word reading but create problems when children try to read irregular words. As synthetic phonics children are taught to place more emphasis on phonics, relying on letter sound correspondences to work out unfamiliar words, it might be presumed that this group would show a greater regularity effect, as irregular words do not have simple letter sound correspondences that regular words do. However, within irregular words, there are some consistent elements which may provide a cue to a word's pronunciation; giving synthetic phonics taught children an advantage over National Literacy Strategy taught children who have a less well-developed method for working out unfamiliar words. It could be that the synthetic phonics children's superior phonological skills have over time boosted their ability to read strange words by focussing more on the pronounceable elements. In terms of models of reading, these results support the connectionist model of word reading. Whilst the dual route model proposes a separate route for reading regular (indirect phonological route) and both regular and irregular (direct visual route) words, this study has found that, consistent with the principles of connectionist models, that even strange words must contain some regular elements that can be accessed by using phonological

information. It is these regular elements that are providing those children with better phonological reading skill, and a more phonological approach, a greater advantage for reading. In addition, the faster and more accurate reading of low frequency exception words compared to low frequency strange words suggests that children are quicker to recognise the more familiar spelling pattern. This is also consistent with connectionist models as the dual route model would predict no differences between exception and strange words, as both would be processed holistically via the direct visual/orthographic route.

Trieman (1984) found that children who were skilled at rules tended to overgeneralise them to exception words. In the current study, those with a more phonological approach to reading did make more phonetic (rule-based) errors in their word reading, however this did not impede their reading of exception or strange words, rather they were better at reading these words than those children with poorer techniques (or rules) to work out the word.

In addition, the current study showed that children taught to read by synthetic phonics were more likely to make errors by regularising the words, however this was also very common for National Literacy Strategy taught children. Regularisation of irregular words is a common error, as Glushko (1979) found that, in adults, 84% of all errors made in exception words were regularizations.

Consistent with previous studies (Baron & Strawson, 1976; Glushko, 1979; Hino & Lupker, 2000; Seidenberg et al., 1984; Waters et al, 1984), and in line with predictions, a significant effect of frequency and regularity was found, both in the accuracy and response time data. Overall, high frequency words were read more accurately and faster

than low frequency words, and regular words were the most accurately and quickly read, followed by exception then strange words. These frequency results are due to the familiarity of the words, where high frequency words are more familiar and therefore more quickly recognised. The regularity results are due to the nature of the spelling and spelling-sound correspondences - those with regular correspondences have no conflicts with spelling-sound rules. The results are inconsistent with a study carried out by Waters et al., (1984) who found that Grade 5 children (who are the closest age match to the current study), were poorest at reading exception words rather than strange words, however this was in a smaller sample of children (n=19). As previously argued, the results of this study are compatible with connectionist models of reading, as the more consistent/regular and familiar the letter sequence, the faster and more accurately it will be read. Exception words have more consistent and familiar letter sequences than strange words, which should take longer to read and be read less accurately due to their unusual and unique spelling patterns which also conflict with spelling sound rules.

Conclusions

This study has highlighted the effects of reading programme on reading ability, reading strategies and phonological reading skills. A programme in which phonics is more strongly emphasised will benefit children in reading all types of words, not just those with regular letter sound correspondences. Their better phonological reading skill and more phonological approach to reading provides them with an advantage for irregular word reading. This is due to the regular components that are found in irregular words, consistent with the principles of connectionist model of reading.

CHAPTER 5: READING STRATEGIES

GENDER DIFFERENCES

Introduction

As has been previously shown, the way in which a child is taught to read will likely affect their strategies for reading. This finding is consistent with other studies comparing the effects of reading programme on reading strategies (Barr, 1972; 1975; DeLawter, 1970, cited in Barr, 1975; Elder, 1971 Johnston & Thompson, 1989; Thompson & Johnston, 2000). Reading strategies have also been found to differ depending on age (Greenberg et al., 2002) and skill level of the reader (Waters et al., 1984). One other source of potential differences in reading strategies is gender differences, and if they exist, this may have consequences on reading instruction in schools.

There is currently some evidence to suggest that boys have a more phonological approach to reading (Thompson, 1987). To recap on the terms being used, if a child takes a phonological approach, they will utilise spelling-sound correspondences when reading, however if a child takes a more visual approach, they will read based on word recognition, context or use cues such as initial letter sound or word length to read. If a child takes a more phonological approach to reading, they will generally take longer to read words, as it takes longer to assemble a correct pronunciation using letter sound correspondences than it does to recognise the word as a visual whole. In a series of three studies comparing gender differences in young readers (aged 6 - 7 years old),

Thompson (1987) found that boys appeared to have a more phonological approach to reading, this being an inherent strategy rather than the product of any instructional method, as children had received no systematic teaching of phonics. Reading strategies were measured through performance on regular and irregular words, regularity of initial word segments and pseudohomophones (nonwords that are phonetically identical to a word, e.g., *nale*). It was found that boys who were at the same reading level as girls, read words with a greater reliance on access to phonological segments. They showed a greater regularity effect between regular and exception words and were influenced to a greater extent by the phonological consistency of the initial multi-letter segment of words. In addition, they showed smaller differences in performance between two different types of pseudohomophones; those which were graphemically different from the lexically matched word (e.g., ‘*whight*’ which matches ‘*white*’), and those which were graphemically similar (e.g., ‘*seet*’ which matches ‘*seat*’). The fact that girls showed greater differences between these two word types indicates that they were relying more heavily on the orthographic structure of the word. There were however substantial overlaps in the distribution of boys and girls. This result was consistent with previous research (Baron, 1979) who also found gender differences, with boys tending to rely more on rules in word reading. This was found in the length of time it took boys to read lists of words orthographically similar but with different pronunciations (e.g., *maid*, *said*, *dough*, *cough*, *great*, *meat*), with boys taking longer. Baron did not offer any explanation for these results but concluded that the “source of these sex differences is a mystery” (Baron, 1979, p. 70).

A later study carried out by Johnston & Thompson (1989), compared the reading strategies of two groups of children, one taught via a systematic phonics method (where children are encouraged to sound out words to read them), the other via the book

experience approach (where children are encouraged to predict what words are based on meaningful context and initial letter). It was found that boys taught via the book experience approach, where there is no explicit teaching of phonics, were more likely to use phonological information than girls. This was shown in their tendency to show a pseudohomophone effect (i.e., to classify as real words, nonwords that are phonetically identical to a real word, e.g., ‘coff’ instead of ‘cough’ or ‘poast’ instead of ‘post’), however the gender differences were not statistically significant.

Further evidence of boys having a more phonological approach to reading, is seen in a large scale study investigating the effects of synthetic phonics on reading and spelling in school-aged children (Johnston & Watson, 2003). In this study, all children followed a systematic synthetic phonics method, and it was found that at the end of Primary 3, boys were a significant 8 months ahead of girls in word reading. In fact, throughout the rest of the duration of Primary school (Primary 4 - 7), boys had significantly better word reading. In addition, boy’s spelling was significantly better than girls at the end of Primary 4, 6 and 7. The results of this study were very surprising, as boys usually fall behind girls in reading and spelling achievement throughout school (National Literacy Trust, 2007). One possible explanation is that the systematic method and focus on letter sound rules for reading which are inherent in synthetic phonics, may have boosted boys reading ability as they are naturally more disposed to phonological ‘rule’ type of learning. Throughout the duration of the study, boys and girls were matched on reading comprehension, which typically requires other skills associated with reading (see Chapter 1). However, it was on those abilities which rely more heavily on phonics, for example rules for reading (decoding) and spelling (segmenting), that boys benefited to a greater extent than girls. Indeed, Thompson (1987) argues that “evidence for such sex differences between boys and girls of equal reading attainment would be important, as it

would be evidence for individual differences in the qualitative nature of reading processes” (Thompson, 1987, p. 212). As said, this was the case in the study by Johnston & Watson (2003), where boys, even after receiving the same instruction as girls, benefited more from those skills which relied more heavily on phonics (single word reading and spelling).

However, despite evidence of boys having a more phonological approach to reading, other research finds no such differences (Trieman, 1984). In this study boys and girls were tested on their reading and spelling of regular, exception and nonwords and in a rapid reading test. Results showed that the interaction between word type and gender was not significant, in other words, boys and girls performance did not differ in their accuracy of reading or spelling regular versus exception words. In addition, there was no gender difference in the errors made in the rapid reading test, leaving the author to conclude that “it does not appear that boys and girls differ in their general reading and spelling styles” (Trieman, 1984, p. 475).

In the current study, boys and girls were matched on all ability tests (single word reading, vocabulary and reading comprehension), therefore qualitative differences in reading strategies could be compared without the confounding variable of ability. In addition, the children were older (approximately 10 years & 5 months) compared to the previous studies which had found gender differences in reading strategies (Thompson, 1987; Johnston & Thompson, 1989), when children are in the earlier stages of learning to read (aged 6 - 7 years old in the former study; aged 8 years old in the latter). It was of interest whether gender differences in reading strategies would still exist at this age group, and whether children (and boys in particular) still utilised phonological information for reading, as evidence suggests that as children grow older, they rely less

on the phonological aspects of words and more on sight word recognition (Waters et al., 1984). Based on previous research (Thompson, 1987), it was predicted that boys would show a greater regularity effect than girls.

In addition to examining gender differences, it was expected that frequency and regularity effects would be found, consistent with those found in previous studies, with high frequency words being read more accurately and faster than low frequency words, and regular words being read more accurately and faster than irregular (strange & exception) words (Baron & Strawson, 1976; Hino & Lupker, 2000; Seidenberg et al., 1984; Waters et al., 1984).

In the following study all children had been taught to read by the same programme and boys and girls were matched on school environment, school experience and instruction (as they were taken from the same classes). Children had been taught to read in accordance with National Literacy Strategy guidelines, by a programme in which phonics (analytic) is one of a number of strategies taught for reading, in addition to word recognition, knowledge of context and grammatical knowledge (see Chapter 2 for a more comprehensive overview). This method of reading instruction does not focus solely on systematic instruction of phonics, therefore any reliance on phonics could not derive exclusively from explicit teaching during the early years, as children are taught to use a variety of strategies.

This study investigated gender differences in reading ability, phonological skills (nonword reading) and reading strategies (through the reading of regular and irregular words). It also examined the relationship between nonword reading and reading, and the effects of frequency and word type on accuracy and speed of reading.

It was predicted that boys would have a more phonological approach to reading. This would be evident in a smaller regularity effect (due the results in Chapter 4), shown by a significantly smaller disparity between regular and irregular word reading compared to girls, and in the length of time taken to read all words (boys would take longer).

It was also predicted that high frequency words would be read more accurately and quickly than low frequency words and that regular words would be read more accurately and quickly than irregular words, for both boys and girls.

Method

Participants

Eighty two children (43 male and 39 female) had been taught to read in accordance with National Literacy Strategy guidelines (see Chapter 2 for more details). All children had English as their first language and were matched on all ability tests carried out. These tests included vocabulary, $F(1, 76) = 1.87, p > .05$, reading comprehension, $F(1, 79) = 1.24, p > .05$ and single word reading, $F(1, 80) = 0.01, p > .05$.

Table 5.1. Participant details

	Age		EPVT		GRT		WRAT	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Male	10.46	0.38	91.20	11.21	93.91	14.03	99.63	15.10
Female	10.46	0.33	87.75	11.61	97.34	13.75	99.36	14.93

Design

This was a mixed design as all children took part in both the regularity task and nonword reading task (within subjects) and comparisons were made across groups (between subjects).

Materials and Procedure

All children completed the same tests as had been used in the previous study (see Chapter 4 for full details of tests and procedure). The tests used are as follows:

Vocabulary: English Picture Vocabulary Test, (Brimer & Dunn, 1968).

Reading comprehension: Group Reading Test II, (Macmillan, 2000).

Word reading: Wide Range Achievement Test, (Jastak Associates, 1993).

Regular & irregular word reading: Regularity Test, (see Chapter 4 and Appendix 1).

Phonological reading skill: Graded Nonword Reading Test, (Snowling et al., 1996).

Results.

The results are split into two sections; 1) exploring gender differences in reading ability, reading strategies and phonological reading skill (nonword reading) and 2) investigating the relationship between phonological reading skill and reading ability.

1) Gender differences

As previously mentioned, boys and girls were matched on all ability tests; vocabulary, reading comprehension and single word reading. Analysis was first carried out examining gender differences in accuracy on the regularity task.

Table 5.2. Gender differences in accuracy of reading high frequency and low frequency regular, strange and exception words (mean and standard deviations).

	Male		Female	
	Mean	S.D	Mean	S.D
HF regular	14.77	0.61	14.85	0.54
HF strange	14.19	1.33	14.31	1.05
HF exception	14.14	1.51	14.36	1.06
LF regular	13.51	2.22	13.41	2.48
LF strange	8.09	4.18	8.21	4.03
LF exception	10.16	3.20	10.31	3.23

A 2 x 3 x 2 (Frequency x Regularity x Gender) analysis of variance was carried and there was a main effect of frequency, $F(1, 80) = 213.78, p < .001$ (effect size = 0.73), with high frequency words, $M = 14.43 (0.10.S.E)$ being read better than low frequency words, $M = 10.62 (0.33 S.E)$. There was also a main effect of regularity, $F(2, 160) = 175.34, p < .001$ (effect size = 0.67), with significant differences in the accuracy of reading all word types. Regular words were read most accurately, $M = 14.13 (0.15 S.E)$ followed by exception, $M = 12.24 (0.23 S.E)$ then strange, $M = 11.19 (0.29 S.E)$ words. There was no main effect of gender though, with boys, $M = 12.47 (0.28 S.E)$ reading words almost as accurately as girls, $M = 12.57 (0.30 S.E)$, $F(1, 80) = .05, p > .05$.

In addition, there was an interaction between frequency and regularity, $F(2, 160) = 154.64, p < .001$ (effect size = 0.66), but no interaction between gender and frequency, $F(1, 80) = 0.03, p > 0.05$ or gender and regularity, $F(2, 160) = 0.20, p > .05$. Finally, there was no three way interaction between gender, frequency and regularity, $F(2, 160) = 0.50, p > .05$. The non-significant interactions with gender indicate that boys and girls did not differ in their accuracy of reading irregular words versus regular words.

Following this, speed of reading on the regularity test was examined. Only times taken from correct responses were used in the analysis.

Table 5.3. Gender differences in speed of reading (in milliseconds) high frequency and low frequency regular, strange and exception words (mean and standard deviations).

	Male		Female	
	Mean	S.D	Mean	S.D
HF regular	837.19	246.27	776.71	226.60
HF strange	881.42	254.92	812.84	282.39
HF exception	875.21	307.25	783.88	252.88
LF regular	994.77	439.29	989.84	432.22
LF strange	1142.13	445.90	1096.76	498.37
LF exception	1031.54	449.25	1022.62	454.80

A 2 x 3 x 2 (Frequency x Regularity x Gender) analysis of variance was carried out and there was a main effect of frequency, $F(1, 80) = 75.49$, $p < .001$ (effect size = 0.49), with high frequency words read faster, $M = 827.87$ (27.27 S.E) than low frequency words, $M = 1046.23$ (47.51 S.E). There was also a main effect of regularity, $F(2, 160) = 15.23$, $p < .001$ (effect size = 0.16), with significant differences in the speed of reading each of these different word types. Regular words were read fastest, $M = 899.63$ (35.35 S.E) followed by exception, $M = 983.79$ (38.78 S.E) then strange words, $M = 928.33$ (38.11 S.E). There was no main effect of gender, with boys, $M = 960.39$ (50.45 S.E) reading words just as fast as girls, $M = 913.14$ (52.97 S.E); $F(1, 80) = 0.41$, $p > .05$.

There was an interaction between frequency and regularity, $F(2, 160) = 3.51, p < .05$ (effect size = 0.04), but not between gender and frequency, $F(1, 80) = 1.14, p > .05$ or gender and regularity $F(2, 160) = 0.33, p > .05$. Finally, the three way interaction between gender, frequency and regularity was not significant, $F(2, 160) = 0.35, p > 0.05$. The non-significant interactions with gender indicate that there were no differences between boys and girls in the speed of reading irregular versus regular words.

Phonological reading skill (nonword reading).

All children who completed the regularity test also completed a test of phonological reading skill (nonword reading).

Table 5.4. Gender differences (mean and standard deviations) for accuracy scores for one syllable and two syllable nonwords.

	Male		Female	
	Mean	S.D	Mean	S.D
1 syllable nonwords	8.21	2.51	8.36	2.35
2 syllable nonwords	6.79	3.12	6.05	3.06

A 2 x 2 (Syllable x Gender) analysis of variance revealed a significant effect of nonword length on accuracy, $F(1, 80) = 90.59, p < .001$ (effect size = 0.53), but no significant effect of gender, $F(1, 80) = 0.26, p > .05$. There was an interaction between

gender and nonword length, $F(1, 80) = 5.16, p < .05$ (effect size = 0.06) as boys were better at reading two syllable nonwords but worse at reading one syllable nonwords.

Table 5.5. Gender differences (mean and standard deviations) for speed of one and two syllable nonword reading.

	Male		Female	
	Mean	S.D	Mean	S.D
1 syllable nonwords	1327.74	978.21	1303.27	852.92
2 syllable nonwords	2286.23	1180.32	2421.43	1434.44

A 2 x 2 (Syllable x Gender) analysis of variance revealed a significant effect of nonword length on speed of reading, $F(1, 80) = 95.77, p < 0.001$ (effect size = 0.55), but no significant effect of gender, $F(1, 80) = 0.06, p > 0.05$. In addition, there was no interaction between gender and nonword length, $F(1, 80) = 0.56, p > 0.05$.

2) Relationship between phonological reading skill and reading ability

The strength of the relationship between nonword reading and word reading was measured through a series of correlations. Due to the nature of the regularity task items (all were one syllable), the association between nonword reading and word reading was measured initially using all nonword items and then using only one syllable nonword items to investigate whether this would hold a stronger relationship.

Table 5.6. Correlations between accuracy in nonword reading and reading ability.

	1	2	3	4	5	6	7	8
Nonword reading (all)	.73	.69	.48	.74	.61	.85	.76	.77
Nonword reading (1 syllable)	.66	.63	.51	.73	.61	.83	.68	.70

1 = WRAT, 2 = GRT, 3 = HF regular, 4 = HF strange, 5 = HF exception, 6 = LF regular, 7 = LF strange, 8 = LF exception.

All correlations between nonword reading and ability/regularity task items were significant, regardless of whether all items or only one syllable items were used, $p < .001$. The correlations (Pearsons r) were then converted in a corresponding Fisher's z coefficient in order to test whether there was a significant difference between correlations of regular and irregular words with nonword reading. In terms of regularity, there was a significant difference between HF regular and HF strange words, $p < .01$, however no other comparisons were significant. In terms of frequency, there was a significant difference between HF regular and LF regular words, $p < .01$ but no other comparisons were significant. This was the case for all nonwords and one syllable nonwords.

The strength of the relationship between speed of reading nonwords and words from regularity task was then measured through a series of correlations. As before, due to all regularity task items being one syllable, the association between nonword reading and word reading was measured initially using all nonword items and then using only one

syllable nonword items, as this may be a fairer comparison to speed of reading one syllable words.

Table 5.7. Correlations between speed of nonword reading and word types (regularity).

	1	2	3	4	5	6
Nonword reading (all)	.64	.73	.66	.74	.69	.74
Nonword reading (1 syllable)	.63	.68	.59	.72	.67	.71

1 = HF regular, 2 = HF strange, 3 = HF exception, 4 = LF regular, 5 = LF strange, 6 = LF exception.

All correlations between speed of reading nonwords and regularity task items were significant, $p < .001$. This implies that children are relatively consistent in their speed of processing letter-sound information (nonword reading) or in accessing the corresponding word recognition unit containing the specific orthographic and phonological information. The correlations (Pearsons r) were converted into a corresponding Fisher's z coefficient in order to test whether there were significant differences between correlations of regular or irregular words with nonword reading, and no significant differences were found.

Whilst the previous analysis showed a relatively strong association between the speed of reading words and nonwords, further analysis was carried out in order to investigate whether there were any significant differences in the speed of reading nonwords versus regular and irregular words. This would indicate whether constructing a pronunciation

of a word using orthographic and phonological information (i.e., nonword reading) takes longer than accessing this information directly from memory (i.e., word reading). Only one-syllable nonwords were used in this analysis to allow a fair comparison with the one-syllable items used in the regularity test. All paired samples t-tests were significant, as all items in the regularity test were read faster than the nonwords, $p < .01$. Therefore, whilst children are consistent in their speed of processing (see previous correlations) they take longer to process and read nonwords. It should be noted however that there is no evidence that the children are necessarily reading all of the words by direct access to stored pronunciations, however it is likely that this is the case for the majority of the words, but cannot be the case for nonwords.

Discussion

Boys and girls were matched on vocabulary, word reading and reading comprehension. In addition, there were no significant gender differences in the accuracy or speed of reading regular words, irregular words or nonword reading. There were regularity effects however, with regular words (both high and low frequency) being read more accurately than irregular words. In addition, there was a significant effect of frequency, with high frequency words being read more accurately and faster than low frequency words. There was also no interaction between gender and regularity, therefore the prediction that boys have a more phonological approach to reading was not supported. Finally, accuracy and speed of nonword reading correlated significantly with accuracy and speed of regular and irregular word reading, and with accuracy in reading skill (word reading and comprehension), however nonwords were processed and read significantly more slowly than all regular and irregular words.

This study found no evidence to suggest that boys naturally have a more phonological approach to reading, as no gender differences were found in the accuracy or speed of regular and irregular word reading. More importantly, no interactions between gender and regularity were found, nor gender differences in nonword reading. As a more phonological approach also benefits the reading of irregular words, all other things being equal (i.e., word recognition), as boys and girls were matched in word recognition, then those taking a more phonological approach would be predicted to be better at reading irregular words and show a smaller regularity effect, however there were no differences.

This result is in contrast to Thompson (1987), who argued that boys took a more phonological approach, suggesting this was a naturally inherent strategy rather than product of instructional method (as phonics was not taught). However, there could be another possible reason for boys' dependence on phonics. Research has found that girls read more often than boys (Coles & Hall, 2002; see also Chapter 7), and through increased exposure to print have likely developed a wider and faster recognition of words based on sight. Through increased reading, it is possible that girls are at a later stage of reading development compared to boys, where there is less dependence on phonics and more on sight word recognition (Waters et al., 1984), whereas boys are still using spelling-sound rules (with varying levels of success) to work out words as many are unfamiliar to them. This is another explanation for the gender difference in reading strategies, and could be investigated through matching children on exposure to print/frequency of reading.

Overall, high frequency words were read faster and more accurately than low frequency words, and regular words were the most accurately and quickly read, followed by exception then strange words. These results are consistent with previous studies of a similar nature (Baron & Strawson, 1976; Hino & Lupker, 2000; Metsala et al., 1998; Seidenberg, et al., 1984; Waters et al, 1984), and are consistent with the results found in the previous study.

Nonwords took longer to read than both high and low frequency regular and irregular words (only one syllable nonwords were included as a fair comparison to the one - syllable words used in the regularity task). This is consistent with previous studies (see Glushko, 1979). Nonwords are letter strings for which complete pronunciations cannot exist in memory, therefore correct pronunciation of these words is carried out by

constructing a pronunciation from knowledge of orthography and phonology. The results of this study indicate that this construction is slower than the direct retrieval of a complete pronunciation of a familiar word (even those that are less familiar, i.e., low frequency).

There were very high correlations between all measures of word reading and nonword reading, indicating the importance of phonological skills to underpin reading skill (Castles & Coltheart, 2004). This result is consistent with previous research in a larger sample (Siegel & Ruan, 1988). What is interesting is that there was a trend towards higher correlations between nonword reading and low frequency words than nonword reading and high frequency words (this was significant for regular words). This suggests that phonological reading skill is more important for reading low frequency words (particularly those that follow regular spelling-sound correspondences compared to their high frequency counterpart), as they provide a method of working out these less familiar words. High frequency words on the other hand, may be more likely to be read through recognition by increased familiarity. This is consistent with McCusker et al. (1981) and Jorm and Share (1983), who argued that children are flexible in using visual or phonological strategies depending on the nature of the task, word frequency being one of the factors. In addition, high frequency strange words were more highly correlated with nonword reading than high frequency regular words. Whilst high frequency regular words are relatively easy to process with basic knowledge of letter-sound rules, strange words require a child to be able to use these rules but also adjust their pronunciation read the word accurately. It may be that children with a more sound knowledge of letter sound rules are also better able to carry out the latter task (i.e., adjust pronunciation), due to less resources being taken up from working out the word

based on letter sound relationship. However this is speculation and cannot be concluded from the results of the current study.

Glushko (1979) investigated the regularity of nonwords in terms of the neighbouring orthographic similarities and argued that words and nonwords are pronounced using similar kinds of knowledge; “the pronunciations of words that resemble them and specific spelling-to-sound rules for multi-letter spelling patterns” (Glushko, 1979, p. 686). The nonwords used in the current study were entered into the MRC Psycholinguistic Database, using the ‘rime’ part of the word (i.e., the last segment of the word appearing after the final consonant e.g., ‘ast’ as in ‘hast’), to look for other words which have the same end but are pronounced differently. It was found that the nonwords used in the current study were mostly regular nonwords with no exceptions as neighbours (i.e., hast, kisp, mosp, prab, gromp, snid, twesk). One nonword however had an irregular neighbour; ‘drant’ as in ‘rant’ and ‘want’, also ‘sted’ had irregular neighbours if added to other words (e.g., the ‘ed’ is pronounced differently if added to ‘swayed’ or ‘versed’). In addition, ‘trolb’ contained no matching entry, the last three letters being a unique end letter sequence. The number of examples of each different type of nonword in the current study was not large enough to allow an analysis, however future studies could compare not only the regularity of nonwords (i.e., ‘hast’ vs ‘drant’), which was investigated by Glushko (1979), but also the frequency of the letter strings contained within nonwords. For example, to compare ‘hast’ (of which many words contain ‘ast’ ending) versus ‘mosp’ (very few words contain ‘osp’ ending) versus ‘trolb’ (which is a unique ending). This would allow a more in-depth test of the facilitation of orthography for reading as all letter strings would be unfamiliar yet regular.

In addition, examining the frequency and the regularity of nonwords would be an alternative technique to compare dual route and connectionist models of reading. According to the dual route model of reading, all nonwords are processed through the indirect phonological route, through recoding of the letter-sound string. Therefore no predictions or expectations would be made based on accuracy or speed of reading different types of nonwords (i.e., nonwords varying in frequency and regularity within the letter-string), although presumably longer nonwords would take longer to process. However, according to connectionist models of reading, the accuracy and speed at which a word (or perhaps nonword) is pronounced is dependant on the relative consistency of the letter-sound correspondences. In other words, nonwords of which letter sequences are more common (e.g., ‘hast’ as opposed to ‘mosp’ or ‘trolb’) will be pronounced more quickly, as these letter-strings will have stronger links between orthography and phonology as they have been accessed more frequently. In addition, those nonwords that follow consistent regular letter sound sequences (e.g., ‘hast’ as opposed to ‘drant’, of which ‘ant’ can be pronounced different depending on whether it is in ‘rant’ or ‘want’), will be pronounced quicker and more accurately due to the consistency of the letter-sound relationship.

Research into reading strategies is important, as it provides some insight into the ways in which some children are more naturally disposed to learning and therefore is of practical use in developing reading instruction. This study found no evidence of boys taking a more phonological approach to reading in the later primary school years, despite other studies finding a difference earlier in school. In situations where older boys and girls may need supplementary teaching in addition to classroom teaching (i.e., poor readers), this study shows no evidence to teach boys with a more phonological

approach than girls, however it appears that all children will benefit from a phonological approach to teaching (Watson & Johnston, 1998; Johnston & Watson, 2004a; 2004b).

What is of interest is the large scale study which found that boys were better readers than girls as a consequence of systematic synthetic phonics instruction (Johnston & Watson, 2004b). This is an unusual result and therefore warrants further research. In the current study, the children did not receive synthetic systematic phonics instruction, therefore any reliance on phonics is less likely to be a product of teaching instruction. However, when children are taught to read via systematic synthetic phonics, this method does seem to boost boys reading quite substantially (and also girls too who were reading well above chronological age throughout the study). It may be that boys naturally prefer the 'rule' learning for letter sound correspondences and the building of words via letter sound relationships and breaking down words to spell using the same letter-sound rules. It could be that boys better reading and spelling was a product of both its reliance on phonics, but also more specifically its systematic method of teaching, and its focus on one rule for reading rather than a number of different strategies for reading words. This would be an interesting route to pursue for future research.

Conclusions

The research into gender differences in reading strategies is very limited (as evidenced by the lack of literature in this area) and offers some potential for further investigation. The current study has shown that boys do not appear to have a more phonological approach to reading, at least in the later stages of reading development, therefore there may be another explanation for their better reading and spelling ability when taught by a systematic synthetic phonics method. It would interesting to investigate whether boys

benefit particularly from systematic aspect of this approach, with its repetitive techniques and strategies and the 'one rule' for word reading which distinguishes it from other methods.

CHAPTER 6: ATTITUDES TO READING

GENDER DIFFERENCES

Introduction

Attitude towards reading is an important factor which is likely to influence a child's regularity of independent reading, their level of involvement in class reading activities, the variety and range of reading topics chosen, their enjoyment of reading, and possibly their reading achievement. Attitude towards reading has been defined as "a state of mind, accompanied by feelings and emotions, that make reading more or less probable" (Smith, 1990), or alternatively as "a system of feelings related to reading which causes the learner to approach or avoid a reading situation". (Alexander & Filler, 1976, cited in McKenna et al., 1995a, p. 934). Both these reading specific definitions of attitude assume that the more positive the attitude, the more likely one will engage in reading activity. Indeed, positive attitudes towards reading have consistently been found to relate to higher reading achievement (McKenna et al., 1995a; Tse, Lam, Lam, Chan & Loh, 2006) and more frequent reading (Sainsbury & Schagen, 2004). In addition, the development of positive attitudes toward reading has been associated with sustained reading throughout the life-span (Cullinan, 1987). This last point highlights the importance of fostering positive attitudes to reading whilst children are still in school.

Numerous studies have been conducted to measure children's attitudes towards reading (Askov & Fishback, 1973; Coles & Hall, 2002; Kush & Watkins, 1996; McKenna et al., 1995a; Parker & Paradis, 1986; Quinn & Jadav, 1987; Sainsbury & Schagen, 2004;

Smith, 1990; Twist, Gnaldi, Schagen & Morrison, 2004). In addition to educational and cognitive factors, there are numerous social, behavioural and environmental factors which influence a child's level of reading activity and achievement, and their overall enjoyment and success in school. These factors include motivation (Baker & Wigfield, 1999; Gottfried, 1990; Guthrie, Wigfield, Barbosa, Perencevish, Taboada, Davis et al., 2004; Morgan & Fuchs, 2007; Wigfield & Guthrie, 1997), competency beliefs (Chapman & Tunmer, 1995, 1997; Wigfield, Eccles, Suk Yoon, Harold, Arbretton, Freedman-Doan et al., 1997), self-esteem (Davies & Bremner, 1999), peer influences and relationships (Alloway & Gilbert, 1997; Henry & Rickman, 2007; Stowe, Arnold & Ortiz, 2000), competing alternatives to reading, (McKenna, et al., 1995a), interest and attitude towards school and reading (McKenna et al., 1995a; Sainsbury & Schagen, 2004), motivational strategies (Onatsu-Arvilommi, Nurmi & Aunola, 2002); family history, (Conlon, Zimmer-Gembeck, Creed & Tucker, 2006), home literacy environment (PIRLS, 2001; Van Steensel, 2006), perceptions of reading (Archer & Macrae, 1991), school and reading curriculum (Coles & Hall, 2002), style of teaching (Alloway & Gilbert, 1997), personality (Alloway & Gilbert, 1997), and school resources (Coles & Hall, 2002).

Models of attitudes to reading and ability

Many models have been proposed to account for the different dimensions of reading attitude and their influence on learning to read. Ajzen and Fishbein (1973), proposed a causal relationship between attitudes and reading behaviour. Causation was seen to proceed from beliefs to attitudes and subjective norms, then to intentions and finally to behaviours. Two types of beliefs were proposed: those regarding the object itself (the reading), and those of a normative nature (how one's friends view reading). Due to the

causal relationship between beliefs and attitudes, the process of challenging old beliefs and introducing new ones was seen as important in shaping and changing attitudes.

Liska (1984) challenged the causal chain proposed by Ajzen and Fishbein (1973), and argued that intentions alone are not enough to cause certain behaviours to occur, for example, a certain level of skill is also necessary, as well as opportunities for social interactions. As such, attitude and normative beliefs were given causal roles regarding behaviour with contingencies such as adequate proficiency. In more recent years, these rather straightforward conceptualisations of reading have been extended upon and more complex models, suggesting more influencing variables have been proposed.

More recently, in a model proposed by Mathewson (1994) attitude is considered as one of a number of factors that will influence an individual's intention to read. Attitude to reading is said to be comprised of three elements; prevailing feelings about reading, action readiness for reading and evaluative beliefs about reading. All elements are influenced by personal values, goals, self-concepts and communications and in turn feedback to an intention to read or continue reading. This intention to read is in turn influenced by external motivators (e.g., incentives) and emotional state (e.g., joy), which can influence feelings of satisfaction. The model forms a complex relationship of influence and feedback between many factors which feed into attitude to reading, however this model has been criticised for not considering the development of attitudes over time.

The McKenna model (McKenna et al., 1995a) was constructed to consider the long-term development of reading attitudes. This model identified three main factors which would influence change in attitudes. The first of these were the beliefs about the

outcomes of reading (judged in the light of the desirability of these outcomes), the second were beliefs about the expectations of others (judged in the light of one's motivation to conform to those expectations), and the third were the outcomes of specific incidents of reading.

All models offer different perspectives regarding the relationship between attitude to reading, reading activity and ability, often setting them within other factors such as beliefs, motivations or feelings. Overall, these models offer different contributions towards how to change attitudes towards reading, whether it being challenging beliefs regarding reading (Ajzen & Fishbein, 1975), improving reading skill and allowing more opportunities for reading (Liska, 1984), enhancing feelings and beliefs towards reading, (Mathewson, 1994), or changing peers attitudes and creating positive reading experiences (McKenna et al., 1995a).

Gender differences in attitudes to reading, reading preferences and reading ability.

A consistent finding across the literature is that girls have a more positive attitude towards recreational reading (Askov & Fishback, 1973; Coles & Hall, 2002; Kush & Watkins, 1996; McKenna et al., 1995a; Sainsbury & Schagen, 2004; Smith, 1990; Swalander & Taube, 2007; Tse et al., 2006). This gender difference has been found to span a wide range of school age groups (Kush & Watkins, 1996; McKenna et al., 1995a; Sainsbury & Schagen, 2004; Smith, 1990), and also widen with age (McKenna et al., 1995a). Whilst there is evidence that both boys and girls' attitudes to reading become more negative as they get older (Kush & Watkins, 1996; McKenna et al., 1995a; Sainsbury & Schagen, 2004), girls' attitudes have been found to be more stable across time (Kush & Watkins, 1996). Girls also read more than boys (Coles & Hall, 2002),

and have better reading ability (PIRLS 2001; 2006; NLS statistics, 2007). Perhaps this higher frequency of reading and better reading ability could be an explanation for girls more positive attitudes towards reading. Indeed, a relationship between ability and attitude to recreational reading has been found, and shown to grow stronger over time (McKenna et al., 1995a).

A factor which is very important in becoming a better reader is the quantity and quality of books which are read. Research has found that girls read more books than boys, but that there is a tendency for all children to read less books as they grow older; however this may be due to the length of books (Coles & Hall, 2002). This study examined the reading habits of 10-14 year old children in England, through questionnaires (n = 7976), and results could be compared with a similar sized study conducted in 1971. Over the last two decades, book reading had generally increased for younger children (10 year olds and 12 year old girls), remained at a similar level for older children (12 year old boys and 14 year old girls), but has decreased for older boys (14 year olds). Whilst most boys prefer reading sports-related, war/spy related or science fiction/fantasy books, girls preferred to read about romance/relationships, school-related or horror/ghost books. Girls had a more positive attitude to reading, with 59.2% of girls reported reading as something positive compared to 47.1% of boys. On the other hand, only 5.2% of girls had a negative response to reading compared to 13.9% of boys. Overall, both boys and girls have a preference for fiction, however, more boys do choose to read non-fiction than girls.

The Progress in Reading International Literacy Studies (PIRLS, 2001; 2006), carried out in conjunction with the National Foundation for Educational Research, studied 140,000 10 year old children from 35 different countries. In both years, in every

country participating in the study, girls had better reading comprehension than boys, indicating that gender differences in reading ability cross language and education systems. Results also showed that in 2001, although children in England were reading at a high level compared to their international counterparts (with only Sweden and the Netherlands higher), children in England reported having poor attitudes to reading compared to children in many other countries. In an index used to categorise responses, England was 32nd out of the 35 countries in terms of positive attitude towards reading (Twist et al., 2004). In 2006, England's position in terms of average reading achievement fell to 19th place compared to its international counterparts. This represented a significant decrease in reading achievement. In addition, children in England still had relatively poor attitudes to reading and were 33rd out of the 40 countries in the study.

Gender differences and attitudes to reading over time

Attitudes to reading over time have been measured through cross-sectional research, comparing attitudes of younger and older children, or through longitudinal studies, following the same pupils over a number of years in school. The results from both cross sectional studies and longitudinal studies are consistent however; attitudes to reading generally become more negative as children get older. Large cross-sectional studies include McKenna et al. (1995a) who found that from grades 1 – 6, attitudes towards recreational and academic reading become more negative as children get older (n = 18,185). In addition, Sainsbury & Schagen (2004) found that older children (Year 6) had more negative attitudes to reading than younger children (Year 4). Longitudinal studies include research by Kush & Watkins (1996) who found that over a period of 3

years (grades 1 - 4), boys and girls (n = 189) recreational and academic reading attitudes dropped significantly, however girls showed greater stability in reading attitudes.

Relationship between reading ability and attitude to reading.

Research has shown that there is an association between reading ability and attitude towards reading. PIRLS (2001; 2006) found that, on average internationally, students with high positive attitudes to reading have substantially higher average reading achievement than those with lower attitudes to reading. McKenna et al. (1995a) through a cross-sectional study of children in Years 1 – 6 found that the strength of the association between ability and attitude to recreational reading grows stronger over time. In this study, reading ability was measured by teacher reports of the child's performance in school, with children being classified into three groups (low, average and high reading ability). However, an objectively scored test to measure reading ability, in comparison to less precise indicators of achievement such as teacher ratings would be more accurate in measuring the strength of the relationship between ability and attitudes to reading, and is arguably a more reliable indicator of this relationship. Askov and Fischbach (1973) measured attitudes towards recreational reading with word reading and paragraph meaning subtests of the Stanford Achievement tests, and found a relationship between attitude and paragraph meaning but not with word reading. Consistent with McKenna et al. (1995a) the relationship between attitude and ability was found to grow stronger over time. One possible explanation for this strengthening association between attitude to reading and ability could be that if children receive constant and consistent feedback from their reading experiences, this feedback will intensify over time, resulting in stronger and reinforcing perceptions of reading. For example, if a child is poor at reading and their experiences of reading are continually

frustrating and negative, this will eventually lead to the belief that the inevitable result of reading is frustration. A child's attitude towards reading will therefore become more and more negative or positive as a result of their continued negative or positive experiences with reading. It follows then that children who are better readers will read more frequently (as it is an activity they are more likely to enjoy). However, there is little research studying the relationship between reading ability, frequency of reading and attitude, as studies either focus on reading ability and attitudes to reading (Askov & Fischback, 1973; McKenna et al., 1995a) or frequency of reading and attitudes to reading (Sainsbury & Schagen, 2004).

The role of other factors

As outlined, there are a multitude of areas which are related to a child's achievement in school. In addition to attitudes to reading this study focuses on three other areas; attitudes to school, competency beliefs and support networks. These areas have been somewhat neglected in past research (perhaps with the exception of competency beliefs) yet may provide valuable insights into the source of gender differences in ability and attitudes. In addition, these areas are likely to affect classroom performance which may impact on achievement in school.

Attitude to school. Whilst there are few studies directly considering attitudes to school and its relation to reading ability, it is likely that the two are related. The ability to read opens a gateway to success in many other areas of school, as most school subjects rely to varying degrees on reading ability. Once children have mastered this fundamental skill, they will accomplish things much more easily, which may in turn lead to more enjoyment from school rather than frustration. It is often speculated that girls have a

more positive attitude to school due to the nature of the school environment; that the rules and restrictions imposed in schools are unfavourable to boys (Alloway & Gilbert, 1997; Daniels, Creese, Hey, Leonard & Smith, 2001). Alloway and Gilbert (1997) argued that literacy classes run counter to the whole idea of masculinity, as literacy classes require children to be able to use self-disclosure, empathic response, introspection, personal and creative expression and to describe feelings and emotion. It is also found that boys have more difficulty being 'good' pupils; those who listen, watch, sit quietly, read, write, are good group members and are unlikely to challenge teachers ideas (Bank, Biddle & Good, 1980). Boys are four times more likely than girls not to do homework (Wiens, 2006). In addition, boys account for 71% of all school suspensions, and 90% of all disciplinary actions are in response to infractions by boys (Wiens, 2006). Finally, boys report to be more overtly aggressive (Crick & Grotpeter, 1995) and are found to be less attentive in class (Samuels & Turnure, 1974). These characteristics conflict with what teachers deem to be 'good' qualities necessary for being successful in school.

Competency beliefs. Competency beliefs refer to "estimates of how good one is at a given activity" (Gottfried, 1990). Competency beliefs are likely to be closely related to reading ability; as children experience success or failure in reading, this will likely elicit positive or negative beliefs in their ability. Chapman, Tunmer & Prochnow (2000) found that children with negative self-concepts of their school performance read lower level books and have poorer word recognition and reading comprehension. In addition, these negative beliefs in their abilities can emerge from when they first start school (within 2 months of schooling) when they first encounter problems with poor letter knowledge and phonological awareness. Chapman & Tunmer (1997) found that the correlation between children's self-concept of their reading ability and their actual

reading ability grows stronger over time, indicating they have better awareness of their reading ability as they grow older. Davies & Brember, (1999) have found that overall boys have significantly higher global self-esteem, however others (Burnett, 1996; Stevenson & Newman, 1986) have found that whilst boys are more confident about their mathematic abilities, girls are more confident about their reading abilities.

Support networks and preferred learning style. It is argued that girls are more likely to co-operate with each other and the teacher but that boys prefer independence, to work alone, and are often more competitive than girls (Daniels et al., 2001). Fisher (2001) questioned children on the Literacy Hour and found that boys were more enthusiastic about the independent work aspect of the Literacy hour than girls. Whilst little research has been carried out looking at classroom support networks, it is possible that having a reliable support network in the classroom may be beneficial for growth and achievement in school. Indeed, Henry and Rickman (2007) found that in children just starting school, the ability level of peers in a child's classroom has direct effects on a child's cognitive skills, pre-reading skills and expressive language skills. In addition, Share, Jorm, Maclean & Matthews (1984) found that the ability level of a child's peers accounts for considerable variance in the child's later reading achievement, over and above their own ability.

The aim of the present study is to investigate gender differences in factors which may influence ability and achievement in school, and examine these as possible contributors to differences in reading ability. A particular focus of attention is in examining the magnitude of any differences between boys' and girls' performance to assess whether these are likely to be of practical importance in the classroom. In addition, the

relationship between reading ability, reading frequency and attitudes towards reading, school, competency beliefs and support networks will also be investigated.

It is predicted that reading ability, frequency of reading and attitudes towards reading will correlate significantly.

It is also predicted that reading ability will correlate with attitude towards school, competency beliefs and support network.

Finally, it is predicted that girls will be better at reading and have a more positive attitude towards reading and school and read more frequently.

Method

Participants

Two hundred and thirty two children (117 boys, 115 girls) from eight different primary schools took part in this study. The average age of these children was 10 years and 7 months (0.35 S.D). All children had previously completed a test of reading comprehension on the same day as the questionnaire. All children had English as their first language.

Test materials and procedure.

Reading comprehension: Group Reading Test II, (Macmillan Unit, 2000).

This test was chosen as it is a comprehensive test measuring word reading, comprehension and vocabulary, all of which are important elements for achievement in school. See Chapter 4 for details of this test.

Questionnaire:

The questionnaire was constructed of two sections; the first section aimed to look at reading choices and frequency of reading. The second section was an 18 item questionnaire exploring the following areas; library use (1 question), preferred learning style (3 questions), attitudes to reading (5 questions), attitudes to school (5 questions), competency beliefs (2 questions) and support (peer & teacher) (2 questions). The full questionnaire can be found in Appendix 2 in addition to the explanations of the questions. The questionnaire was constructed so that it was easy to read and the vocabulary could be understood by children of this age group. Nevertheless, the

examiner read out all the items on the questionnaire so that reading ability did not affect completion. Each item was read one by one, allowing sufficient time for children to respond before the next item was read. After the introductory section, children were shown, by means of a practice question, how to use the 5 point Likert scale that was used to measure attitudes in the questionnaire. Children were encouraged to use the full range of the Likert scale and to be as honest as possible when answering. All testing was carried out within the children's classrooms.

Results

The results have been split into four sections; 1) gender differences, 2) correlations between all questionnaire areas, 3) correlations with reading ability and 4) correlations with frequency of reading.

1) Gender differences

Analysis of variance was carried out to investigate whether there were any significant differences between the two groups.

Reading comprehension. Girls were significantly better at reading, $M = 100.96$ (11.58 S.D) compared to boys, $M = 97.50$ (13.20 S.D); $F(1, 233) = 4.57, p < .05$ (effect size = 0.01). This is a very small effect size.

Responses to introductory questions:

Frequency of reading at home. Girls, $M = 4.00$, (1.12 S.D) reported reading significantly more often than boys, $M = 3.21$ (1.39 S.D); $F(1, 231) = 22.60, p < .001$ (effect size = 0.09). The child's answer to this question was marked on a point-based scale, an answer of every night received 5 points, a few times a week (4), less than once a week (3), not very often (2), never (1).

Library Use. Girls ($M = 3.31$, 1.10 S.D) also reported borrowing books from the library more often than boys, ($M = 2.48$, 1.29 S.D); $F(1, 231) = 22.51, p < .001$ (effect size = 0.09).

Table 6.1. Book type preference (percentage of children)

Book Type	Boys favourite book		Girls favourite book	
	type (percentage)		type (percentage)	
	n = 117		n = 115	
	Top 3	1 st choice	Top 3	1 st choice
Fiction	75.0	22.5	68.7	43.5
Non-fiction	40.8	10.8	37.4	6.1
Comics	70.8	31.7	33.9	4.3
Magazines	70.0	27.5	81.7	32.2
Poetry	18.3	3.3	43.5	9.6
School books	25.0	4.2	34.8	4.3

Note: Children were asked to put the number one beside their favourite book type, the number two beside their second favourite, and the number three beside their third favourite. The values in the table represent the percentage of children who chose this category of book as one of their top 3 choices (Top 3), or as their favourite choice (1st choice).

The overall pattern for favourite book type was quite similar for boys and girls, fiction being preferred overall to non-fiction books. However, whilst boys preferred comics more than girls, girls indicated more of a preference for poetry. Girls also liked books from school more than boys. As this data was categorical, statistical analysis using a normal distribution curve to examine differences between boys and girls could not be carried out.

Table 6.2. Book subject preference (percentage of children)

Book Subject	Boys favourite book		Girls favourite book	
	subject (percentage)		subject (percentage)	
	n = 117		n = 115	
	Top 3	1 st choice	Top 3	1 st choice
Adventure	50.8	25.8	59.1	21.7
Horror/ghost	65.0	27.5	65.2	32.2
Romance/relationships	3.3	2.5	37.4	9.6
Animal-related	10.8	3.3	35.7	11.3
Science fiction/fantasy	8.3	0.8	9.6	1.7
Comedy	51.7	12.5	48.7	14.8
Crime/detective	21.7	1.7	14.8	1.7
Sports-related	43.3	16.7	22.6	7.0
War/spy-related	45.0	9.2	7.0	0.0

Note: These categories are the same as those used in the W H Smith Children's Reading Choices Project (Coles & Hall, 2002).

Whilst there are some gender differences for favourite book subject, boys and girls do have quite similar tastes, with adventure, horror/ghost and comedies being favourite topics for both boys and girls. However, sports-related and war-spy related books proved favourites for boys, whereas girls preferred romance-relationships and animal-related books. As before, due to the nature of the data, statistical analysis to examine gender differences using a normal distribution curve could not be carried out.

Table 6.3. Preferred group size for reading and working.

	Alone		Group		Whole Class	
	Boys	Girls	Boys	Girls	Boys	Girls
Pref. method of reading (%)	64.4	73.0	26.9	21.7	8.7	5.3
Pref. method of working (%)	30.3	34.8	57.8	54.8	11.8	10.4

Note: Children were asked if they preferred to read or work alone, in a group or as a whole class. Children were only allowed to put one option, therefore the results show the percentage of children who put this as their first choice.

Both boys and girls had a preference for reading alone, but working in a group. Again, statistic analysis could not be carried out to examine whether any differences were significant.

Questionnaire responses

Factor Analysis.

As many of the variables were found to be correlated, principal factor analysis with Varimax (orthogonal) rotation was used to see what grouping the items in the questionnaire formed. This analysis gave rise to four different factors from the 14 items put into the analysis from the questionnaire (items regarding library use and preferred learning style were kept separate).

Table 6.4. Factor loadings for all questions.

Question	ATS	ATR	CB	SUP
Q1		.73		
Q3		.71		
Q8		.71		
Q11	.47	.50		
Q14		.55		
Q4	.67			
Q7	.48			
Q9	.73			
Q10	.73			
Q13	.69			
Q2				.85
Q5				.51
Q6			.72	
Q12			.73	

Note. Factor loadings less than .35 are not presented. Items with the highest loadings are given in bold.

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

The questions loaded onto four factors which are described as follows: attitude to school (ATS); attitude to reading (ATR); competency beliefs (CB) and support (peer & teacher) (SUP). Attitude to school refers to a child's enjoyment of school and how much they value its importance. Attitude to reading refers to a child's enjoyment of reading both

within and outside of school. Competency beliefs refer to a child's perception of their reading ability and overall ability in school. Finally, support (peer & teacher) refers to the child's perception of their support network in class from both their teacher and peers. These groupings were found to hold for both boys and girls separately. Therefore, these factors were used in the subsequent analyses.

Table 6.5. Gender differences before and after controlling for reading ability (mean & standard deviations).

	Before controlling for R.A		After controlling for R.A	
	Boys	Girls	Boys	Girls
	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)
Attitude to reading	2.99 (0.93)	3.41 (0.83)	3.02 (0.87)	3.38 (0.86)
Attitude to school	3.08 (0.86)	3.53 (0.85)	3.09 (0.87)	3.53 (0.86)
Competency beliefs	3.74 (1.02)	3.62 (1.02)	3.79 (0.97)	3.58 (0.97)
Support (peer & teacher)	3.67 (0.96)	3.80 (0.98)	3.66 (0.97)	3.81 (0.97)

Analysis of variance revealed that before controlling for reading ability, girls had a significantly more positive attitude to reading, $F(1, 230) = 9.72, p < .001$ (effect size = 0.04), and school, $F(1, 230) = 14.56, p < .001$ (effect size = 0.06). There were no other significant gender differences.

Analysis of co-variance was carried out to control for differences in reading ability, and it was revealed that girls still had a significantly more positive attitude to reading; $F(1,$

227) = 9.51, $p = 0.002$ (effect size = 0.04) and school, $F(1, 227) = 4.63$, $p < .05$ (effect size = 0.02).

2) Correlations between all areas identified in questionnaire

Also of interest was the strength of the relationship between all areas measured in the questionnaire. Correlations were carried out before and after accounting for reading ability. Boys' and girls' scores were analysed separately to see if there were differences in strength of relationship between attitudes and feelings regarding school.

Table 6.6. Correlations between areas for boys and girls.

	Boys				Girls			
	1	2	3	4	1	2	3	4
1. Attitude to reading	----	.33**	.37**	.07	----	.43**	.28**	-.01
2. Attitude to school	.37**	----	.47**	.27**	.43**	----	.25*	-.07
3. Competency beliefs	.42**	.50**	----	.15	.27**	.24*	----	.04
4. Support	.07	.27**	.14	-----	.00	-.07	.06	----

Note: N = 117 (boys) and N = 155 (girls), * $p < .05$ ** $p < .005$ (bonferroni correction).

The lower left quadrant represents the strength of the correlation before accounting for reading ability (bivariate pearson correlation). The upper right quadrant represents the strength of the correlation after accounting for reading ability (partial correlation).

Both boys and girls show high correlations between all areas relating to internal thoughts and feelings (attitudes to reading, school and competency beliefs), but only

boys' attitudes to school were significantly associated with their perceived support network (external source of influence). The correlations (Pearsons r) were converted in a corresponding Fisher's z coefficient in order to see if there were significant differences between the boys' and girls' correlations. Before and after controlling for reading ability, boys were found to have significantly greater correlations between both attitude to school and competency beliefs, and attitude to school and support networks than girls, $p < .01$. Before controlling for reading ability, the relationship between attitude to reading and competency beliefs was also stronger for boys than girls, $p < .01$.

3) Correlations of questionnaire factors with reading ability.

Table 6.7. Correlations between reading ability and questionnaire areas.

Reading Ability	1	2	3	4	5
All	.22**	.17**	.32**	-.03	.32**
Boys	.29**	.22*	.29**	-.02	.24**
Girls	.07	.05	.37**	-.07	.39**

Note: $N = 232$, N boys = 117, N girls = 115, * $p < 0.05$ ** $p < 0.01$.

1 = attitude to reading, 2 = attitude to school, 3 = competency beliefs, 4 = support (peer & teacher), 5 = frequency of reading.

Overall, reading ability correlated with frequency of reading, competency beliefs, attitude to reading and attitude to school; only support (peer & teacher) did not correlate. However, when split by gender, only boys' reading ability correlated with attitude to reading and to school. The correlations (Pearsons r) were converted in a corresponding

Fisher's z coefficient in order to see if there were significant differences between the boys' and girls' correlations. There was a significant gender difference in the size of the correlation between attitude to reading and reading ability, favouring boys. That is, the better the boys' reading comprehension, the more positive their attitude to reading. Girls showed no such correlation.

4) Correlations with frequency of reading.

Table 6.8. Correlations between frequency of reading and questionnaire areas.

Reading Activity	1	2	3	4
All	.50**	.34**	.24**	.08
Boys	.44**	.30**	.32**	.10
Girls	.49**	.26**	.21*	.02

Note: N = 232, N boys = 117, N girls = 115, * $p < 0.05$ ** $p < 0.01$.

1 = attitude to reading, 2 = attitude to school, 3 = competency beliefs, 4 = support (peer & teacher).

Overall, frequency of reading correlated most strongly with attitude to reading, followed by attitude to school and competency beliefs. There was no significant correlation between frequency of reading and support network. Boys and girls showed very similar associations, so the subsequent analyses were not split by sex. The correlations (Pearsons r) were converted in a corresponding Fisher's z coefficient in order to see if there were significant differences in the strength of these correlations, and it was found that the correlation between frequency of reading and attitude to reading was

significantly stronger than the one between frequency of reading and attitude to school, $p < .01$.

Comparing Tables 6.7 and 6.8, both attitude to reading and attitude to school correlated significantly more strongly with frequency of reading than reading ability, $p < .01$ (Fisher's z coefficient comparisons). Whilst competency beliefs correlated more strongly with reading ability than reading frequency, this comparison was not significant.

Discussion

Girls had better reading ability, read more frequently and had a more positive attitude to reading and school compared to boys. No significant gender differences were found in competency beliefs or support networks. Reading ability correlated with boys' attitudes to reading and school, but not that of girls, whereas reading ability correlated with both boys and girls' frequency of reading and competency beliefs. Boys' beliefs in their abilities were more strongly related to their attitude to reading and school, whilst girls' beliefs were more strongly related to their reading ability. Whilst previous studies have focused on gender differences for specific factors (i.e., attitudes to reading), they have neglected to consider gender differences which may exist in the association between such factors. Indeed, gender differences appeared to be very prominent in the association between factors.

The results of this study are consistent with many other studies; gender differences favouring girls were found in reading ability (NLT statistics, 2007; PIRLS, 2001; 2006) and attitudes to reading (Coles & Hall, 2002; Kush & Watkins, 1996; McKenna et al., 1995a; Sainsbury & Schagen, 2004). Indeed, most studies which have examined gender differences in reading ability and attitudes to reading have found them, in all cases favouring girls. However, after examining the effect sizes for the ability and attitudes comparisons, it is clear that the difference in ability, although statistically significant, is smaller than the differences in attitudes.

Published literacy statistics for schools in England reveal that a higher percentage of girls achieve the standard expected in Key Stages 1 - 4 in Literacy (National Literacy Trust, 2007). However, as the National Literacy Trust provides statistics by

categorising children into bands of performance, no meaningful comparison using a normal distribution curve for the sample can be carried out. PIRLS (2001; 2006), on the other hand, publishes literacy statistics which provide information from which effect sizes can be calculated. In every country participating in PIRLS 2001 and 2006, girls had better reading comprehension than boys. In the relevant comparisons with English speaking countries, effect sizes were calculated using the means and standard deviations presented in the published PIRLS documents (both in 2001 and 2006). Effect sizes are calculated in a different way to the partial eta squared effect sizes which are used commonly for assessing the magnitude of differences in ANOVA results. As such, they provide a different value of effect size (Cohen's d), where 0.20 is a small effect, 0.50 is medium and 0.80 is considered a large effect (Cohen, 1977; 1992). For the purpose of comparing the current study with PIRLS and other previous studies, the effect sizes according to Cohen's d were calculated based on the data collected (Cohen's d is a measurement of the magnitude of the difference between two means, taking into account the variation). In terms of reading ability, the current study found an effect size of 0.28, similar to that found in the relevant comparisons with English speaking countries; 0.26, 0.25 (England), 0.21, 0.29 (Scotland), 0.22, 0.17 (USA) and 0.28, 0.27 (New Zealand), where the former value refers to 2001 and the latter to 2006. The effect sizes from both the PIRLS 2001 and 2006 study and the current study would be classified as relatively small according to Cohen's d (if $d = 0.20$, in normally distributed populations of equal size and variability, only 14.7% of their combined area is not overlapped).

In comparison to gender differences in reading ability, studies which have examined gender differences in attitudes towards reading have found larger differences. These studies typically use a Likert scale to measure attitudes (both Kush and Watkins, 1996

and McKenna et al., 1995a used the Elementary Reading Attitude Survey which produces a mean score between 10 and 40 for a recreational reading and an academic reading scale). Kush and Watkins (1996) carried out a study of the same pupils ($n = 189$) over two time periods (Grade 1 and Grade 4) and found gender differences in recreational reading which were greater than in academic reading. When effect sizes were calculated using the means and standard deviations, in Grade 1, effect sizes of 0.43 (recreational) and 0.28 (academic) were found, compared to Grade 4, where effect sizes of 0.53 (recreational) and 0.07 (academic) were found. In addition, McKenna et al. (1995a) tested a large number of pupils ($n = 18,185$) from different grades and of different ethnicity and reported gender differences for both recreational and academic scores. Again, effect sizes were calculated using the means and standard deviations presented in the paper. It was found that in each year group (Grade 1 - 6), the gender differences in attitudes were greater for recreational reading than academic reading, and the magnitude of the gender difference for both recreational and academic reading increased steadily with age. Effect sizes ranging from 0.40 - 0.74 (average $r = 0.58$) were found in recreational reading, and effect sizes ranging from 0.17 - 0.36 (average $r = 0.28$) were found in academic reading. Both these studies indicate that gender differences in attitudes to reading depend greatly on the nature of what is being read, or the purpose for which it is being read, recreational reading producing greater differences. In the current study, gender differences in attitude towards reading were found, before ($d = 0.48$) and after ($d = 0.42$) controlling for reading ability (however the questionnaire contained a combination of academic and recreational reading questions). According to Cohen (1977) an effect size of 0.50 (similar to the recreational differences found) would be large enough to be visible to the naked eye and represents 33.0% of non-overlap between the two equally sized equally varying populations. The effect sizes do appear consistently to be greater for attitudes to recreational reading than reading ability itself.

The method by which attitudes towards reading are measured will affect the type of results found. Sainsbury & Schagen (2004) asked children to either agree or disagree with a series of statements such as 'do you enjoy reading?' This forced choice method found a higher percentage of girls agreed with the positive reading statements compared to boys. However, the forced choice method reduces the quality of a response that can be given by a child compared to the Likert method.

In addition to differences in attitudes to reading, it was also found that girls have a more positive attitude to school, before ($r = 0.53$) and after ($r = 0.51$) controlling for reading ability, these effect sizes being greater than reading ability itself. A result with girls favouring school was predicted as it has been suggested that the rules and restrictions imposed in schools are unfavourable to boys in particular. In addition, it may have been that admitting to enjoying school, runs counter to their 'macho' image (Alloway & Gilbert, 1997; Daniels et al., 2001). No gender differences were found in competency beliefs or support networks (peer & teacher) however.

Finally, girls reported borrowing more books from the library ($d = 0.69$) and reading more often outside of school ($d = 0.63$), these gender differences represent relatively large effect sizes (if $d = 0.80$, 47.4% of the populations areas are not overlapped). This higher frequency of book reading is in line with the suggestion that people who have a more positive attitude to something are more likely to seek that particular thing out and choose it over alternative activities (Mckenna et al., 1995a). It is also consistent with Coles and Hall (2002) who found that girls read more often than boys. However, it is important to note that measurements of frequency of reading often involve asking children how often they read, or how many books they have read recently. The question asking children how often they read may be misunderstood however, with children

taking this to mean frequency of book reading, when there are other sources of reading (i.e., the internet). Indeed, PIRLS (2006) found that whilst girls read significantly more stories or articles in books or magazines compared to boys (this is the case in 35 out of 40 countries), boys read significantly more stories or articles on the internet (in 21 out of 40 countries). The international average for frequency of reading book stories/articles or internet stories/articles is significantly higher for girls and boys respectively. It is important therefore in future studies to take into account the various sources of reading material that children may use, all of which may be developing their reading skills.

Consistent with previous research, the current study found an association between reading ability and attitude to reading (McKenna et al., 1995a). In addition, there was also an association between reading ability and attitude to school, competency beliefs and frequency of reading at home. In contrast to previous studies, the current study used an objectively scored test to measure reading ability, in comparison to less precise indicators of achievement used previously, such as teacher ratings (McKenna et al., 1995a). This adds to the quality of the measure taken and is arguably a more reliable indicator of the relationship between reading ability and other areas. Such a measure also allows correlations to be carried out to discover the strength of the relationship, and this uncovered some interesting results.

Whilst an association between ability and attitude has been found previously (McKenna et al., 1995a), it has not been possible as yet to investigate the source of this relationship. In the present study, the associations between the factors were examined to discover whether they were a potential source of the differences in responses made by boys and girls. Interestingly, when results were split by gender, it was only boys' reading ability

that correlated with their attitude to reading and attitude to school. It seems that an important source of gender differences may be detectable in how attitudes, ability and beliefs relate to each other. These gender differences in the relationship between areas may be of practical use. This study provides an interesting insight into boys' attitudes; although causation cannot be determined, it is possible that achievement in a particular area is important in order to foster positive attitudes in that particular area, as boys are much more likely to measure their enjoyment towards something as a result of achievements made in that area. In terms of applicability, interventions with poor reading boys should perhaps be partly achievement focused, so that when progress is made, feelings of success and more positive attitudes are fostered in that area. As positive attitudes towards reading have been found to be related to continued reading into adulthood (Cullinan, 1987), strategies for increasing attitudes to reading in school may likely have a positive impact on reading frequency and ability after school. In addition, there were significantly closer relationships between boys' beliefs in their abilities and their attitudes to reading and school than for girls, suggesting a need for more praise and encouragement to increase confidence in their abilities, in order to promote more positive attitudes to reading and school.

Reading ability was most strongly related to competency beliefs, highlighting the influence that success or failure has on a child's beliefs in their ability (this was more so the case for girls). In addition, boys in particular showed a very close relationship between beliefs in their abilities and their attitudes to reading and school, again highlighting the need for achievement to foster positive attitudes in these areas.

Whilst many studies have considered either the relationship between attitudes to reading and reading ability (McKenna et al., 1995a) or attitudes to reading and reading activity

(Sainsbury & Schagen, 2004), this study has measured the strength of the relationship between these three variables. How frequently a child reads is very important, as those who read more frequently are more likely to develop better sight word recognition, have a wider vocabulary, better reading comprehension, verbal fluency and general knowledge. In this study there was a relatively close relationship between ability and frequency of reading (particularly for girls). Interestingly, a much stronger relationship was found between reading frequency and attitudes than reading ability and attitudes, suggesting that attitudes have more impact on reading frequency than being a product of ability as the former are more closely related. However, as with all correlational studies, it is not possible to draw conclusions on the direction of causality between reading attitude, activity and achievement.

When the results for boys and girls were analysed separately, there was a stronger relationship between all factors in the boys' responses than the girls (with the exception of the correlation between attitude to reading and school). Boys' attitudes in one area are more closely tied to their attitudes or feelings in other areas, therefore interventions with boys experiencing reading problems should focus not only on improving reading skills, but on fostering positive attitudes and increasing confidence in abilities. Combining this with extra reading instruction will more likely lead to active and positive participation in literacy activities, and sustained reading throughout school and into adulthood, than if extra reading instruction is given alone. Interestingly, boys' attitudes to school were significantly more closely related to their perceived support network (from teachers and peers), highlighting this as another avenue which could be used to promote more positive attitudes in school.

Consistent with research carried out by Coles and Hall (2002) both boys and girls reported a preference for fiction over non-fiction, with slightly larger numbers of boys

enjoying non-fiction. However the results from this study suggest that differences between boys and girls in terms of reading topic are not as different as has previously been argued. Whilst the study by Coles and Hall (2002) looked at the book subjects that children had recently read, this study used the same categories to look at the book subjects boys and girls would like to read about. Boys and girls both reported adventure, horror/ghost and comedies as their favourite book subjects. Other favourite topics chosen by the boys were sports-related and war spy-related (consistent with Coles & Hall), whilst girls enjoy romance-relationships (consistent with Coles & Hall) and animal related books. These results suggest that whilst boys and girls may read about different topics (Coles & Hall, 2002), their preferences for reading materials are similar, therefore criticisms that have previously been made about the school reading curriculum, that it chooses topics more favourable to girls than boys, are perhaps inappropriate (Coles & Hall, 2002; Fisher, 2001). Rather, the gender differences in subjects read about may be due to the availability of reading material for boys or girls, or suggestions made by teachers or friends, without accurately reflecting book subject interests.

The organisation and structure regarding the way children read and learn in class will likely impact on their enjoyment and performance in class. When children were asked to rate their preferred structure for reading and learning (alone, group, whole class) the pattern of results was very similar for both boys and girls. The majority of boys and girls preferred to read alone, followed by group reading then whole class reading. In terms of working in class, the majority of both boys and girls preferred to work in a group, followed by alone then as a whole class. These results conflict with the idea that boys prefer to work more independently, (Daniels et al., 2001; Fisher, 2001) in fact more girls said they would like to work alone (although this difference was small). In addition there were no differences in support networks; both boys and girls were equally

likely to help each other or ask the teacher if they were having difficulty with something in class.

The results of this study suggest that perhaps not all areas are as distinct as may have been expected as there are close relationships between all areas relating to internal thoughts and feelings (attitudes and competency beliefs) compared to external factors (support). Whilst factor analysis identified the items as measuring different constructs, these close relationships between internal factors highlight the importance of fostering positive attitudes, or increasing self-belief, as a child who is more positive in one area may impact in a positive way in other areas of school life. When developing reading programmes designed to tackle reading problems, it is not just reading ability which needs to be improved, but rather the attitudes and confidence in abilities in order to have a comprehensive programme of reading recovery which will have long lasting effects.

The results of this study also have potential consequences for models of attitudes to reading which assume that the relationships between factors are more rigid than the current study implies. For example, Liska's model (1984) highlights the importance of ability as a mediating factor in the causal connection between beliefs and attitudes, however the results of this study imply that this would only be important when it is boys' attitudes that are being examined. In addition, the Mathewson model (1994) and McKenna model (1995a) consider a range of factors which will influence an individual's intention to read, with complex relationships between beliefs, feelings, attitudes and intentions. However the strength of these relationships have not been examined differentially for boys and girls, and it may be that some relationships hold for boys but not for girls (or vice versa). There may also be differences in the strength of the association between these factors for boys and girls, as in the current study,

associations between attitudes and beliefs were generally stronger for boys than girls (although this depended on the nature of the attitudes as girls showed a closer association between their attitudes to reading and school). These models of attitudes to reading need to be tested for boys and girls separately, and consistent results need to be found if they are to be generalised to both.

Conclusions

The gender differences that have been found to exist in reading ability appear to be consistently smaller than the gender differences in attitudes and reading frequency. Another substantial and powerful source of gender differences may be found in the associations between these areas, as boys and girls were found to differ very markedly in the strength of the correlations found between attitudes, beliefs and reading ability. By examining these relationships, it is possible to make testable predictions about what features of a reading programme might be enhanced in order to produce greater improvements in reading skill for both boys and girls. In addition, the results of this study have consequences for models of attitudes to reading, which assume that the association between factors is consistent, regardless of gender. These associations need be examined further by assessing boys and girls beliefs and attitudes separately.

CHAPTER 7: ATTITUDES TO READING

THE EFFECT OF READING PROGRAMME

Introduction

Attitude to reading is becoming an increasingly popular area to be studied. Within schools this is the type of research that teachers would like to have more information about. It has been found that teachers rate research intended to increase motivation to read as more important than that intended to improve comprehension (O'Flahaven, Gambrell, Guthrie, Stahl, Baumann & Alvermann, 1992). Discussions with teachers have shown that they are placing increasing focus on getting children interested in reading, assuming that increased reading skill will follow.

In response to this, investigation into the effects of reading instruction is changing. Whilst previously focus was on the effects of reading programmes on reading achievement and ability, there is also now a move towards investigating the effects of reading instruction on children's attitudes to reading. This research has been carried out more extensively in the U.S., and there is a distinct lack of research in this area in Britain, where focus has mainly been on looking at the effects of teaching on students achievement. Indeed, goals set by the National Literacy Strategy for literacy are achievement focused (i.e., by 2002, 80% of all 11year old should have reached the standards expected of their age in English in the Key Stage 2 National Curriculum tests, National Literacy Trust, 2005). In addition, it has been argued that the NLS and national tests have discouraged children from reading for pleasure (Pullman, 2004). In

the sections on reading in Key Stages 1 - 3 of the National Literacy Strategy, verbs include, 'reinforce', 'predict', 'check', 'discuss', etc however the word 'enjoy' does not appear once (Pullman, 2004), highlighting the focus of the NLS on achievement. However, more recently the National Literacy Trust has published a review investigating attitudes to reading, entitled "Reading for Pleasure: A research overview" (National Literacy Trust, 2006), thereby acknowledging its importance in reading. In this review however, there are no studies carried out in Britain comparing the effects of reading programmes on attitudes (with the exception of Sainsbury & Schagen, 2004, however there is a clear confounding factor with this study which makes it difficult to draw conclusions, see below).

As most research has been carried out in the US, the literature reflects this. One large scale study carried out specifically to look at the effects of instructional technique on attitudes to reading compared two very different approaches; whole-language practices and traditional basal approaches (McKenna et al., 1995b). In order to appreciate how these different approaches may affect attitudes, it is important to give a brief description of the philosophies and practices behind them. A whole language approach is described as follows:

"teachers plan literacy instruction on the basis of the actual, uncontrolled vocabulary of the students themselves. Daily creative writing opportunities are provided. Decoding skills are directly taught but on an ad hoc basis and not according to a prescribed invariable sequence." (McKenna et al., 1995b, p. 22).

On the other hand, the description of a traditional basal approach is:

“it introduced reading skills gradually and sequentially and organised them into numerous sequences, or strands, through which each student progressed concurrently. The core components of the series included; student readers, work books, teachers guides, teachers notebooks and skills assessment booklets. Workbooks were used on a daily basis and writing instruction was minimised and not systematically related to reading” (McKenna et al., 1995b, p. 23).

The two programmes appear to be very different, both in their teaching philosophy and the child’s experience of literacy lessons. Two studies were carried out to measure directly the effects of reading instruction with children from all primary age groups (Grades 1-5). Consistent with previous research, in the first study (n=918), girls had a more positive attitude to reading (Coles & Hall, 2002; Kush & Watkins, 1996; Sainsbury & Schagen, 2004), and attitudes to reading became more negative as children got older (Kush & Watkins, 1996; Sainsbury & Schagen, 2004). However, most importantly, there was no effect of instructional approach on attitudes to reading (as measured with the Elementary Reading Attitude Survey; ERAS - see previous chapter for more details). The second study (n = 1146) tightened the criteria for description of a whole-language school; the criteria being as follows:

“emphasis on comprehending what is read, use of language that has purpose and relevance to the learner, use of real literature in a variety of forms, the writing process to learn to write and revise, cooperative student work where students are empowered to make many choices, emphasis on affective aspects of the students learning experience and no systematic sequential skill instruction; reliance on ad hoc, situated instruction during teachable moments” (McKenna et al, 1995b, p. 23).

For this study the data from the traditional basal school in the first study was retained and used as the comparison with the new whole language school. Again however, there was no effect of instructional approach on attitudes towards reading. To conclude, even with very different approaches to teaching reading, there were no effects of programme on attitudes towards reading.

This result is consistent with a meta-analysis carried out on fourteen studies comparing children's reading attitudes in whole language and traditional basal approaches (Stahl et al., 1994). Of the fourteen studies, two favoured whole language, one favoured traditional instruction, whereas eleven yielded no significant difference. Therefore, the two types of reading instruction compared (whole word and basal) did not significantly differ in their effects on reading attitudes. The authors argued that whole language approaches appeared to have small positive effects on reading comprehension, however this difference was not significant, and was the result of very few studies showing small effect sizes.

Sainsbury & Schagen (2004) compared children's attitudes to reading before and after the introduction of the National Literacy Strategy (NLS), thereby comparing two different methods of teaching reading but at different time periods (1998 and 2003). It was found that enjoyment of reading had significantly dropped since the introduction of the NLS, however children's confidence as readers had increased (children reported to be less likely to need help and less likely to find reading difficult). Whilst it could be argued that the NLS programme was responsible for the less positive attitudes to reading, both social and technological changes in the five year period could explain these differences. For example, children increasingly have greater exposure to other sources of entertainment such as computer games, DVDs, Satellite T.V etc. It is very

important therefore that comparisons are made in the same time period so confounding factors such as these do not affect the comparisons.

Whilst there is an argument that phonics instruction produces negative attitudes compared to more whole language approaches, reports of success and better reading by people teaching and being taught via phonics, argue for its implementation in schools. They maintain that when children learn to read better by this method they will have more enjoyment from reading. There is also a debate about the type of phonics being taught; analytic or synthetic and the different levels of enjoyment children will gain from these different phonics approaches. Some argue against only teaching by synthetic phonics (Dombey, 2005), stating that “the most effective teachers use a variety of approaches, with a clear focus at the start on both the technical aspects and the making of meaning” and that “a combination of analytic and synthetic” is more appropriate. They would argue that a synthetic phonics approach focuses mostly on the technical aspects at the expense of reading for meaning, however synthetic phonics programmes do include and support the teaching of reading for meaning. It is of interest therefore to compare children’s attitudes to reading from these two different ways of teaching phonics; analytic and synthetic.

Literacy experts and those responsible for modifying the reading programmes used in schools understand the importance for children to have positive attitudes towards reading, and enjoy the method by which they are taught. In order for reading programmes to be successful, it is vital that more research be carried out in this area. The comparison of analytic and synthetic phonics is particularly interesting as it is examining attitudes to reading by comparing the method of teaching phonics in England

prior to 2007 (analytic) with the new synthetic phonics method being introduced this year (Letters & Sounds; DfES, 2007).

In the following study, two different types of reading instruction were compared; analytic and synthetic phonics. Differences between the two groups were not as distinct as previous research carried out in the U.S. comparing traditional basal and whole language approaches. Both contained phonics elements but of different types and with different emphasis. Synthetic phonics focuses more on phonics for reading in addition to reading for meaning. The strategy of sounding and blending letter sound correspondences is taught to be foremost in children's reading strategies for unfamiliar words. The National Literacy Strategy approach at the time that the children in the present study were taught advocated a searchlight model, with phonics (analytic) one strategy for reading, and knowledge of context, grammatical knowledge and word recognition other strategies taught for reading words. For a more detailed account see Chapter 2.

It was predicted that there would be no effect of reading instruction on frequency of reading, attitude to reading, attitude to school, competency beliefs and support networks.

It was predicted that type of reading instruction would not affect the strength of associations between all factors, therefore the correlations would be similar for both synthetic and analytic phonics taught group.

Finally, it was predicted that those taught to read by synthetic phonics would have better reading and spelling ability.

Method

Participants

One hundred and sixty eight children took part in this study. The average age of these children was 10 years and 7 months (0.34 S.D). Seventy eight (38 boys) had been taught to read by synthetic phonics (average age 10 years & 8 months (0.32 S.D)), and ninety (50 boys) by National Literacy Strategy guidelines (analytic phonics) (average age 10 year & 6 months (0.33 S.D)). Synthetic and analytic phonics schools were matched on socioeconomic status. Although the synthetic phonics taught children were tested in Clackmannanshire, these children were not in the experimental intervention (Johnston & Watson, 2004a).

Test materials and procedure.

Reading comprehension: Group Reading Test II, (Macmillan Unit, 2000)

Again, this test was chosen as it is a comprehensive test measuring word reading, comprehension and vocabulary, all of which are important elements for achievement in school. See Chapter 4 for more details of this test.

Vocabulary: English Picture Vocabulary Test 2, (Brimer & Dunn, 1968)

See Chapter 4 for details of this test.

Schonell Spelling Test, (Schonell, 1932)

Children were asked to spell each of the 100 words pronounced by the examiner. Each word was first read individually, then embedded in a sentence, then read individually

again. Following words were not read until the examiner felt all the children had completed spelling the last word.

Questionnaire

See Chapter 6 for details of the questionnaire and Appendix 2 for the actual questionnaire.

All tests were group administered and carried out on the same day within the children's classroom.

Results

The results have been split into five areas; 1) effect of reading instruction, 2) correlations between all questionnaire areas, 3) correlations with reading ability, 4) correlations with frequency of reading and 5) poor readers. A factor analysis of the questionnaire items had previously been carried out in Chapter 5 to identify item groupings with a larger sample of children, therefore this was not carried out again for the following analysis.

1) Effect of reading programme.

Table 7.1. Effect of reading programme on vocabulary (EPVT), reading comprehension (GRT) and spelling (Schonell) (standardised scores and standard deviations).

Group	Vocabulary		Comprehension		Spelling	
	stan.	S.D	stan.	S.D	stan.	S.D
	score		score		score	
SP (n = 78)	94.24	12.81	103.69	11.31	104.51	13.10
NLS (n = 90)	90.45	11.42	99.08	12.78	99.89	14.41

Analysis of variance revealed that children taught to read by synthetic phonics had significantly better vocabulary; $F(1, 166) = 4.09, p < .05$ (effect size = 0.02), better reading comprehension; $F(1, 166) = 6.07, p < .05$ (effect size = 0.04) and better spelling;

$F(1, 166) = 4.71, p < .05$ (effect size = 0.03). Vocabulary was controlled for using analysis of co-variance and it was found that those taught by synthetic phonics ($M = 102.67, 15.16$ S.D) did not have better reading than those taught by analytic phonics ($M = 100.00, 14.51$ S.D); $F(1, 166) = 2.68, p > .05$. In addition, synthetic phonics taught children ($M = 103.79, 14.52$ S.D) did not have better spelling ability than those taught by analytic phonics ($M = 100.55, 18.28$ S.D) after controlling for vocabulary; $F(1, 166) = 2.49, p > .05$

Responses to introductory questions

Frequency of reading. Reading programme had no effect on the frequency with which children read at home, with those taught by synthetic phonics ($M = 3.45, 1.94$ S.D) reading just as often as those taught by analytic phonics ($M = 3.70, 1.81$ S.D); $F(1, 165) = 2.45, p > .05$. This was also true after controlling for differences in vocabulary and reading comprehension; $F(1, 165) = 1.83, p > .05$, as there were no statistical differences between synthetic phonics ($M = 3.46, 1.81$ S.D) and analytic phonics ($M = 3.73, 1.80$ S.D) taught children.

Library Use.

Reading programme had no effect on how frequently children borrowed books from the library, with those taught by synthetic phonics ($M = 3.03, 1.31$ S.D) borrowing just as often as those taught by analytic phonics ($M = 2.75, 1.56$ S.D); $F(1, 166) = 1.56, p > .05$. Again, this was also true after controlling for vocabulary and reading comprehension; $F(1, 166) = 1.95, p > .05$, with synthetic phonics taught children ($3.00, 2.06$ S.D) borrowing books just as often as analytic phonics taught children ($M = 2.70, 1.94$ S.D).

Table 7.2. Effect of reading programme on attitudes before and after controlling for reading ability (mean & standard deviation).

	Before controlling for R.A		After controlling for R.A	
	SP	NLS	SP	NLS
	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)
Attitude to reading	3.08 (0.88)	3.20 (0.95)	3.02 (0.88)	3.25 (0.85)
Attitude to school	3.34 (0.97)	3.22 (0.90)	3.30 (0.97)	3.26 (0.95)
Competency beliefs	3.79 (0.94)	3.69 (1.01)	3.74 (0.97)	3.76 (0.95)
Support (peer & teacher)	3.72 (0.98)	3.73 (0.96)	3.70 (0.97)	3.75 (0.95)

Before controlling for reading comprehension, there was no effect of reading programme on any of the factors measured; attitudes to reading, $F(1, 166) = 0.69$, $p > .05$, attitude to school, $F(1, 166) = 0.65$, $p > .05$, competency beliefs, $F(1, 166) = 0.51$, $p > .05$ or support, $F(1, 166) = 0.01$, $p > .05$.

After controlling for reading comprehension, there was still no effect of reading programme on any of the factors measured; attitudes to reading, $F(1, 165) = 2.74$, $p > .05$, attitude to school, $F(1, 165) = 0.11$, $p > .05$, competency beliefs, $F(1, 165) = 0.01$, $p > .05$ or support, $F(1, 165) = 0.12$, $p > .05$.

2) Correlations between all areas identified in questionnaire

Also of interest was the strength of the relationship between all areas measured in the questionnaire. Correlations were carried out before and after accounting for reading ability. Scores from synthetic phonics and analytic phonics taught children were analysed separately to see if there were differences in strength of relationship between attitudes and feelings regarding school.

Table 7.3. Correlations between questionnaire areas for synthetic phonics and analytic phonics taught children.

	Synthetic phonics				Analytic phonics			
	1	2	3	4	1	2	3	4
1. Attitude to reading	---	.58**	.36**	.03	---	.29*	.14	.08
2. Attitude to school	.57**	---	.47**	.10	.35**	---	.27*	.12
3. Competency beliefs	.40**	.46**	---	.14	.22*	.34**	---	.13
4. Support	.05	.16	.10	---	.10	.14	.15	---

Note: N = 78 for synthetic phonics and N = 90 for analytic phonics taught children for bivariate and partial correlation, * $p < .05$ ** $p < .005$ (bonferroni correction).

The lower left quadrant represents the strength of the correlation before accounting for reading ability (bivariate pearson correlation). The upper right quadrant represents the strength of the correlation after accounting for reading ability (partial correlation).

For those children taught by synthetic phonics there were highly significant correlations between all internal factors (attitudes to reading, school and competency beliefs). These

close associations were not found with the external factor however (support). For children taught to read by analytic phonics, there were still significant correlations between most internal factors, however these associations were not as strong. Again, the internal factors did not correlate with the external factor. The correlations (Pearsons r) were converted in a corresponding Fisher's z coefficient in order to see if there were significant differences in the strength of these correlations between synthetic and analytic phonics taught children. Children taught by synthetic phonics showed significantly closer associations between their attitude to reading with attitude to school and competency beliefs, before and after controlling for reading ability. In addition, after controlling for reading ability their attitude to school was significantly more highly correlated with their competency beliefs compared to analytic phonics taught children.

3) *Correlations between questionnaire areas and reading ability.*

Table 7.4. Correlations between reading ability and questionnaire areas.

Reading Ability	1	2	3	4	5
All	.29**	.17*	.27**	.10	.34**
Synthetic phonics	.27*	.03	.22*	.11	.32**
Analytic phonics	.33**	.28**	.30**	.09	.37**

$N = 168$, $N_{SP} = 78$, $N_{AP} = 90$, * $p < 0.05$ ** $p < 0.01$.

1 = attitude to reading, 2 = attitude to school, 3 = competency beliefs, 4 = support (peer & teacher), 5 = frequency of reading.

Frequency of reading, attitudes to reading, competency beliefs and attitudes to school correlated significantly with reading ability, however support network did not. When the results were split based on reading programme, a similar pattern of associations was found with the exception of one. Whilst analytic phonics taught children showed a high correlation between reading ability and attitude to school, this was not the case for synthetic phonics taught children. The correlations (Pearsons r) were converted in a corresponding Fisher's z coefficient, and it was found that there was a significantly stronger relationship between reading ability and attitude to school for children taught by analytic phonics compared to synthetic phonics, $p < .01$

4) Correlations between questionnaire areas and frequency of reading.

Table 7.5. Correlations of questionnaire factors with frequency of reading.

Reading Activity	1	2	3	4
All	.52**	.35**	.26**	.15
Synthetic phonics	.53**	.46**	.35**	.17
Analytic phonics	.51**	.25*	.19	.13

$N = 168$, $N_{SP} = 78$, $N_{AP} = 90$, * $p < 0.05$ ** $p < 0.01$.

1 = attitude to reading, 2 = attitude to school, 3 = competency beliefs, 4 = support (peer & teacher).

Attitude to reading, attitude to school and competency beliefs correlated with frequency of reading however support network did not. The strength of associations between factors was similar regardless of reading programme, the most notable exceptions being that synthetic phonics children showed a stronger correlations between frequency of

reading and attitude to school and competency beliefs. The correlations (Pearsons r) were converted in a corresponding Fisher's z coefficient in order to see if there were significant differences in the strength of these correlations, and both attitude to school, $p < .01$ and competency beliefs, $p < .05$ were found to be significantly more correlated with frequency of reading for synthetic phonics taught children.

5) Poor readers

These refer to children achieving well below the standard expected of them at a particular age. The success of either teaching method could be argued to be in how effective it is in reducing numbers of poor readers, whose poor reading skill may affect their attitudes to reading and beliefs in their abilities. Analysis was therefore carried out with poor readers (children who scored less than 90 on the GRT), in order to examine the relationship between reading ability and attitudes to reading and school. Fourteen percent of the children in the synthetic phonics group met this criteria ($n = 11$) whereas twenty three percent in the analytic phonics group did ($n = 21$).

Table 7.8. Ability scores of poor readers in synthetic phonics and National Literacy Strategy groups.

Group	Age	Vocabulary		Comprehension		Spelling	
	mean	S.D	stan.	S.D	stan.	S.D	stan.
S.D	score		score		score		
SP (n = 11)	10.81 (0.35)	80.45	(7.89)	85.82	(3.55)	90.45	(9.47)
NLS (n = 21)	10.51 (0.30)	84.35	(10.08)	81.70	(4.75)	83.70	(12.81)

In this group of poor readers, those taught by synthetic phonics ($M = 85.82, 3.54$ S.D) had better reading comprehension than those taught by analytic phonics ($M = 81.14, 5.29$ S.D); $F(1, 30) = 6.92, p < .05$ (effect size = 0.19). There were no differences however in vocabulary; $F(1, 30) = 1.23, p > .05$ or spelling; $F(1, 30) = 2.34, p > .05$. There was a significant difference in chronological age however, with synthetic phonics children being older, $F(1, 30) = 6.27, p > .05$. However this difference in chronological age would have been controlled for in the standardised scores in the tests. Further analysis of variance examining attitudes to reading was carried out after controlling for the difference in reading ability.

Table 7.9. Effect of reading programme on attitudes in poor readers (mean and standard deviations).

	Synthetic phonics		Analytic Phonics	
	Mean	S.D	Mean	S.D
Attitude to reading	2.86	1.13	2.91	1.09
Attitude to school	3.46	1.16	2.87	1.10
Competency beliefs	3.28	1.16	3.38	1.15
Support network	3.46	1.29	3.43	1.10
Frequency of reading	3.38	1.03	2.66	1.97

There were no differences between the groups in terms of attitudes to reading; $F(1, 29) = .02, p > .05$, school; $F(1, 29) = 1.71, p > .05$, competency beliefs; $F(1, 29) = .05,$

$p > .05$, support network; $F(1, 29) = .01$, $p > .05$ or frequency of reading; $F(1, 29) = 1.71$, $p > .05$

Correlations between reading ability and attitudes to reading were carried out on poor readers for analytic and synthetic phonics group separately.

Table 7.10. Correlations between reading ability and questionnaire areas in poor readers.

Reading Ability	1	2	3	4	5
Synthetic phonics	-.39	-.25	.09	-.19	-.00
Analytic phonics	.16	.02	.23	-.04	.40

N = 32, N SP = 11, N AP = 21

1 = attitude to reading, 2 = attitude to school, 3 = competency beliefs, 4 = support (peer & teacher), 5 = frequency of reading.

There were no significant correlations between reading ability and questionnaire areas for both the synthetic and analytic phonics taught children, however this could be due to low power in the study (small numbers of participants). As before, the correlations (Pearsons r) were converted in a corresponding Fisher's z coefficient in order to see if there were significant differences in the strength of these correlations. The only significant difference between the two groups correlations was in the relationship between reading ability and frequency of reading, analytic phonics showed a significantly closer relationship between these two variables.

Discussion

The results of this study show that whilst the method of teaching phonics had a significant effect on vocabulary knowledge, reading comprehension and spelling ability, there were no differences in frequency of reading, attitude to reading, attitude to school, competency beliefs or support networks. Whilst synthetic phonics children performed significantly better on all ability tests these differences were relatively small and were not significant after controlling for vocabulary. Interestingly, there was a much closer association between reading ability and attitude to school for children taught by analytic phonics compared to synthetic phonics. However, synthetic phonics taught children showed significantly stronger associations between frequency of reading and both attitude to school and competency beliefs. In addition, they showed closer associations between attitude to reading and both attitude to school and competency beliefs. Finally, their attitude to school was more closely related to their competency beliefs. A group of poor readers were selected to examine attitudes in children experiencing reading problems. There were proportionally fewer poor readers in the synthetic phonics group, and this group had significantly better reading comprehension, however there were no differences in attitudes or beliefs. The relationship between attitudes and ability was different, only those taught by analytic phonics showed a positive correlation between reading ability and attitudes to reading, competency beliefs and frequency of reading.

Before discussing the results of this study it is important to make one important point. In the previous chapter more concrete conclusions could be made regarding differences between boys and girls as they had shared exactly the same environment throughout their education (i.e., teacher, school, class, area). Therefore differences in attitudes and the relationships between attitudes and beliefs could not be attributed to differences in

schooling, teachers, etc. In the current study, whilst the conclusions are made based on type of reading instruction, there are other factors which could be influential in the area of attitudes and beliefs. These mediating factors pose a problem not just for the current study but for all studies that compare the effects of reading instruction. However the effects of these mediating factors are usually minimised by carrying out very large scale studies (e.g., McKenna et al., 1995a). In order to minimise the mediating factors in the present study, the schools were matched carefully in terms of socioeconomic status, a factor known to have influence on school achievement and quality of teaching (Bowey, 1995; McDonald-Connor et al., 2005; Molfese, DiLalla & Bunce, 1997; White, 1982). However, schools could not be matched in terms of other variables (for example, the synthetic phonics schools were based in Scotland and the analytic phonics schools in England). The conclusions made therefore need to be taken with caution, and a larger sample size is needed in order to draw more firm conclusions. Whilst this was beyond the scope of the current study, it was deemed important to carry out a study investigating the effects of synthetic phonics and analytic phonics on attitudes as no research had been published examining this comparison. More research should be carried out however with a larger sample size, varying more widely in terms of socioeconomic status, as in the current sample all children were from schools ranked as average in terms of SES.

Consistent with previous research, those taught to read by synthetic phonics had better reading and spelling (Johnston & Watson, 2004a). In addition, they had better vocabulary, this could be a consequence of their better reading, as written text is an important source of vocabulary acquisition once children become fluent readers (Cunningham & Stanovich, 1991, 1998; Echols et al., 1996). However after controlling for vocabulary, the differences in reading ability disappeared. There were no

differences in terms of attitudes or beliefs. This was predicted as the two programmes were more alike in terms of their literacy teaching than those compared in the U.S. which also found no effects of instruction on attitudes (Stahl et al., 1994). If this is the case, the programme which produces greater gains in achievement should be recommended, particularly if it gives more benefits to children at risk of reading failure; a synthetic phonics programme has been found to produce proportionately fewer underachievers compared to analytic phonics programmes (Watson & Johnston, 1998), this was also found in the current study.

Whilst differences were not found between the two groups in terms of attitudes and beliefs, there were differences in the relationships between these factors. In correlations with reading ability, for those taught by analytic phonics, their reading ability was more closely tied to how much they enjoyed school, those reading better enjoyed school more than those who had greater difficulties with reading. In correlations between questionnaire areas, the synthetic phonics children showed closer relationships between their attitudes (to reading and school) and competency beliefs, as those children with better beliefs in their abilities enjoyed reading and school more. As previously mentioned, from such a small sample conclusions cannot be confidently drawn, however if differences in associations were found in a larger sample, these relationships should be examined further.

One association of particular importance would be the one between reading ability and attitude to reading. Does type of reading instruction foster a relationship whereby positive attitudes to reading are reliant on good reading skill? In other words, are some types of reading instruction not enjoyable unless the child is good at it (i.e., they foster their own positive attitudes through their ability rather than through their method of

being taught). Or can children have positive attitudes to reading even if they are relatively poor readers? The results of this study suggest that different types of reading instruction do not produce a difference in this association, however research with a larger sample could investigate this further. In the current study further analysis was carried out with a group of poor readers from both the analytic and synthetic phonics group (those who had a standardised score of below 90 on the reading comprehension test). There were no differences between the groups in terms of attitudes or beliefs after controlling for differences in reading ability. In looking at the patterns of associations between ability and attitudes in the two groups there was only one significant difference in strength of correlation, that between reading ability and frequency of reading, with poor reading analytic phonics children showing a stronger association between these two measures. In addition, those taught by synthetic phonics showed a relatively strong inverse relationship between reading skill and attitudes to reading, implying that their poor reading was not reflected in negative attitudes to reading, whilst analytic phonics taught children showed a very weak positive relationship. However, these correlations were taken from small samples due to the low frequency of children scoring less than 90, this draws again on the need for further research. In addition, to examine further the effects of reading instruction on the relationship between reading ability and attitudes to reading, research must include standardised measures of reading instruction, as used in the current study, as opposed to teacher ratings of ability into categories as has previously been used as an indicator of ability (see McKenna et al., 1995a).

With current changes being made to the reading programme in England, there is a small window of opportunity to investigate attitudes in children taught by the previous programme (Progression in Phonics, DfES, 1999, later supplemented with *Playing with Sounds*, 2004), with those starting school now and who will be taught via a different

phonics method (Letters and Sounds, DfES, 2007). A study similar to that carried out by Sainsbury & Schagen (2004) could be carried out, investigating attitudes to reading in children now and in five or six years time after the new programme has been introduced. However, there will always be the confounding factor of time. Alternatively, schools could be chosen known to teach via different methods and matched on socioeconomic status to make justifiable conclusions, as was done in the current study.

Conclusions

This study found that whilst a synthetic phonics programme produced gains in reading ability (comprehension), spelling and vocabulary, overall these gains were modest. However the particular benefit of the synthetic phonics programme appeared to be in the lower proportion of underachievers, and also fewer extremely poor achievers in this group. The study found no effect of reading programme on attitudes to reading, school, competency beliefs or support, indicating that both types of reading instruction produce similar levels of enjoyment from reading. However further research with a larger sample size and in a wider variety of schools is necessary.

CHAPTER 8: COGNITIVE PROCESSES

GENDER DIFFERENCES

Introduction

Studies investigating gender differences in ability commonly consider differences in terms of verbal, quantitative and visual-spatial abilities. Indeed, it is generally found that females show superior performance on verbal tasks (Hyde & Linn, 1988), whilst males perform better on quantitative and visual-spatial tasks (Goldstein, Haldane & Mitchell, 1990; Hyde, Fennema, & Lamon, 1990). Whilst this tri-partite model effectively includes a full range of abilities, it is argued to be vague and somewhat simplistic (Halpern & Wright, 1996). Within each class of abilities there are a number of different tasks which are often used to measure a particular skill, for example, verbal tasks encompass word fluency, grammar, reading, spelling, verbal analogies, vocabulary, word naming, language production, generation of synonyms, vocabulary recognition and oral comprehension (Halpern & Wright, 1996). Each of these tasks require the use of different cognitive processes, and individuals may differ in the strategies they use in order to achieve the same results in these tasks. This last point raises some concern with regard to what these tests are actually measuring, as final test scores do not take into account these differences in strategies, but consider solely the end result. However the strategies used may require very different cognitive processes which may also differ in terms of their effectiveness.

In a meta-analysis conducted with 165 studies of gender differences in verbal ability, the differences between the genders were not uniform across tasks, in fact there was huge variation in effect sizes ranging from $d = 0.02$ (vocabulary) to $d = 0.33$ (speech production) (Hyde & Linn, 1988). Across all age groups, the mean effect size difference on all measures of verbal ability was $d = 0.11$, a difference so small it could be argued to be meaningless in any practical sense. According to Cohen's d , 0.20 is a small effect size (Cohen, 1992), therefore this effect size is particularly small. There was also substantial variation in the magnitude of the gender differences depending on age of participants. For those aged 5 and younger, the effect size was $d = 0.13$, for those aged 6 - 10 years old, $d = 0.06$, and for those aged 11 - 18 years old, $d = 0.11$, on all tests. Whilst the criteria used for admission into the meta-analysis was perhaps not very stringent, as some studies had small sample sizes or were unpublished, this meta-analysis highlights the problems of broadly categorising a number of skills and abilities under one heading. It underlines the variation that can be found within one category, and differences that can be found with age. In order to understand gender differences in abilities, it is arguably more appropriate to consider the underlying cognitive processes which are being drawn upon when performing a particular task.

Halpern & Wright (1996) suggested a process-oriented model of cognitive sex differences in order to explain the gender differences which occur within verbal, quantitative and visual-spatial tasks. In this process-orientated approach, tasks are analysed as a function of what the individual is actually doing when performing the task. After considering the tasks on which males and females perform better within all three categories, it was concluded that females are better at tasks requiring rapid access to and retrieval of information that is stored in memory (synonym and letter generation fluency and simple arithmetic). Males, on the other hand, are better on tasks that require the

ability to maintain and manipulate mental representations in short term memory (mental rotation and verbal analogies). In a study measuring these predictions, one hundred and fifty adults (72 male, average age 29 years & 3 months (8.56 S.D)) completed five cognitive tasks which used the skills identified above, and results showed that four out of these five showed gender differences in the expected direction (contrary to predictions, males were better at simple arithmetic). Whilst it was predicted that retrieval of arithmetic facts would be an easy and automatic task, it is possible that it required more manipulation of information than expected, therefore this could explain why males performed better on this task.

Standardised tests of intelligence

Standardised tests of intelligence have often been criticised on the grounds that they are not based on sound theory (Esters & Ittenbach, 1997). Whilst some popular measures of assessing intelligence are not theoretically driven (e.g., Wechsler Intelligence Scale for Children, (WISC IV, 2003)), others are developed from theory (e.g., Kaufman Assessment Battery for Children (KABC-II, 2001); the Woodcock-Johnson Tests of Cognitive Ability (WJ III NU; Woodcock, McGrew & Mather, 2001), and the Cognitive Assessment System (CAS; Das & Naglieri, 1997)). Standardised intelligence tests are used widely throughout the world with children and adults as reliable indicators of IQ. However the tests vary widely in terms of the particular abilities they test.

Do intelligence and reading achievement correlate?

Numerous studies have investigated the relationship between intelligence and reading achievement; some have found highly significant correlations between these two

variables, whereas others have found very weak or non-existent relationships. Stanovich, Cunningham and Feeman (1984b), found correlations that ranged from $r = .33$ to $r = .56$ between reading comprehension and intelligence (as measured by Raven's Progressive Matrices) when assessing children of different ages (Grades 1, 3 & 5). Carver (1990) also investigated the relationship between reading and intelligence (as measured by Raven's Progressive Matrices) and found an average correlation of approximately $r = .50$ (range = $.36 - .68$) for children in Grades 2 - 12. Later, Naglieri (1996) tested a larger sample of children ($n = 2,125$) from Grades 2 - 9 and found consistent correlations between reading comprehension and intelligence (as measured by Matrix Analogies Test-Short Form and the Naglieri Nonverbal Ability Test), ranging from $r = .43$ at Grade 2 to $r = .58$ at Grade 5 (average correlation of $r = .57$). More recently, Muter et al. (1998) found that preschool measures of IQ (as measured by the four verbal and four performance subscales of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI, 1967)) were strongly correlated with later reading and spelling ability. Indeed, correlations between IQ and later reading and spelling ranged from $r = .38 - .45$. Finally, Naglieri & Ronning (2000), carried out an extensive study ($n = 22,000$) investigating the relationship between reading comprehension and intelligence (as measured by Matrix Analogies Test-Short Form and the Naglieri Nonverbal Ability Test) and found a correlation of $r = .56$ with the former intelligence test and $r = .49 - .61$ with the latter. These studies, taken from a large sample of children, across a wide range of age groups, could be interpreted as indicating that general intelligence has a strong and consistent relationship to reading ability. However, these results are in contrast to those of Vellutino, Scanlon & Lyon (2000), who have argued that intelligence is poorly correlated with reading ability. Vellutino et al. (2000) found that the strength of the correlation between IQ and reading comprehension varied relatively widely (range = $.04 - .56$), depending on the age of the participant (Grade 3

versus Grade 1), the measure of IQ (verbal versus non-verbal) and the skill level of the readers (normal versus impaired), the former in each case producing higher correlations between reading achievement and IQ. Weaker correlations were found between IQ and word reading (range = .00 - .31), many of which were inverse, and almost all of which were not significant. They argue that support for the strength of the correlation between IQ and reading is often due to high verbal content and/or entailed reading ability within intelligence tests (for example, Muter et al., 1998), however many studies find a relatively strong relationship between reading and IQ even with non-verbal measures of intelligence (e.g., Raven's Progressive Matrices).

One problem when assessing the association between reading and intelligence is that some intelligence tests often contain subtests which are, by their very nature, highly related to reading comprehension (i.e., the vocabulary or comprehension sub-scale of the Wechsler Intelligence Scale for Children (WISC, Wechsler, 2003)). Correlations between such tests and reading achievement may be contaminated due to shared variance contributed by language based abilities underlying performance on both measures. Indeed, results from the WISC show much higher correlations between the verbal IQ measures with word reading and comprehension, than the non-verbal (performance) IQ measures (Vellutino et al., 2000). There is a good rationale therefore to use intelligence tests which do not include subscales which are obviously related to reading achievement, such as the Kaufman Assessment Battery for Children (KABC II; Kaufman & Kaufman, 2001) or the Cognitive Assessment System (CAS; Naglieri & Das, 1997). Whilst these measure intelligence, they do not contain components which are naturally related to reading, however they still find high correlations between reading achievement and intelligence (particularly the CAS). In fact correlations between intelligence (total standardised score on CAS) and reading ability (Woodcock-

Johnson-Revised (WJ-R, Woodcock & Johnson, 1989) were found for broad reading ($r = .71$), basic reading skills ($r = .69$) and reading comprehension ($r = .72$) scores. However when intelligence and phonological awareness are pitted against each other, phonological awareness emerges as a stronger correlate or better predictor of reading skill than cognitive or intellectual ability (Dally, 2006; Joseph et al., 2003; Share et al., 1984; Stanovich & Siegel, 1994; Stanovich, Cunningham & Feeman, 1984a; 1984b; Torneus, 1984; Tunmer & Nesdale, 1985).

The Cognitive Assessment Scale and PASS theory

It has been proposed that “PASS theory offers a substantially different approach to evaluating basic psychological processes that have been called ability or intelligence.” (Naglieri & Das, 1990). The Cognitive Assessment Scale (CAS, Naglieri & Das, 1997) was developed in order to measure the four cognitive processes outlined below (PASS), and has been proposed as a new innovative way to measure intelligence, offering an alternative to more established IQ testing measures such as the Wechsler tests (WPPSI, WISC IV, Wechsler, 1967; 2003), Kaufman Assessment Battery for Children (KABC II, Kaufman & Kaufman, 2001), McCarthy Scales of Children’s Abilities (MSCA, McCarthy, 1972) and Stanford-Binet Intelligence Scales (SB5, Roid, 2003). These types of test tend to focus on task content, by measuring ability on factors such as verbal ability, non-verbal ability and functioning, memory/sequencing and quantitative ability. However, the Cognitive Assessment Scale is a more process based assessment rather than content based, as intelligence has been re-conceptualised to consider underlying cognitive processes rather than task content.

The PASS model

The planning, attention-arousal, simultaneous and successive (PASS) cognitive processing model is a theory proposed to describe ability within the framework of information processing. The PASS model is based upon Luria's analyses of brain structures (1970). Luria proposed that human cognitive processes could be described within the framework of three functionally interrelated systems or units. The first unit, located in the base of the brain, provides appropriate levels of attention and cortical arousal. The second unit, located in the posterior cortex of the brain, processes information using simultaneous and successive processes, and the function of the third unit, located in the brain's frontal cortex, is to provide planning, structuring of cognitive activities and self-monitoring (Naglieri & Rojahn, 2001; Warrick & Naglieri, 1993).

The four cognitive processes that measure planning, attention, simultaneous and successive processing are separate but interrelated constructs. Planning is important in order to determine, choose and employ an appropriate strategy in order to solve a problem or complete a task. Planning provides intentionality, self-regulation, impulse control and utilisation of knowledge. Attention is required so that individuals can selectively attend to particular information and inhibit distracting and useless information. Attention in tasks allows individuals to be more focused and selective. Simultaneous processing allows the person to deal with many pieces of information at the same time, integrating information or stimuli into a coherent whole in order to make sense of it. Finally, successive processing involves working with information in a specific serial order, allowing the person to perceive stimuli, whether letters, symbols, sounds or movement in sequence (Naglieri & Das, 1990). These cognitive processes contribute to performance but do not determine it. Other major factors which influence

performance are knowledge base (accumulated knowledge learnt through reading, instruction or past experience) and motivation (including personality factors and amount of effort exerted).

Whilst the authors of the Cognitive Assessment System (Naglieri & Das, 1997) argue for its validity as a four factor theory of information processing, others (Kranzler & Keith, 1999; Kranzler & Weng, 1995a; 1995b) argue that the planning and attention factors should be combined based on data gathered using the CAS. They suggest that a (PA)SS model (i.e., a combined planning and attention factor with separate simultaneous and successive factors), is a better fit to the data than the four factor PASS model. Kranzler & Weng (1995a) re-analysed data presented previously by Naglieri et al. (1991, cited in Kranzler & Weng, 1995a) and compared the fit provided by the PASS model with two other alternative models; a combined planning and attention factor with separate simultaneous and successive factors (i.e., (PA)SS), and an extension of the PASS model to include a second order g factor (i.e., PASS + g). They concluded that the best fit to the data was the combined (PA)SS model. They have since argued against the validity of this four factor theory (Kranzler & Keith, 1999; Keith et al., 2001). However in response to this, Puhan, Das & Naglieri (2005) have argued that planning and attention processes are separate but interdependent processes. They state that Naglieri & Das (1997) have provided greater evidence for the four factor theory through several confirmatory studies supporting four factors, carried out with a much larger number of participants, compared to one smaller scale study supporting three factors (Puhan et al., 2005).

Gender differences

Gender differences in reading

Gender differences are consistently found in reading achievement, both in national tests and international studies (NLT statistics, 2007; PIRLS 2001; 2006). It is consistently found that a higher percentage of girls achieve the standard expected in Key Stages 1 - 4 (NLT statistics, 2007), whilst an international study examining reading ability in 35 (2001) or 40 (2006) countries found that girls had better reading comprehension than boys in all participating countries (PIRLS, 2001; 2006). However, neither of these studies examined the magnitude of the difference between boys' and girls' reading ability. Indeed, when effect sizes are measured, gender differences have been found to be relatively small (Logan & Johnston, submitted). As illustrated in Chapter 6, relatively small effect sizes were found both the PIRLS 2001 and 2006 studies, $d = 0.26$, $d = 0.25$ (England), $d = 0.21$, $d = 0.29$ (Scotland), $d = 0.22$, $d = 0.17$ (USA) and $d = 0.28$, $d = 0.27$ (New Zealand), where the former represents the 2001 results, and the latter represents the 2006 results. These would effect sizes would be classified as small according to Cohen's d (where an effect size of 0.20 is considered small and 0.50 is considered medium) (Cohen, 1992). Nevertheless, gender differences in reading are consistently found, and by examining differences in cognitive processes, this may reveal potential sources of variance in reading.

Gender differences within the PASS model

Previous studies have found gender differences within the framework of PASS cognitive processes (Naglieri & Rojahn, 2001; Warrick & Naglieri, 1993). Specifically,

it has been found that girls perform better on tasks measuring planning and attention, with no gender differences in simultaneous and successive processing.

Naglieri & Rojahn (2001) carried out a study with 1,100 boys and 1,100 girls from three different age groups; 5 - 7 year olds, 8 - 10 year olds and 11 - 17 year olds. All children completed tests measuring planning, attention, simultaneous and successive processing. In all age groups, boys and girls performed similarly on measures of simultaneous and successive processes ($d < 0.12$). However, there were consistent significant gender differences found in measures of planning ($d = 0.34$) and attention ($d = 0.36$), favouring girls. These effect sizes are considered relatively small (Cohen, 1992). Naglieri & Rojahn (2001) suggest that these gender differences in planning and attention could be interpreted as reflecting different rates of maturation of the prefrontal cortex. Indeed, the structure and function of the prefrontal cortex changes significantly during childhood, in particular early childhood. However no research has been found to show that there are differences in the maturation rates of the prefrontal cortex in boys and girls (Romine & Reynolds, 2005). On the tasks measuring attention, there were differences in effect sizes over the age groups being tested (planning, simultaneous & successive scales showed minimal linear developmental trends). The gender difference in attention widened with age; 5 - 7 year olds ($d = 0.28$), 8 - 10 year olds ($d = 0.36$), and 11 - 17 year olds ($d = 0.43$).

These results are relatively consistent with those found in a previous study carried out by Warrick & Naglieri (1993). In this study 197 children (94 male) from three age groups (Grade 3, mean age = 9.3 years, S.D = 3.7 months, Grade 6, mean age = 12.2 years, S.D = 4.7 months and Grade 9, mean age = 15.2 years, S.D = 5.3), were examined on tests measuring the four cognitive processes. Girls scored higher on

measures of planning at all ages (Grade 3, $d = 0.43$, Grade 6, $d = 0.52$ and Grade 9, $d = 0.35$), however these differences were not significant. The only significant difference in attention was in the Grade 3 comparison, where a large significant difference was found ($d = 0.96$), compared to those differences in attention between the older children (Grade 6, $d = 0.19$ and Grade 9, $d = 0.22$).

The PASS model and reading

The PASS model has been coupled with word reading and comprehension, as all the cognitive processes outlined in the model are required for reading in varying degrees (Joseph et al., 2003).

At the word reading level, planning is necessary to regulate initial responses, to verify that the correct pronunciation is given when speaking and reading words. Attention is important so that individuals are alert to the discrete sounds and letters, and are able to inhibit irrelevant stimuli. Simultaneous processes are associated with surveying all the elements of a word and acquiring the sound and letter patterns in a hierarchical manner (i.e., understanding that certain letters cue the sounds of other letters in words - e.g., the 'e' at the end of the word 'came' cues the reader to say the 'a' as a long vowel sound). Finally, successive processes are associated with sequentially decoding the sounds in words through one to one correspondences with letters and sounds. Joseph et al. (2003) found that the successive scale was highly correlated with phonological memory ($r = 0.81$).

Likewise, the PASS model can also explain elements of reading comprehension. Planning and attention are required for the same purposes, to remain focused and alert

to what is being read and to evaluate and verify understanding of what is being read. The importance of planning and attention will increase with the complexity of reading material (Das, 2005). Simultaneous skills are necessary to integrate words, sentences or passages into a coherent whole in order to make sense of it. Finally, successive processing is necessary in order to process the reading material in the correct sequence.

Whilst all cognitive processes have been linked to reading achievement, simultaneous and successive processes in particular, have been argued, at least theoretically, to be the most important for reading (Das et al., 2000).

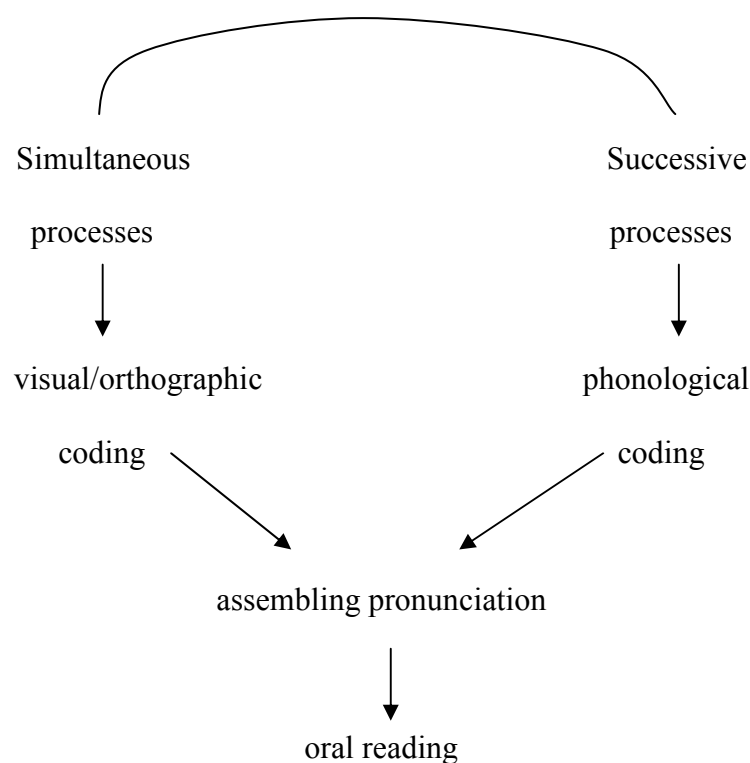


Fig 8.1: Processes underlying word recognition (Das et al., 2000).

Das et al. (2000) likened the necessity of simultaneous and successive processes to the dual route model of reading. The original dual route model (Coltheart, 1978) states that

words can be read by either direct visual access (holistic processing) or through phonological coding of the sounds in the word (grapheme-phoneme conversions), the former they argue relates to simultaneous processing and the latter to successive processing. Further, they argue that due to the importance of phonological processing in word decoding, successive processes are more important at the word reading level, with simultaneous processing playing a secondary role in visual word identification. However, simultaneous processes will be more important in reading comprehension, to integrate information into a coherent whole for understanding.

If simultaneous skills are more important for reading comprehension and successive skills for word reading (Das, 2000), it could be that simultaneous skills can be likened to higher level language skills necessary for reading (such as those proposed by Cain & colleagues, 1999, 2004a, 2004b), for example, inference and integration skills. Inference and integration skills refer to the ability to integrate information across sentences and ideas in a text into a coherent whole, which is essentially the purpose of simultaneous processing. In addition, comprehension monitoring (the ability to detect inconsistencies in text, such as scrambled sentences, contradictory sentences etc.) could be associated with planning and attention. Comprehension monitoring requires readers to be focused on the material being read, whilst the detection of errors requires readers to regulate their reading to resolve any reading problems, and evaluate their understanding of the text. As such they arguably depend upon both planning and attention. Cain et al. (2004a) found that inference skills and comprehension monitoring explain unique variance in reading comprehension, after controlling for verbal ability, word reading ability and vocabulary, highlighting the importance of these higher level skills. In addition, much research has been carried out that illustrates the importance of reading accuracy (lower level skills) in reading comprehension (Dally, 2006; de Jong &

van der Leij, 2002; Muter & Snowling, 1998). Successive skills can be likened to lower level language skills, as the letter sound string must be sequentially blended from left to right for accurate word reading, this requires the ability to process letter sounds in sequence (successive processing). Reading comprehension therefore seems to depend on both these lower level and higher level skills, and the PASS model of word reading may be a good test of both these types of skills.

To gain insight into the relationship between PASS cognitive processes, phonological processes and basic reading performance, a study was conducted with children who had been referred with reading problems (Joseph et al., 2003). The importance of phonological memory (sometimes called memory span) was considered (through digit span and nonword repetition). Phonological memory becomes more crucial as children grow older and attempt to read new multisyllabic words. This is because if children are unable to store all the sounds or sound chunks in their intermediate memories, they may have difficulty blending all of the sounds together to form whole words. Indeed, phonological memory was found to be a skill that distinguishes good readers from poor readers (Muter & Snowling, 1998). Joseph et al. (2003) found that in the group of children referred with reading problems (aged 7;05 - 9;02) both phonological awareness and the combined PASS scores were more highly associated with word reading and nonword reading than the strength of the association between phonological memory and word and nonword reading. Overall, there was a very strong correlation between phonological awareness and both word reading ($r = 0.71$) and nonword reading ($r = 0.70$). These relationships were stronger than that between the combined PASS scores and word reading ($r = 0.61$) and nonword reading ($r = 0.60$). However, these correlations were stronger than that between phonological memory and word reading ($r = 0.44$) and nonword reading ($r = 0.44$). This study highlights that the strength of the

association between PASS and reading is stronger than that of other skills often found to be associated with reading (i.e., phonological memory), and gives credence to the PASS as a correlate of reading achievement.

Earlier research carried out by Kirby & Das (1977) examined the relationship between school achievement and simultaneous and successive processing in boys (with a mean age of 9 years & 2 months, 4.9 months S.D). Reading comprehension, vocabulary and two measures of IQ known to correlate highly with measures of school achievement were used as the achievement measures, and well-known tests were used as markers for simultaneous (e.g., Raven's progressive matrices, memory for designs) and successive (e.g., serial recall, digit span) processes. It was found that proficiency with both types of processes were necessary for good performance on the school achievement measures (i.e., reading, vocabulary and IQ), but that neither by itself was sufficient for high achievement. It is clear therefore that by including measures of intelligence and cognitive processes, it is possible to have a more comprehensive profile of the important skills necessary for reading to develop.

Das et al. (2000) argue that successive processes are theoretically important for decoding words (processing letter sound correspondences sequentially for reading). Indeed, Joseph et al. (2003) found that successive processes were highly correlated with phonological memory ($r = 0.81$). However, if this is the case, then successive skills should be most highly correlated with nonword reading compared to the other cognitive processes. In the study by Joseph et al. (2003), successive skills ($r = 0.41$) were less strongly correlated with nonword reading compared to planning ($r = 0.43$) and simultaneous skills ($r = 0.50$). However this study may not be particularly representative, as the children tested were referred with reading problems. Their scores

on the nonword reading test ($M = 90.30$, 11.75 S.D) indicate that they were performing below average, and this could be explained by the fact that they did not have adequate phonological awareness ($M = 87.37$, 11.67 S.D) or phonological memory ($M = 86.64$, 10.34 S.D) to carry out this task successfully.

Other evidence of the link between successive skills and reading are studies which have shown that children with poor reading ability tend to score poorly on measures of successive processing (Das et al., 1994a; Kirby, Booth & Das, 1996; Kirby & Robinson, 1987). However, training in successive processing does result in improvement in word reading and spelling (Boden & Kirby, 1995; Das et al., 1994b; Das, Mishra & Pool, 1995). Interestingly, gains in word reading have been found from training in successive skills, without improvements in successive processing measures, implying that improvements have been made in the application of successive processing, rather than in successive processing itself (Boden & Kirby, 1995).

The aim of the present study was to examine gender differences within the framework of PASS cognitive processes as a possible explanation of differences in reading ability. In addition, the relationship between intelligence and reading ability was examined. The PASS model was chosen as it has shown high correlations with reading ability and yet does not contain sub-tests which are, by their nature, related to reading itself. These tests were also easy to adapt into group administered tests. Vocabulary and reading (single word reading & comprehension) were also tested. Vocabulary was measured so that it could be used as a possible control factor for differences in reading ability, and reading comprehension was measured to identify gender differences and examine its relationship to intelligence.

It was predicted that girls would have better reading ability and perform better on measures of planning and attention.

It was also predicted that simultaneous and successive processes would correlate more highly with reading ability than planning and attention.

Method

Participants

One hundred and forty one children (67 boys) took part in this study. Children had just started their final year at primary school. Both boys and girls had an average age of 10 years and 8 months (0.36 S.D and 0.37 S.D. respectively). All children completed tests measuring planning, attention, simultaneous and successive processes. In addition, children also completed three ability tests; vocabulary (EPVT), single word reading (WRAT) and reading comprehension (GRT). All children completed these three tests, with the exception of one class who did not complete WRAT reading (n = 44, 19 boys) but completed all other tests. See Table 8.1 for means and standard deviations.

Materials

Tests of reading ability and vocabulary knowledge:

Vocabulary: English Picture Vocabulary Test 2, (Brimer & Dunn, 1968).

Single word reading: Wide Range Achievement Test, (Jastak Associates, 1993)

Reading comprehension: Group Reading Test II, (Macmillan, 2000).

See Chapter 4 for details of all these tests.

Tests of cognitive ability:

Tests measuring planning, attention, simultaneous & successive cognitive processes were designed in order to be group administered. Two tests were designed to measure each cognitive process. All tests had a practice section at the front so that children

understood the nature of the test before it started. All tests were timed (with the exception of the word order task). Children were given a certain length of time to complete as much of the test as possible before the examiner stopped the watch. Children were not expected to finish the test, rather, they were being tested on how much they could complete in a certain length of time. Children were instructed before the test that it was timed and were told that when the examiner said “Stop, put your hands on your heads”, they had to stop at the exact place where they were, put down their pencils and put their hands on their heads. By doing this the examiner could be sure that no child was still completing the test after the allocated time. All children complied with this rule.

All tests were constructed by the examiner, however they were based upon tests devised and used by Naglieri & Rojahn (2001) and Warrick & Naglieri (1993). Care was taken to ensure that tests were written at a level of vocabulary which was understandable to children, however, in addition, the examiner read out all the information to the children beforehand. Test booklets were administered so that children sitting beside each other received different forms of the same test (this was to prevent copying and both forms were of equal difficulty). See Appendix 3 for these tests.

Planning

Task 1. Trail making Task (2 versions)

There were two parts to this test. In the first part, children were required to connect numbers in a sequential order (1 - 25). These numbers were presented in a quasi-random order on the page. This test was devised so that the connecting lines drawn between the numbers would never cross over. Children completed 2 versions of this

test. In the second part of the test, children were required to connect numbers and letters in sequential order, alternately between numbers and letters (i.e., 1 - A - 2 - B - 3 - C etc). Again these items were presented in a quasi-random order on the page and the connecting lines could never cross over each other. There were also 2 versions of this test. Children were seated so that they completed alternative versions at the same time so there could be no copying. Both versions were of equal difficulty. Both parts of this test had a practice section at the front so children could familiarise themselves with the test. Children were given twenty seconds to do as much of the test as possible.

Task 2. Visual Search Task

In this task, a target number or letter was presented in a box in the centre of a page, surrounded by a field of similar stimuli (i.e., numbers or letters). These stimuli were randomly organised, however half of all stimuli were above the target letter, and half were below. Children were required to find the five targets present in the top half of the page, and after doing so, find the 5 targets present in the bottom of the page. In total there were 300 distracter items and 10 targets. An un-timed practice test was given beforehand so that all children understood the nature of the test. Children were given forty seconds to do as much of the test as possible.

Attention

Task 1. Stroop Task

In this task, the words red, green, blue and yellow were printed in different colours of ink (Times New Roman, font 24). The ink colours were also red, green, blue and yellow, however they did not correspond to the actual word. Each word and each ink colour appeared with the same frequency in this task and no same word or ink colour

appeared successively. There were six rows of words with seven words per row. Children were asked to ignore the word, and only write what colour of ink it was underneath each word. Children were told only to write the first letter of the ink colour, this was so that writing speed would not affect their progress on this task. Children were instructed to complete the task row by row, starting at the top of the page. An un-timed practice test was given beforehand so that all children understood the nature of the test. Children were given forty five seconds to do as much of the test as possible.

Task 2. Letter Pairs Task (2 versions)

There were two parts to this test. Children were required to circle letter pairs which corresponded to the requirement of the instructions. In the first part, target letter pairs were physically the same (i.e., aa, AA), these were set amongst letter pairs which were physically different but the same letter (i.e., Aa). In the second part, target letter pairs were the same letter (i.e., Aa, AA), and were set amongst letter pairs which were different (i.e., Nc, KH). Target letter pairs accounted for 12.5% of all letter pairs, and were evenly distributed throughout the test. Children were instructed to start at the top and work through the task one row at a time. An un-timed practice test was given beforehand for each version so that all children understood the nature of the test. Children were given fifty seconds to do as much of the test as possible.

Simultaneous

Task 1. Picture Selection Task

In this task, children were required to match a sentence to one of four drawings presented below. The task involved understanding the relationship between items. A square, triangle, circle and star were used as the items and were presented in different

relationships to each other; either above, below, right and left of another. Children were required to choose the drawing which fitted the description of the sentence (e.g., which one shows the triangle below the circle, and to the left of the star). Children were told that both the second items related to the first item which was underlined. Of the four drawings, two were correct based on the relationship between the first item and target item and only one was correct based on the relationship between all three items. An un-timed practice test was given beforehand so that all children understood the nature of the test. There were 2 versions of this test. Children were seated so that they completed alternative versions at the same time so there could be no copying. Both versions were of equal difficulty. Children were given one minute and twenty seconds to do as much of the test as possible.

Task 2. Picture Drawing Task

In this task, children were asked to draw the relationship between items as described in a sentence. The target items to be drawn were a square, triangle, star, circle and cross, and the relationships between the items were; left, right, above, below, (e.g., draw a square above a cross, and to the left of a circle). An un-timed practice test was given beforehand so that all children understood the nature of the test. There were 2 versions of this test. Children were seated so that they completed alternative versions at the same time so there could be no copying. Both versions were of equal difficulty. Children were given one minute and thirty seconds to do as much of the test as possible.

Successive

Task 1. Number Relation Task

In this task, children were presented with a series of sentences which consisted of relationships between numbers (e.g., the eight is fouring, the seven sixed the two). After each sentence there was a question (e.g., who is fouring? Who sixed the two?). Children were required to answer these questions. Children were seated so that they completed alternative versions at the same time so there could be no copying. Both versions were of equal difficulty. An un-timed practice test was given beforehand so that all children understood the nature of the test. Children were given one minute and thirty seconds to do as much of the test as possible.

Task 2. Word Order Task

In this task, children were required to write down words in the same order as stated by the examiner (i.e., a serial order recall task). This test consisted of 9 one syllable high frequency words; book, frog, shoe, girl, leg, doll, man, cow & ant. An ascending stair case procedure was used and each series of words read to the child ranged in length from 3 to 8 words (the same word never appeared twice in a sequence). Words were presented at the rate of one per second. The children were asked to listen to the whole sequence of words and when the last word was said, to write down the sequence in the same order. Children were told just to write the first letter of each word so that writing speed would not affect their performance. Children were told that the order of the words was very important and to put a dash where they forgot a word.

Procedure

All tests were group administered (with the exception of WRAT), carried out in the children's classroom with the teacher present. The word reading test (WRAT) was carried out individually in a quiet room within the child's school.

Results

Results are split into two sections; 1) gender differences and 2) correlations between reading ability and PASS cognitive processes.

1) Gender differences

Table 8.1. Gender differences in vocabulary (EPVT), reading comprehension (GRT) and single word reading (WRAT) (mean and standard deviations).

Gender	EPVT		GRT		WRAT	
	Mean	S.D	Mean	S.D	Mean	S.D
Boys	93.34	11.73	98.24	14.30	100.98	15.23
Girls	90.06	12.38	101.68	11.41	103.96	12.81

Note: EPVT & GRT (67 boys and 72 girls); WRAT (48 boys and 47 girls)

Analysis of variance revealed that boys and girls were matched on all ability tests as there were no significant gender differences in vocabulary, $F(1, 137) = 2.57, p > .05$, reading comprehension, $F(1, 137) = 2.48, p > .05$, or single word reading, $F(1, 93) = 1.06, p > .05$.

Table 8.2. Gender differences for planning, attention, simultaneous and successive processes (mean scores and standard deviations).

Group	Planning		Attention		Simultaneous		Successive	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Boys (n = 67)	54.73	10.52	73.13	22.83	21.69	11.57	44.33	17.99
Girls (n = 74)	60.11	11.63	84.68	23.72	23.15	11.74	49.51	16.11

Despite the children being matched on all tests of verbal and reading ability, there were significant gender differences on both planning; $F(1, 137) = 8.14, p = .005$ (effect size = 0.06), and attention scales; $F(1, 137) = 8.53, p = .004$ (effect size = 0.06) with girls scoring higher on both. There were no gender differences in simultaneous, $F(1, 137) = 0.55, p > .05$, or successive, $F(1, 137) = 3.21, p > .05$ processes.

Factor Analysis.

As two tests were used to measure each cognitive process, principal factor analysis with Varimax (orthogonal) rotation was used to see how the individual tasks loaded onto the four cognitive processes. This analysis gave rise to two different factors.

Table 8.3. Factor loadings for all tests

Test	Planning & Attention	Simultaneous & Successive
Plan 1	.69	
Plan 2	.70	
Att 1	.68	
Att 2	.67	
Sim 1		.77
Sim 2	.48	.67
Suc 1		.74
Suc 2	.36	.47

Note. Factor loadings less than .35 are not presented. Items with the highest loadings on a factor are given in bold. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

The tasks loaded onto two factors, supporting the validity for the newly constructed tasks. There were those related to planning and attention, and those related to simultaneous and successive processes. Simultaneous 2 and successive 2 were loaded onto ‘simultaneous & successive’ as they had their highest loading on this factor. Previous research has used the Cognitive Assessment System (CAS), a standardised measure of four distinct subscales which have been tested extensively for reliability and validity (Naglieri & Das, 1997). Due to resource constraints, these tests were copied from detailed task descriptions from the CAS (Naglieri & Rojahn, 2001 and Warrick & Naglieri, 1993), and developed as group administered tests. Factor analysis revealed that these tasks measured only two distinct factors. Despite this, further analysis was

first carried out with planning and attention as separate factors and simultaneous and successive scores as separate factors due to the need on theoretical grounds for distinguishing these variables (Naglieri, 1999). Following this, planning and attention were combined, as were simultaneous and successive scales, in line with the results of the factor analysis.

As factor analysis revealed that planning and attention loaded on to one factor and simultaneous and successive scores on to another, scores were converted to z scores and averaged so that each process (e.g., planning) contributed fifty percent to the combined total (e.g., planning & attention), and analysis was carried out using the two combined factors.

Table 8.4. Gender differences for combined planning and attention and combined simultaneous and successive scores, z scores and standard deviations.

Group	Planning & Attention		Simultaneous & Successive	
	Mean	S.D	Mean	S.D
Boys	-0.13	1.34	-0.29	1.11
Girls	0.08	1.27	0.34	1.32

There was a significant gender difference favouring girls, when planning and attention tests were combined; $F(1, 137) = 9.34, p < .01$ (effect size = .06). There was still no significant gender difference when simultaneous and successive test scores were combined, $F(1, 137) = 0.96, p > .05$.

2) Correlations between cognitive tests and reading ability

Due to the results of the factor analysis, correlations were carried out combining planning & attention and simultaneous & successive processes.

Table 8.5. Correlations between (PA)(SS) tests, reading comprehension and single word reading.

	Planning & Attention	Simultaneous & Successive
Comprehension (GRT)	.23*	.64**
Word reading (WRAT)	.34**	.64**

N = 141 GRT; N = 97 WRAT, * $p < 0.05$, ** $p < 0.001$.

A combined simultaneous & successive scale correlated more highly with reading comprehension and word reading than the combined planning & attention scale. The combined simultaneous & successive scale correlations were as strong for both reading comprehension and word reading (despite the differences in sample size).

The correlations (Pearson's r) were converted into a corresponding Fisher's z coefficient in order to see if there were significant differences between the correlations. Simultaneous and successive scores correlated significantly more highly with reading comprehension and word reading than planning and attention, $p < .01$.

As the simultaneous and successive tests contained a reading component, two further correlations were carried out. The first controlling for word reading by partial

correlations, and examining the relationship between reading comprehension and planning & attention and simultaneous & successive processes. The second controlling for reading comprehension and examining the relationship between word reading and planning & attention and simultaneous & successive processes.

Planning and attention did not correlate with reading comprehension after controlling for word reading skill ($r = 0.03$, $df = 94$, $p > .05$), however simultaneous and successive skills still correlated with reading comprehension after controlling for word reading ($r = 0.40$, $df = 94$, $p < .01$).

However, planning and attention did correlate with word reading after controlling for reading comprehension ($r = 0.23$, $df = 94$, $p < .05$), as did simultaneous and successive skills ($r = 0.26$, $df = 94$, $p < .05$).

Discussion

Gender differences were found on both the planning and attention tasks, with girls performing better on both. However, girls did not, as predicted, read better than boys. There were no gender differences on simultaneous and successive processes. Furthermore, simultaneous & successive processing significantly correlated with word reading and comprehension, whilst planning & attention did not. After controlling for word reading, simultaneous & successive skills still correlated with reading comprehension, and after controlling for reading comprehension, both planning & attention, and simultaneous & successive skills correlated with word reading.

In this study, factor analysis revealed that the tasks used to measure the four cognitive processes loaded onto only two factors; 1) planning & attention and 2) simultaneous & successive. Indeed, this link between planning and attention tasks has been found before (Kranzler & Keith, 1999; Kranzler & Weng, 1995; 1995b). These authors argue that PASS measures a combined planning/attention factor in addition to simultaneous and successive processes, known as the (PA)SS model as opposed to PASS (Kranzler & Keith, 1999; Kranzler & Weng, 1995a; 1995b). In response to this, the authors of the CAS have argued that these processes are interrelated but separate (Puhan et al., 2005) and that there is a more extensive body of data in favour of the four factor theory of information processing. In addition, Puhan et al. (2005) argue that factor analysis is one form of empirical evidence but that a “theoretical rationale must pre-exist the statistical manoeuvres of which the essential purpose is to provide evidence for the theory” (Puhan et al., 2005, p. 76). In other words, the theoretical rationale cannot be an afterthought. They argue that there is theoretically good reason for treating planning

and attention as separate but interrelated processes based on the work by Luria (1970), who stressed the importance of treating planning and attention separately.

The results of the factor analysis in the present study favour a (PA)(SS) model. This has been proposed before (Kranzler & Keith, 1999) but has provided a worse fit to the data than both the (PA)SS and PASS models and therefore has not been given any credence. Regardless of whether planning and attention were kept separate or combined, gender differences were found in planning and attention skills, consistent with previous research (Naglieri & Rojahn, 2001). In addition, this study demonstrated that these gender differences are not a product of differences in ability (as boys and girls were matched on vocabulary and reading skill), but rather reflect differences in the levels of planning and attention skills. To put into context the magnitude of these differences and for comparisons with Chapter 6 regarding gender differences in abilities, effect sizes were calculated according to Cohen's d , and were found to be 0.49 for planning, and 0.50 for attention. Previous studies which have found gender differences in planning and attention have also found gender differences in word reading, comprehension, proofing and dictation in the same population (Naglieri & Rojahn, 2001), therefore these differences in planning and attention may have reflected differences in general ability. However, this study shows that they exist despite being matched on ability tests, and the magnitude of the differences are relatively large. Warrick & Naglieri (1993) did not include tests other than those measuring PASS processes, therefore this cannot be assessed in their study.

The gender differences found in planning and attention skills may provide a possible explanation for differences often found in school test results and in overall performance in schools. In addition, they may have important implications for instructional

approaches in schools. Tests of planning measure the ability to form plans of action, evaluate different strategies, execute them and then evaluate them. They require impulse control and self-monitoring for successful completion. It has been found that there are beneficial effects of training in planning and goal setting (Naglieri & Gottling, 1995; 1997; Naglieri & Johnson, 2000) and these may be of particular use for instruction with boys. Boys' poorer ability to plan has been used as a possible explanation for procedural errors and misapplication of methods in basic arithmetic tests, as boys are more likely to inappropriately apply procedures which are correct for some problems but not others (Geary, 1994). Studies which have used planning based interventions for children with learning disabilities and also poor planning and mathematic abilities have found considerable improvements in mathematics computation (Naglieri & Gottling, 1995; 1997; Naglieri & Johnson, 2000). These planning based interventions have required children to engage in self-reflection and verbalisation of strategies regarding how the mathematical problems should be completed, and studies consistently show that those children with poor planning consistently benefit more from this type of intervention compared to those who are not poor in planning (Naglieri & Gottling, 1995; 1997; Naglieri & Johnson, 2000). However, it is not instruction alone which is important, it is the type of instruction given. It has been found that poor planners benefit from a different type of instruction compared to those with good planning processes, in particular they benefit from verbalising strategies when formulating plans of action (Kar, Dash, Das & Carlson, 1993). It may be that poor planners (more likely boys) will benefit more from such instruction. There is also the potential use for interventions in these skills to improve writing skills (Harris & Wachs, 1986). Poor simultaneous skills have been found to be correlated with an inability to indicate clear relationships between sentences and paragraphs, similar to Cain's (2004a) finding with inference and integration skills in

reading. In addition, successive skills have been linked to sentence level errors and the ability to develop sequences of ideas in writing, whilst planning ability has been found to have a powerful influence in organising content. This highlights the educational potential of the PASS cognitive processes approach beyond its relationship with reading alone. Indeed, Ashman & Conway (1997) have linked the concepts found in cognitive psychology and cognitive education to application within psychoeducational assessment, instruction and methods of adapting student behaviour. In addition they focus on a number of instructional methods to improve cognitive processes (Ashman & Conway, 1993).

In the current study, girls were found to have better skills in attention. This may help to explain differences in classroom behaviour, with girls being able to stay focused on a specific topic for longer. Indeed, it has been found that girls are more attentive than boys in the early years of school (Samuels & Turnure, 1974), therefore boys may be more suited to shorter time spans of learning due to their shorter attention spans. This is a possible explanation as to why synthetic phonics works so well for boys (Johnston & Watson, 2004b), as literacy lessons are short but focused. In addition, they teach one strategy for reading so that children are not confused by being taught different reading strategies which will require far greater attention than practising and rehearsing one technique. Differences in attention may also affect achievement in tests, which appear long and arduous and require children to remain attentive for relatively long time periods. It may also affect the strategies children use for carrying out tasks, with girls employing longer sustained periods of attention and boys using short bursts of attention. In addition, it may affect the amount of information children are able to listen to and retain from long class lessons. Yeh (2003) found that the teaching of phonemic awareness and reading in young children (aged 4-5 years) was more effective when

children had previously been taught attention skills, indicating that this factor can affect performance. It may be the case that in this study, in a test environment, all children pay more attention and so this cannot be used to distinguish between levels of achievement. As gender differences in attention do exist, this could also provide further insight into the disproportionately higher incidence of boys diagnosed with attention deficit hyperactivity disorder (ADHD) and with other behavioural problems which have educational, social and emotional consequences. The gender differences found in planning and attention therefore have consequences for classroom instruction, for example, remediation may take the form of practising skills which draw on these cognitive processes, such as monitoring of task performance and rehearsal (Das, 1999). In addition, children may be instructed to attend more to planning stages of tasks or be given shorter lessons to maintain their attention.

Whilst it was found that girls were better at planning and attention it should be noted that these results cannot be generalised to all ages groups, as studies tend to find differences in the magnitude of the effect size based on age (Hyde & Linn, 1988; Naglieri & Rojahn, 2001; Warrick & Naglieri, 1993).

In the current study, simultaneous and successive processes correlated more highly with reading skills than measures of planning and attention. This is consistent with numerous other studies which have found that simultaneous and successive processes correlate with both reading comprehension (Kirby & Das, 1977; Naglieri, 1999), and reading decoding (Das et al., 2007; Joseph et al., 2003; Naglieri, 1999). In addition, this is theoretically consistent as simultaneous processes are argued to be necessary for integration of information into a whole (comprehension) and successive processes for coding information in a serial order for processing (word decoding) (Das et al., 2000).

However, it could be argued that the results from this study are partly due to the nature of the simultaneous and successive tests devised, as unfortunately these tests contained a reading component. However, the language used in the simultaneous and successive tests was very simple and repetitive so as to minimise the possibility that reading ability may affect performance. In addition, in the successive test which required no reading skill, there was still a high correlation with reading comprehension (0.53) and single word reading (0.54). Finally, it was ensured that all participants were able to read the practice items used in these tests during the practice section. All words contained within the simultaneous and successive tests were high frequency (over 100 per million, Children's Printed Word Database, Masterson et al., 2002), with the exception of three words; star, square and triangle. However, these words were set beside their relative picture at the start of the test booklet so that children would be able to see what shape each word stood for. Nevertheless, it is vital to change the format of the tests measuring simultaneous and successive process in future to see if the same associations with reading are found.

In addition, planning correlated with both word reading and comprehension, a finding less often cited in the literature but often found (Naglieri & Das, 1990; Joseph et al., 2003). Consistent with the results in the present study, attention is far less often found to be correlated with reading (Joseph et al., 2003)

Das, Naglieri and colleagues (1990; 1999; 2000; 2007) have outlined a specific model of cognitive processes and have argued theoretically how they relate to reading. However, the roles of these processes appear to be assumed in many of the research studies carried out, which tend to be either training studies to improve, for example, planning skills, or which highlight possible sources of gender differences. There

appears to be very little research evidence to confirm the roles of each of these processes, which may be investigated by examining how they may differ with stage of reading acquisition, skill level of the reader, or difficulty of the text. Future research could concentrate on the relative importance of the four cognitive processes for different aspects of reading. For example, it may be that successive skills are required more in the earlier stages of learning to read. At this stage of reading development, children need to process sequences of letter sound strings to decode unfamiliar words (i.e., phonics) which may depend heavily on successive processing. In later reading, they need to be able to adhere to more complex phonics rules (i.e., long vowel rule for 'came' or 'more'), requiring more holistic processing of the word, which may be more heavily dependent on simultaneous processing. In later stages of reading development, studies could look at task complexity, comparing reading material which is very complex with easier material, to see if the former requires substantially more planning and attention. As argued, whilst the authors of the CAS have hypothesised about the roles of each of these processes, further research needs to test this. If results show that the hypothesised relations are true, then this would provide more evidence for the PASS model as a comprehensive model of cognitive processes which can be applied to reading.

The Planning, Attention, Simultaneous and Successive model is growing in popularity and influence as a useful and alternative measure of intelligence, and has advantages over other tests of IQ due to its independence from any reading related components (although the PASS tests created in the present study unfortunately had a reading component (albeit a simple one) due to the need to conduct the testing in groups). The PASS tests were created and used in this study because the traditional way of conceptualising intelligence is changing. The tri-partite model of abilities; verbal,

visual-spatial and quantitative abilities, which was often used to understand gender differences in abilities is arguably over-simplistic (Halpern & Wright, 1996). The PASS model measures underlying cognitive processes, rather than task content, and therefore is arguably a better measure of overall ability. Indeed, it has received good reviews by other researchers; “It appears that this test will become an important, as well as innovative, tool for the assessment of cognitive status” (Anastasi & Urbina, 1997, cited in Naglieri, 1999, p. 145). Also, Gindis (1996, cited in Naglieri, 1999, p. 160), after his review of the data on PASS and CAS stated that “The Cognitive Assessment System...promises to be one of the most effective and original instruments in the field....[and] is a landmark in the field of educational/school psychology.”

Conclusions

Gender differences in planning and attention were found despite there being no differences in vocabulary knowledge or reading ability. These differences in planning and attention provide a possible explanation for reports of poor classroom behaviour (often from boys) and school achievement (with boys falling behind girls in national and international assessment). These results represent a possible source of intervention to improve ability and behaviour, with children lacking in planning and attention skills (most likely boys) to be taught to plan more thoughtfully and be more tactical in their use of strategies. It also highlights the importance of teaching skills in attention or creating learning opportunities which will naturally help children to remain more focused (e.g., shorter lessons). Techniques to improve these skills are available and may offer some solutions. This will hopefully provide benefits which will improve the learning environment within schools.

CHAPTER 9: COGNITIVE PROCESSES

THE EFFECT OF READING INSTRUCTION

Introduction

As shown in Chapter 8, there are gender differences in underlying cognitive processes, as measured according to the planning, attention, simultaneous and successive model of cognitive processes (PASS, Naglieri & Das, 1990). This result is consistent with previous research (Naglieri, & Rojahn, 2001; Warrick & Naglieri, 1993), and has useful application in schools, through identifying children (in particular boys) with poor planning and attention and structuring support around these areas. In addition to planning and attention however, simultaneous and successive processes have been consistently linked to reading comprehension (Das et al., 2000; 2007; Kirby & Das, 1977; Naglieri, 1999; Naglieri & Das, 1990) and reading decoding (Das et al., 2000; Joseph et al., 2003; Naglieri, 1999, Naglieri & Das, 1990). Theoretically, simultaneous processing is linked to reading comprehension as it is necessary for integrating information into a whole in order to understand what has been read, whereas successive processing is linked to word reading as it is necessary for coding information in a serial order for processing, i.e., recoding the letter-sound string to read (Das et al., 2000). Existing studies also support the importance of planning processes in reading comprehension (Das et al., 2000).

In studies of early reading, letter knowledge (Adams 1990; Foy & Mann, 2006; Muter, 1994; Chall, 1967), phonological awareness (Castles & Coltheart, 2004; Hulme et al.,

2000; Muter et al., 1998), vocabulary (Bowey, 1995; Share et al., 1984) and general cognitive ability (Bowey, 1995; de Jong & van der Leij, 1999; Scanlon & Vellutino, 1997) have been found to be powerful predictors of later reading. In later reading however, the relative contribution of letter knowledge and phonological skills will diminish (particularly letter knowledge) and other processes will become potential predictors of reading, such as decoding skill (Gough & Tunmer, 1986), broader language skills and vocabulary (Gough & Tunmer, 1986; Nation & Snowling, 2004), memory, inference and integration skills (Cain & Oakhill, 1999; Cain et al., 2004a) and underlying cognitive processes (Das et al., 2000) to name but a few.

The way in which a child is taught to read, or skills taught prior to reading instruction, often produce differences in reading ability. This has been found in a number of studies comparing the effects of different reading programmes or focus on certain skills for reading (Hatcher et al., 1994; 2004; Johnston & Watson, 2004a; 2004b; Yeh, 2003). However, an area that has not been investigated is whether the method of teaching instruction affects not only reading ability but also the cognitive processes underlying this ability.

All reading programmes focus to a certain extent on different skills for learning to read, comparisons often being made between those focusing on rhyme via phonemic awareness. In terms of teaching at the level of the phoneme, the way in which a child is taught these skills can vary, with distinctions being made between analytic or synthetic phonics for example (see Chapter 2 for a more comprehensive overview). Whilst these methods of teaching are being used primarily for developing reading skills, it is possible that they are having effects on other underlying skills. For example, synthetic phonics focuses on early sounding and blending for reading, and teaches children to process

letter sound relationships in sequence to read unfamiliar words accurately. Children are encouraged to use this technique for all word reading (for irregular words, attention is always brought to the regular components of the word). Analytic phonics teaches letter-sound correspondences at a much slower rate, and early on will use a form of sight-word reading with only the initial letter giving a guide to pronunciation. When children begin to read, they do not have as an extensive knowledge of phonics and will use a variety of strategies for reading unfamiliar words, such as trying to work out what the word is based on context. This requires children to be able to work out which possible words could fit into the sentence or passage to integrate it together with the rest of the text. The former approach to reading (synthetic phonics) may be expected to train children in successive skills, through practice of sounding and blending in sequence and consistently adopting this strategy to read all unfamiliar words. The latter approach (analytic phonics i.e., as previously advocated by the National Literacy Strategy) may be expected to train children in, for example, simultaneous skills, as they try to integrate an unfamiliar word into the text in order to read it accurately. Predictions made about the effect of analytic phonics (as prescribed by the National Literacy Strategy) on cognitive processes are not as clear-cut, as children are encouraged to use a variety of strategies for reading (searchlight model, see Chapter 2) which may draw upon many of the underlying processing skills required for reading. However, clearer predictions can be made regarding synthetic phonics, as this focuses predominately on sounding and blending for reading (which is a sequential/successive approach to reading), therefore a closer association between reading and successive processing may be found, in addition to better successive processing skills, in children taught by this method.

In addition to the PASS cognitive processes, vocabulary knowledge may be expected to make a contribution to reading, over and above phonological skills (Nation & Snowling,

2004). However its importance may vary depending on the reading skill being tested, one study found that it is more important for reading comprehension and exception word reading (Ricketts et al., 2007) than regular word reading. The association between vocabulary and reading also appears to be stronger in older children (as tested in the current study), compared to younger children (Stanovich et al., 1984b). Therefore vocabulary is likely to be correlated with reading, but more closely with reading comprehension than word reading (which contains a mix of regular and irregular words). Phonological reading skill (nonword reading) will also be closely associated with word reading (Ellis & Large, 1988; Siegel & Ryan, 1988) and reading comprehension (Siegel & Ryan, 1988; Stanovich et al., 1984b)

In the following study, children from two classes taught to read by different programmes were compared. One had been taught by synthetic phonics, the other by National Literacy Strategy guidelines, which teaches analytic phonics, but also advocates other strategies for reading (see Chapter 2 for a more comprehensive overview of these two programmes). All children were tested on measures of ability (vocabulary, single word reading and reading comprehension), underlying cognitive processes (planning, attention, simultaneous and successive) and phonological reading skill (nonword reading)

It was predicted that simultaneous and successive processes would correlate more highly with reading ability than planning and attention skills.

In addition, it was predicted that vocabulary and nonword reading skill would correlate highly with reading ability.

It was also predicted that synthetic phonics taught children would have better successive processing skills due to learning to read via a sequential method of sounding and blending

It was also predicted that synthetic phonics taught children would show higher correlations between word reading and successive processing.

Finally, it was predicted that National Literacy Strategy taught children would draw upon all underlying processing skills to a similar degree.

Method

Participants

Fifty one children took part in this study (average age 10 years & 6 months, 0.38 S.D). Twenty three children (9 boys) had been taught by Synthetic Phonics (average age 10 years & 7 months, 0.28 S.D) and twenty eight children (16 boys) had been taught by National Literacy Strategy guidelines (average age 10 years & 5 months, 0.40 S.D) which used an analytic phonics method of teaching. The children were from two different classes from schools matched carefully on socioeconomic status. Although the synthetic phonics taught children were tested in Clackmannanshire, these children were not in the experimental intervention (Johnston & Watson, 2004a).

Details of teaching

The main difference between these two programmes is that synthetic phonics focuses more on phonics for reading (in addition to reading for meaning), sounding and blending letter-sound correspondences being foremost in a child's strategies for reading. The National Literacy Strategy approach at the time that the children in the present study were taught advocated a searchlight model, with phonics (analytic) one strategy for reading, with a late introduction of sounding and blending, and knowledge of context, grammatical knowledge and word recognition other strategies taught for reading words. For a more detailed account see Chapter 2.

Materials

Reading ability and vocabulary knowledge:

Single word reading: Wide Range Achievement Test (Jastak Associates, 1993)

Reading comprehension: Group Reading Test II (Macmillan Unit, 2000)

Vocabulary: English Picture Vocabulary Test 2 (Brimer & Dunn, 1968)

See Chapter 4 for details of these tests

Underlying cognitive processes:

Planning: Trail making Task and Visual Search Task

Attention: Stroop Task and Letter Pairs Task

Simultaneous: Picture Selection Task and Picture Drawing Task

Successive: Number Relation Task and Word Order Task

These tests are the same as outlined in Chapter 9 and were devised based on task descriptions taken from Naglieri & Rojahn (2001) and Warrick & Naglieri (1993). See Appendix 3 for stimuli.

Phonological reading skill:

Graded Nonword Reading Test (Snowling et al., 1996)

See Chapter 4 for details of this test. Children can score a maximum of 20 on this test.

Procedure

All tests were group administered (with the exception of the single word reading test and nonword reading test), carried out in the children's classroom with the teacher present. The single word reading test and nonword reading test were carried out individually in a quiet room within the child's school.

Results

Results are split into three sections; 1) effect of reading programme on reading skill (including low achievers) 2) effect of reading programme on PASS cognitive processes and 3) correlations between reading ability and PASS measures.

1) Effect of reading programme on reading skill.

Table 9.1. Comparison of vocabulary (EPVT), reading comprehension (GRT), single word reading (WRAT) and nonword reading, for synthetic phonics and National Literacy Strategy taught children, (standardised scores (mean score for nonword reading) and standard deviations).

Group	EPVT		GRT		WRAT		Nonword	
	stan.	S.D	stan.	S.D	stan.	S.D	Mean	S.D
	score		score		score			
SP (n = 23)	101.00	11.77	110.65	10.26	109.43	9.85	17.64	2.24
NLS (n = 28)	89.61	10.49	97.43	11.82	99.82	13.39	15.85	4.05

There was a significant effect of group on vocabulary; $F(1, 49) = 13.34, p < .001$ (effect size = 0.21), reading comprehension; $F(1, 49) = 17.79, p < .001$ (effect size = 0.27), single word reading; $F(1, 49) = 6.58, p < .05$ (effect size = 0.12) and nonword reading skill; $F(1, 49) = 5.27, p < 0.05$ (effect size = 0.08), with synthetic phonics taught children performing better on all tests.

After controlling for differences in vocabulary, there were no significant differences between the groups on reading comprehension; $F(1, 51) = 3.01, p > .05$, or word reading; $F(1, 51) = 0.11, p > .05$. In addition, there was a significant difference in vocabulary after controlling for word reading and comprehension, $F(1, 51) = 4.57, p < .05$ (effect size = 0.08).

After controlling for differences in phonological reading skill, there was still a significant difference between the groups reading comprehension; $F(1, 51) = 8.34, p = .006$ (effect size = 0.14) and vocabulary; $F(1, 51) = 13.29, p = .001$ (effect size = 0.21), however there was no significant difference on word reading; $F(1, 51) = 1.53, p > .05$.

Low achievers

As previously mentioned in Chapter 7, the relative success of a particular teaching method could be argued to be in how effective it is in reducing numbers of low achievers, therefore the proportion of children achieving a standardised score lower than 100 on the reading tests (i.e., below expected performance based on their chronological age) was examined.

Table 9.2. Percentage and distribution of scores in low achievers (those scoring below 100 on standardised tests) in word reading and comprehension for synthetic phonics and National Literacy Strategy taught children.

Standardised score	Synthetic Phonics	National Literacy Strategy
Single word reading		
60-70	0%	3.1%
70-80	0%	6.2%
80-90	12%	21.9%
90-100	12%	25%
Total scoring below 100	24%	56.2%
Reading comprehension		
70-80	0%	12.4%
80-90	4%	15.5%
90-100	20%	25%
Total scoring below 100	24%	52.9%

Despite there being small overall differences in mean reading performance, the distribution of scores for reading tests revealed that there were proportionally more low achievers in the National Literacy Strategy taught group and there were also some extremely poor readers in this group compared to the synthetic phonics group.

2) *Effect of reading programme on PASS cognitive processes*

As before, a factor analysis was carried out and the tests loaded onto two factors; planning & attention and simultaneous & successive (PA)(SS). However, when the tests were combined to form this two factor theory, there was a similar pattern of associations in the following analysis, as when the tests were kept separate, as in the original four factor theory. Therefore, for theoretical reasons (i.e., examining the relationship between reading and successive skills in synthetic phonics taught children), the four factor structure was retained and the following analysis was carried out keeping these factors separate. In the analysis, successive skills were split so that the effect of reading programme on memory span could be investigated (successive task 2 - word order). This test contained no reading component for the children (to see the problems identified with other simultaneous and successive measures see previous chapter), therefore was a pure measure of memory span.

Table 9.3. Comparison of reading programme on planning, attention, simultaneous and successive processes, mean scores and standard deviations.

	Plan		Att		Sim		Suc1		Suc2 (mem. span)	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
SP	55.41	9.17	83.23	16.14	24.77	10.37	26.18	13.34	27.82	4.13
NLS	54.77	13.36	77.87	21.41	20.43	11.53	23.30	8.31	20.93	14.26

Before and after controlling for word reading ability there were no significant differences between the groups on the following cognitive processes; planning, $F(1, 51) = 0.38, p > .05$, attention, $F(1, 51) = 0.97, p > .05$, simultaneous, $F(1, 51) = 1.96, p > .05$, and successive 1 task, $F(1, 51) = 0.92, p > .05$. There was a significant difference on the memory span task however, $F(1, 51) = 4.82, p < .05$ (effect size = 0.09) with synthetic phonics children scoring higher than National Literacy Strategy taught children. However this was not significant after controlling for word reading ability, $F(1, 51) = 0.90, p > .05$, reading comprehension, $F(1, 51) = 0.78, p > .05$ or vocabulary, $F(1, 51) = 0.88, p > .05$.

When the groups were compared on reading ability after controlling for differences in memory span it was found that the synthetic phonics children still had better reading comprehension, $F(1, 53) = 10.42, p < .005$ (effect size = 0.16) and vocabulary, $F(1, 53) = 11.62, p = .001$ (effect size = 0.19), however the difference in single word reading was no longer significant, $F(1, 53) = 2.42, p > .05$.

There was huge variation in children's memory span in the National Literacy Strategy taught group, as indicated by the size of the standard deviation. The synthetic phonics group performed more consistently. Indeed, covariance analysis increased the mean performance for the National Literacy Strategy group, as the adjusted means were higher after controlling for reading comprehension ($M = 22.53, 15.07$ S.D), word reading ($24.59, 13.49$ S.D) and vocabulary ($26.26, 17.92$ S.D). In addition, the adjusted mean performance for the synthetic phonics group was lower, and the standard deviations much higher, after controlling for reading comprehension ($M = 25.64, 17.99$ S.D), word reading ($M = 24.42, 15.99$ S.D) and vocabulary ($M = 22.93, 51.64$ S.D).

This variation in memory span was of interest, particularly in those low achievers, therefore the proportion of children achieving different levels of memory span were examined.

Table 9.4. Percentage and distribution of memory span scores for all children and low achievers, for synthetic phonics and National Literacy Strategy taught children.

Memory span	Synthetic Phonics	National Literacy Strategy
All children		
> 16	0%	48.4%
16-25	36%	26.0%
26+	64%	25.6%
Low achievers (<90 GRT)		
> 16	0%	77.8%
16-25	0%	11.1% (1 child)
26+	100% (1 child)	11.1%
Low achievers (<90 WRAT)		
>16	0%	55.6%
16-25	66.7%	33.3%
26+	33.3% (1 child)	11.1% (1 child)

There were proportionally more children with poor memory span in the National Literacy Strategy group. Of the children with very poor reading comprehension (see those who scored less than 90, Table 9.2), most children taught by the National Literacy

Strategy also had a poor memory span. Of the children with very poor word reading (see those who scored less than 90, Table 9.2), a high proportion of National Literacy Strategy children had poor memory span. For those taught by synthetic phonics, even the poor achievers had relatively good memory span scores.

3) Correlations between reading ability and PASS cognitive processes

The strength of the associations between reading ability, PASS, nonword reading and vocabulary was investigated to examine whether reading instruction affects these relationships.

Table 9.5. Correlations between PASS tests, reading comprehension and word reading for children taught by synthetic phonics or National Literacy Strategy guidelines.

	1	2	3	4	5	6	7
<hr/>							
Synthetic Phonics							
Reading comprehension	.18	-.16	.51**	.35	.09	.30	.65**
Word reading	.22	.10	.53**	.37	.22	.54**	.44*
National Literacy Strategy							
Reading comprehension	.25	.44*	.57**	.41*	.37*	.57**	.45*
Word reading	.39*	.37*	.62**	.57**	.55**	.67**	.57**

SP; N = 23, NLS; N = 28, * p<0.05, **p<0.01

1 = planning, 2 = attention, 3 = simultaneous, 4 = successive 1, 5 = memory span (successive task 2), 6 = nonword reading, 7 = vocabulary.

Contrary to predictions, successive skills tended to correlate more highly with word reading and reading comprehension for children taught to read by National Literacy Strategy guidelines compared to synthetic phonics taught children, however this difference was not significant. For children taught to read by synthetic phonics, vocabulary and simultaneous skills correlated with reading comprehension, whilst nonword reading, simultaneous skills and vocabulary correlated with word reading. For children taught to read in accordance with National Literacy Strategy guidelines, all tests correlated with word reading and reading comprehension (with the exception of planning). The greater number of significant correlations in this group however could be due to the wider variation in children's scores on each of the tests, as indicated by the standard deviations in Tables 9.1 and 9.3.

There were a number of differences between the two groups. One notable difference was in the measure of attention; for those taught by National Literacy Strategy guidelines there was a high positive association between a child's reading comprehension and their attention skills, however in the synthetic phonics group this was association was negative. The correlations (Pearsons r) were converted in a corresponding Fisher's z coefficient in order to see if there were significant differences between the group's correlations. No correlations were significantly different, this may be due to the small sample size in this study however.

Discussion

Synthetic phonics taught children had better reading ability (single word reading and comprehension), vocabulary and phonological reading skill (nonword reading). In addition, there were proportionally fewer poor readers in the synthetic phonics group and greater consistency in the scores. However after controlling for vocabulary there were no differences in reading skill (both word reading and comprehension), and after controlling for phonological reading skill or memory span there were no significant differences in word reading, although there were still significant differences in comprehension. Between the groups, there were no significant differences in underlying cognitive processes, except that synthetic phonics taught children had longer memory spans before controlling for reading ability, and there was far less variability in their memory scores. After controlling for reading ability, there was no significant memory span difference; adjusted means increased in the National Literacy Strategy group and decreased in the synthetic phonics group. Finally, National Literacy Strategy taught children showed more and stronger associations between reading and all other tests carried out.

To begin, one important point to make is that the two groups used in this study were matched on socioeconomic status (using the indicator percentage of free school meals), as this has been found to be an important variable affecting reading achievement (Bowey, 1995; McDonald-Connor et al., 2005; Molfese et al., 1997; White, 1982). There were also no differences between the groups on all tests of cognitive processing (with the exception of memory span). Therefore it has been concluded that these were well matched schools on which to understand the effects of reading programme. One contention however is that the synthetic phonics children had better vocabulary, and the

differences in reading skill (both word reading and comprehension) disappeared after co-varying for vocabulary. In addition, after co-varying for differences in reading skill (word reading and comprehension) there were still differences in vocabulary. It is important therefore that this vocabulary difference is resolved the best it can be.

It is well known that written text is an excellent source of learning new vocabulary (Cunningham & Stanovich, 1991; 1998; Echols et al., 1996). Therefore it may be that the synthetic phonics children had better vocabulary as a result of reading more often, rather than being a result of these children being generally more intelligent, as there were no differences between the groups on any of the cognitive processing measures. The results are also consistent with previous studies which have found that synthetic phonics produces better readers (Johnston & Watson, 2004a) compared to analytic phonics programmes. However, after controlling for vocabulary these effects did disappear. After controlling for differences in phonological reading skill and memory span, there was still a significant difference between the groups' reading comprehension, however there was no significant difference in word reading. This suggests that the synthetic phonics children's better reading could have been due, in part, to their better phonological reading skill and/or memory span, in addition to their better vocabulary. The discussion which follows will not be focused on the effects of reading programme on reading skill, as no solid conclusions can be made based on the results found; it is unclear what the mediating role of vocabulary is to word reading, however it seems clear that it played a role in comprehension. Rather, the discussion will focus on the associations found between the measures of reading and cognitive processes, and the memory span difference found between the two groups. This will be done taking into account the differences in vocabulary, although results will also be discussed before co-varying for this variable.

Whilst the word order test used (used also by Naglieri & Rojahn, 2001 and Warrick & Naglieri, 1993) was a measure of successive processing, it is also a good measure of memory span (Gathercole & Baddeley, 1990; Parrilla, Kirby & McQuarrie, 2004). Those taught by synthetic phonics had a better memory span ($d = 0.67$, a relatively large effect size), however there were no significant differences on any of the other cognitive processing tests. It is suggested that this better memory span and less variation in memory span scores in synthetic phonics children may be due to the way in which they were taught to read. Synthetic phonics teaches sounding and blending for reading as the primary method for reading words and children will therefore have had more experience of paying attention to the sequence of letters in a word, retaining this information and processing it in order to read the word correctly. The more skilled they will have become at this, the longer the length of words they will have been able to process and read using this technique. Therefore, this method may train successive processes and memory span indirectly. Indeed, successive processing has been found to be required for phonological coding and articulation of sequences of letters and sounds (Das, Mishra & Kirby, 1994; Kirby & Das, 1990). In this study however, after controlling for word reading, comprehension and/or vocabulary, there were no differences between synthetic phonics and National Literacy Strategy taught children in memory span, as adjusted means increased in the National Literacy Strategy group and decreased in the synthetic phonics group. It is either the case that their better memory spans contribute to their better reading (which in turn may affect vocabulary) and so this effect is diminished by controlling for reading ability, or that these children had a better memory span regardless of reading instruction. In the tests used in this study, if children are taught by a sequential sounding and blending method for reading, it is more likely that memory span would play a more important role in single word reading (due to its increasingly long word length) than comprehension (which requires a combination of

different skills, e.g., vocabulary, inferences skills etc). Indeed, after controlling for memory span, there was still a significant difference in comprehension and vocabulary, however there was no longer a significant difference in word reading, suggesting that the better memory span that synthetic phonics children had was explaining at least some of their better results in word reading. The same results were also true for phonological reading skill, perhaps due to synthetic phonics' greater reliance on phonics and its benefits for reading unfamiliar words in the absence of context.

The National Literacy Strategy taught children generally showed closer associations between all cognitive skills and reading. There are three different ways to interpret this finding. The first is that the National Literacy Strategy programme is better at utilising children's strengths in other areas (i.e., underlying cognitive processes) and drawing upon these for reading, thereby showing greater coherence between all the tests and reading skill. The second interpretation is that the closer associations could be due to the greater variability in their scores (with the exception of vocabulary) compared to the synthetic phonics group. This was evident in the standard deviations and suggests that although all children may start school with varying levels of ability, synthetic phonics creates more consistency in ability throughout a classroom and allows fewer numbers of low achievers. The third interpretation is that children who are generally more 'clever', i.e., have more sophisticated cognitive skills and strategies are better at reading, thus showing greater coherence among skills. The only way to discount any of these interpretations would be to examine these relationships in reception year children before they have received any formal reading instruction, and then again later following these different types of reading instruction. This was investigated in the following chapter (Chapter 10) through pre-testing children on a variety of reading-related and cognitive skills prior to reading instruction, and then following different reading programmes to

examine the role of memory span and other cognitive processes in these different types of instruction.

As predicted, vocabulary and nonword reading correlated highly with both word reading and comprehension. Whilst vocabulary correlated more strongly with comprehension, and nonword reading with word reading, these differences were not significant, but were in the direction that would be expected. This study therefore reinforces the importance of both these skills for later reading ability and is consistent with other studies which have found close associations between reading ability and vocabulary (Nation & Snowling, 2004; Ricketts, 2007; Stanovich et al., 1984b) and nonword reading (Ellis & Large, 1988; Siegel & Ryan, 1988; Stanovich et al., 1984b). When correlations were split by reading programme, there were relatively large (but not significant) differences between the groups in the associations between vocabulary and nonword reading and reading comprehension. Interestingly, synthetic phonics children showed closer associations between vocabulary and reading comprehension, whilst National Literacy Strategy taught children showed closer associations between nonword reading and comprehension. As synthetic phonics children generally have good nonword reading skill and less variation in ability (see Table 9.1 for means and standard deviations), although they have good reading comprehension, their vocabulary is perhaps limiting the extent to how good their reading comprehension could be, rather than their good phonological reading skill. Indeed, their phonological skill seems to be providing them with an advantage in word reading. Likewise, although National Literacy Strategy taught children have poorer vocabulary knowledge, they also have poorer nonword reading and greater variation in ability (as indicated by standard deviations), therefore their phonological reading skill may be placing more limits upon

their comprehension. This would explain the pattern of results found in the strength of the correlations.

Whilst there were no effects of reading programme on cognitive processes, there were differences in the relationship between skills used/required for reading. In particular, for those taught by National Literacy Strategy guidelines, the children with better reading tended to have better attention, suggesting a close relationship between the two. Attention can be divided into two categories; focused or divided. The former requires an individual to focus on one source of information and exclude others, whilst the latter requires the individual to share time between two or more sources of information (Pashler, 1998). The tests used in the current study measured focused attention, which was also the type of attention required in the reading tests (both word reading and comprehension). Attention is a voluntary activity and its role in reading is to provide an appropriate level of concentration so that something can be read and understood to the best of a child's ability. The results linking the relationship between attention and reading are similar to those found previously in younger children, where training in attention skills were found to boost performance in reading and reading related skills (Yeh, 2003). Also, Dally (2006) found significant negative associations between inattentiveness (as rated by teachers) and word recognition ($r = -.56$) and reading comprehension ($r = -.50$) in the first grade, and in the second grade (word recognition, $r = -.40$ and reading comprehension, $r = -.52$). However the current study indicates that in older children, the role between the two may be mediated by the way in which a child is taught.

The current study found that the strength of the relationship between phonological reading ability (nonword reading) and reading was similar to that between simultaneous

and successive processes and reading. However, there was a reading component to the simultaneous and successive skills (albeit very simple and repetitive), and this may have strengthened their relationship with reading ability. Further research could eliminate this reading component through individual testing sessions. This was not possible for the current study, where tests needed to be group administered because of constraints imposed by the schools, and the only way to measure these skills was for each child to work individually through the questions themselves (differences in pace meant they had to read themselves). However, this reading component needs to be acknowledged and changes made in future to eliminate this factor.

In addition, Das et al., (2000) argued that theoretically, simultaneous processing should be more closely associated with reading comprehension, as it is necessary for integrating information into a whole in order to understand what has been read, whereas successive processing should be more closely associated word reading, as it is necessary for coding information in a serial order for processing, i.e. recoding the letter-sound string to read. The results of this study suggest that both simultaneous and successive processes are highly associated with word reading and comprehension (although successive processes were more highly related to word reading this difference was not significant). However, again the reading component needs to be removed from these tests in order to make any firm conclusions.

One surprising result from this study is that children taught to read by the National Literacy Strategy approach showed closer associations between successive processing (and memory span) and reading skill than those taught by synthetic phonics, however this may be due to the greater variability in the National Literacy Strategy children's memory span scores. The narrower range of scores in the synthetic phonics group may

have led to non significant results. Further research is warranted in order to investigate this relationship further. In particular, it would be beneficial to examine this relationship at different age groups to investigate the relative importance of this skill as children progress through school. A study comparing a systematic synthetic phonics school versus a National Literacy Strategy analytic phonics school and investigating the cognitive skills associated with reading at each grade would be of interest and educational importance, as teaching could be structured around developing those underlying skills related to reading into the literacy programme. Due to current changes in the literacy programme in England, with the introduction of synthetic phonics as opposed to analytic phonics, there is a small window of opportunity in which to carry out such a study.

The two reading programmes compared in this study have different approaches to teaching reading, however they are not at opposite ends of the spectrum, as the only difference between them is the way in which phonics is taught, and the emphasis placed on phonics as a strategy for reading unfamiliar words. It would be interesting to investigate the effect of reading programme on cognitive processes with children taught to read by two very different approaches, for example, a very systematic phonics method compared to a whole word/language based approach (similar to the book experience approach used in New Zealand; Johnston & Thompson, 1989; Thompson, 1987). This may uncover some differences in cognitive processes, particularly for simultaneous and successive skills, which, as highlighted in the introduction, could be strengthened indirectly through practice and training received during the teaching of reading and later reading strategies.

This area of research offers great potential for future studies, as it is an area which has previously been neglected but is important in order to understand whether the effects of reading instruction develop skills they are not necessarily focusing on. The current study has found that this may be the case with memory span, as those children taught to read in a way which focuses on sounding and blending sequentially for reading have better memory spans, however this result needs to be replicated in a group of children matched on vocabulary and reading skills. Another interesting avenue of research would be to examine how different types of reading instruction may foster different associations between skills required at different age groups/stages of reading development.

Conclusions

Whilst synthetic phonics taught children had better vocabulary, reading skill and nonword reading, there were no differences in any measures of cognitive processing skills, with the exception of one; memory span. This may have been a result on the way in which they were taught to read; sequential sounding and blending for reading. After controlling for memory span and phonological reading skill there were no differences between the groups word reading scores, however there were still differences in comprehension and vocabulary, suggesting that synthetic phonics' memory span and phonological reading skill may have been benefiting their word reading in particular. It is concluded that further research is required, particularly to match the groups on vocabulary, in order to make more firm conclusions regarding the effects of reading programme on developing cognitive skills.

CHAPTER 10: COGNITIVE PROCESSES

EFFECT OF READING PROGRAMME (EARLY INTERVENTION)

Introduction

There is considerable debate regarding how reading should be taught to children when they start school and the important skills necessary for reading to develop. There are many different factors which will determine a child's success in school, however if they are able to read well, this will be of enormous benefit in all other areas of school, as most subjects draw upon reading skills to some extent. It is crucial that children are taught to read in a way which will maximise their chances of success in reading, this is particularly true for those children at risk of reading problems later in school. In addition to the importance of reading instruction in the early years, it is essential to take into account the influence of other factors which can affect a child's success in school.

The influence of home environment and preschool

When arriving at school, there is often substantial variation amongst children with regards to the skills already acquired which are beneficial for reading, as there are multiple sources of influence on children before they even start school. Prior to school, children will have had varied experiences within their home environment; there will be differences in terms of learning materials at home, language stimulation, preparation for school and parent attention and support, and it is likely that whatever literacy experiences children have will benefit them for starting school. Foy & Mann (2003)

found that a home literacy environment in which children have exposure to reading related media, in which parents are actively involved in children's literature, and which has a focus on teaching, is directly and indirectly (through letter and vocabulary knowledge) associated with phoneme and rhyme awareness. In addition, Stevenson & Newman (1986) found that a number of pre-kindergarten tests (naming letters, paired associates, reversals and category naming) were very highly associated with word reading and comprehension later in school (Grade 5 & 10). Very high correlations between these pre-kindergarten measures and later reading were found with Grade 5 word reading ($r = .61$) and comprehension ($r = 0.60$), and Grade 10 comprehension (0.61). The variation in pre-school literacy experiences has been highlighted by Teale (1986, cited in Adams, 1990, p. 89) who visited twenty four preschoolers homes (in low income areas) and found that there was huge variation regarding the amount and type of literacy activities that children experienced in their homes. For example, in some homes children received more than 20 minutes of storybook time a day, in other homes it averaged at less than 20 minutes per month. The differences in accumulated time that children will have spent in literacy activities will be vast (e.g. in one year alone a child read to for 20 minutes a day will have received 109 hours of reading, in comparison to just over 3 ½ hours if a child receives on average 20 minutes a month). If this is multiplied by the number of years before children start school, this difference is huge. Moreover, those children who are read to more frequently are possibly taking part in a wider range of literacy activities in the home. When arriving at school, teachers will have an impossible task to try to make up these differences in order to help those children with less experience catch up with their more experienced peers. Adams (1990) argued that the likelihood that a child will succeed in the first grade depends most of all on how much he or she has already learned before reaching school.

In preschool/nursery, there will be differences in terms of teachers' skills and support, learning materials and facilities, preparation for school and activity choices available. Indeed, research has found that high quality preschool/nursery experiences lead to stronger academic outcomes, particularly in children at risk for academic underachievement (Campbell, Pungello, Miller-Johnston, Burchinal & Ramey, 2001). Other studies have noted huge variation across and within preschool classrooms in the amount and type of language used and literacy learning opportunities offered to children (McDonald-Connor, Morrison & Slominski, 2006). McDonald et al. (2006) noted that whilst one class spent ninety minutes in language and literacy activities (including play), another class spent only four minutes, and that children within the classroom at the same time were experiencing different learning opportunities. In addition, Scanlon & Vellutino (1996) found great variation amongst the percentage of time teachers devote to various activities during the kindergarten day. It is important therefore to account for the differences that preschool experiences may have had on children when they first start school.

McDonald-Connor et al. (2005) examined a large variety of sources of influence on students learning in the first year of school. These included teacher variables (qualifications, practices warmth/responsiveness), classroom environment, class size, socioeconomic status (SES, as measured by income and mothers education), child variables (vocabulary, word identification/recognition, phonological decoding, language skills), home learning environment and preschool literacy environment. It was found that language, word identification/recognition, home learning environment and family SES accounted for most variability in vocabulary and early reading skills at the end of the first grade. However it was a child's home learning environment and SES which had the greatest unique effects on their first-grade outcomes. However, if SES, home

and preschool factors were taken into account, classroom practices uniquely predicted children's vocabulary and word recognition skills in the first grade underlining the importance of these factors also. The importance of SES has also been discussed by McLoyd (1990) who argued that children from lower income families who live in lower income communities are at much greater risk for academic underachievement than those living in higher income families and communities. However, White (1982) carried out a meta-analysis with 101 studies examining the relationship between socio-economic status and academic achievement, and found large variation in the strength of the association between the two measures, depending on the definition of SES (income/education/occupation versus family characteristics) and the unit of analysis (individual versus aggregated) used. He stated that as SES is typically defined (income/education/occupation and individual units of analysis), SES is only weakly correlated with academic achievement ($r = 0.22$). However, by using aggregated test scores, this association appears much stronger ($r = 0.73$), additionally, incorrectly using family characteristics (e.g., home atmosphere) as the measure of SES, strengthens the association with individual academic achievement ($r = 0.55$). This highlights the variation in strengths of associations which may be found based on ways of measurement.

Finally, Cameron, McDonald-Connor, Morrison & Jewkes (2007) also point out the importance of establishing rules and routines early in school through spending more time on organisational activities (i.e., explaining the purpose of activities and how to complete them successfully), but then sharply decreasing this instruction. This had been found to lead to significantly better academic outcomes (word reading skill), compared to classrooms with little initial organisation, as children are more likely to

take ownership over their own learning and have the knowledge to work more independently.

Early teaching of reading.

There are a variety of different ways to introduce children to reading, and to teach early reading skills. The teaching of initial reading can range from introducing children to reading words at a whole word level, or through the smallest unit level (the grapheme). As previously discussed there is often substantial variation in teacher practice, both in terms of the emphasis put on certain skills for reading to develop, and the type of skills that are taught. Those teachers initially using a whole word approach do not draw children's attention to the alphabetic principle underlying the English language, but rather words are taught as visual wholes. Teachers will often use flash cards with the word written on, or may point out these words in a big book, drawing attention to the word within the sentence. However, a more phonological approach teaches children that words are made up of individual sounds, and children are taught to read via phonics, a method which focuses on letter sound relationships. To teach using phonics, letter sound correspondences are taught to children, who are then taught to break words down into their constituent sounds (analytic phonics), or instructed to sound and blend the sounds to read the word (synthetic phonics).

Analytic and Synthetic Phonics in initial reading instruction

Analytic phonics is the teaching of letter sounds and blending after reading has already begun. Indeed, children will likely have already been taught to read some words via a whole word approach before phonics begins. In analytic phonics, children's attention is first brought to initial letter sounds, with alliterative strategies used to draw attention to

common letter sounds (e.g., man, mouse, milk, mother). Following this, children's attention is brought to final sounds, followed by middle sounds. At this stage children may be taught to sound and blend. Analytic phonics also introduces children to word families (e.g., came, same, game), which can be likened on some cases to onset-rime teaching, and irregular high frequency words are taught as visual wholes. Therefore this method is not totally focused on phoneme level teaching, as some teaching of whole words will be carried out and word-families teaching may draw children's attention to rimes.

Synthetic phonics teaches letter sounds at a much faster rate and before reading has begun. Children are taught to sound out each letter sequentially and then blend the phonemes to read the word. This technique of sounding and blending is advocated for reading all words, and no onset-rime or whole word teaching is carried out. With high frequency irregular words, attention is brought to the more regular parts of the irregular words, where letter sounds are a guide to pronunciation. Synthetic phonics teaches at the level of the smallest sound unit (phoneme) and does not use rhyme to teach common endings. To reiterate, synthetic phonics advocates sounding and blending phonemes sequentially, from left to right, early on, for the reading of most words. See Chapter 2 for a more comprehensive overview of both types of reading instruction.

One large-scale study which compared the effectiveness of analytic and synthetic phonics when children first started school found that children taught to read by synthetic phonics read and spelt better than those taught by analytic phonics (Johnston & Watson, 2004a). In addition, they had better phonemic awareness, which would likely provide them with an advantage for later reading due to its importance in reading. See Chapter 2 for more details of this study.

Evans & Carr (1985) compared a phonics taught group of children with a language orientated group (where children learn to read at their own rate and own style). It was found that a basic reading level was less universally acquired in the language experience group. Interestingly, there was greater coherence in the correlations between information processing (i.e., visual analysis, short-term memory, non-verbal reasoning, visual-motor-integration), language and reading achievement for performance in the phonics group compared to the language-orientated group. This implied that the phonics classes were drawing more upon these cognitive skills for reading. This was evident in higher reading scores in the phonics group, a smaller variation about the mean and greater tendency of different cognitive abilities and skills to vary together.

For thirty years word recognition has generally been considered as a modular system that does not draw on skills outside the reading system. This is largely due to theorising about skilled adult reading on the one hand, and the emphasis on the role of phoneme awareness in learning to read on the other hand. However, when children are first exposed to print, it is likely that they will use the skills they have developed in other domains to scaffold their first attempts to recognise words. There have been some attempts to look at the associations between developing word reading skill and cognitive skills, many of the latter featuring in measures of intelligence.

Intelligence

Research carried out into early reading tends to focus more on reading-related skills (i.e., letter knowledge, phonemic awareness and rhyme awareness) at the expense of general intellectual abilities. Earlier studies have indicated that IQ is a weaker predictor of early reading development compared to phonological awareness or letter knowledge (Dally,

2006; Stanovich & Siegel, 1994; Vellutino et al., 2000; Stanovich et al., 1984a; 1984b). In addition, phonemic awareness has been shown to be relatively independent of general intelligence, general language ability and verbal memory (Ellis & Large, 1987, Wagner & Torgesen, 1987). The concept of intelligence is incredibly broad and can be used to encapsulate a whole range of skills and abilities. Whilst some skills may bear some relation to academic achievement (e.g., memory span, speed of processing), others are advantageous in other areas of life (e.g., the concept of emotional intelligence). Within reading research, it is often the same areas of intelligence or abilities that are considered, as success in these skills often provide some advantage for reading. Vocabulary is often measured, as it is argued to set the limits for our understanding and comprehension of reading. As previously mentioned, it has been shown that over and above phonological skills, vocabulary and language skills contribute to reading development (Nation & Snowling, 2004). In addition, memory span (measured by digit or word span) has been found to be associated with reading ability. A study investigating kindergarten reading readiness scores found that auditory memory (recall of sequence of words in a sentence) accounted for unique variability in reading achievement in fourth grade (Kurdek & Sinclair, 2001). In addition, Johnston, Rugg & Scott, (1987) found that memory span was highly correlated with poor readers' reading ability, but not their IQ. Finally, visual discrimination is important, particularly in the early stages of learning to read (Carr, 1981), in order to make fine discriminations between similar looking letters (e.g., b versus d, p versus q). Evans, Bell, Shaw, Moretti & Page (2006) found that visual-perceptual ability correlated significantly with word reading, and that letters with unique visual properties were more likely to be remembered by children (e.g., X and O). Whereas, Stuart et al. (2000) found that children with poor phonological skills rely heavily on visual memory, highlighting that the importance of visual skills in reading may depend based on other skills that children already possess.

Whilst IQ has been found to be a weaker predictor of early reading development compared to phonological awareness or letter knowledge (Dally, 2006; Scanlon & Vellutino, 1996; Stanovich & Siegel, 1994; Vellutino et al., 2000; Stanovich et al., 1984a; 1984b), it is of interest whether (and which) skills related to IQ can account for significant variance in reading after reading-related abilities have been accounted for. The purpose of the following section is to review some studies which have included a range of reading-related and IQ measures and examine the contribution of these skills to early reading development.

Scanlon & Vellutino (1996) carried out a large scale study ($n = 1,407$) using an extensive battery of tests in kindergarten (whilst children were in the first half of the year) and then again during first grade. The test battery included a) pre-reading and rudimentary reading measures, b) rudimentary maths measures, c) linguistic tasks, d) memory and visual-auditory learning tasks, e) conceptual development tasks and f) executive function tasks. All schools advocated a whole language approach to teaching and were located in communities which were middle to upper middle class. Of all tasks included, kindergarten letter and number identification, word identification and phoneme segmentation had the strongest correlations with first grade reading measures. Stepwise regression analysis revealed that when each group of predictor variables (i.e. a, b or c) were used to predict reading performance at the end of first grade, pre-reading accounted for the largest proportion, explaining 41% of the variance (letter identification accounting for the largest proportion by explaining 35% of the variance). Maths measures explained 34.1%, the largest proportion from number identification which explained 31.4% of the variance. Linguistic abilities explained 26.3%, of which the largest proportion came from phoneme segmentation (18.5%). Memory explained 23.9% (of which 14.9% was explained by visual auditory learning and 9% was

explained by verbal memory). Conceptual development explained 17%, visual processing 11% and executive function tasks 9%. A final analysis showed that when all variables were entered into the analysis, a total of 49% of variance in first grade reading was explained, most of which was by rudimentary reading skills, but in particular letter identification, after which very little additional variance was accounted for. This study therefore would argue that in beginning readers, reading-related skills account for most variance, the contribution of other skills being negligible.

Prior to this, Butler, Marsh, Sheppard & Sheppard (1985) tested children on a wide range of skills prior to school and found that these loaded onto six different factors; psycholinguistic abilities, figure drawing, language, rhythm, perceptual motor skills and spatial/form perception. In addition, IQ tests formed a separate IQ measure (however these tests did require a large component of English usage; Peabody Picture Vocabulary Test and the Slosson Intelligence Test). Reading achievement was measured in Grades 1, 2, 3 and 6 and regression analysis for each age group revealed that overall, language, psycholinguistic abilities then spatial/form perception accounted for most variance in reading achievement throughout these years (IQ was not entered into the regression analysis). However, the pattern of associations changed throughout the different levels of reading development. In Grade 1, psycholinguistic abilities correlated more highly with reading, followed by language skills, however in Grade 2, language skills followed by spatial/form perception were most highly correlated with reading. All six sets of predictors became more closely associated as children got older, this is possibly due to mutual facilitation (as previously proposed by Guthrie, 1973) and has been found in other studies (see below).

Stanovich et al. (1984b) tested first, third and fifth grade children on measures of general intelligence (Raven's Progressive Matrices and Peabody Picture Vocabulary Test), decoding speed (speed of nonword reading and word reading), phonological awareness (phoneme deletion and phoneme oddity) and listening comprehension, and used these variables to predict concurrent reading ability and also investigate the strength of associations between these tests and reading. For first grade children, speed of nonword reading correlated most highly with reading, followed by phonological awareness, speed of word reading, listening comprehension, vocabulary and finally performance on Raven's Progressive Matrices. All correlations were significant. However, when reading related tests (decoding and phonological awareness) were entered first into a regression analysis, listening comprehension and general intelligence contributed no extra variance to reading. However, decoding skill contributed significant extra variance even when entered last. The aim of the study was to test the idea that general intelligence is strongly related to reading once differences in decoding ability have been accounted for, however this was not supported. One important observation was that the interrelationships between the tasks increased with age (higher correlations were found in third then fifth grade) consistent with the previous study.

This was also found by Ellis & Large (1988) who examined the pattern of association between skills at age 5, 6, and 7 and found that the nature of reading skill changes rapidly throughout the first three years of acquisition. In the earlier stages of learning to read, very specific variables were found to be beneficial for reading, such as letter knowledge, but later reading development drew upon a wider range of skills for reading and closer associations were found between intelligence, reading related tasks and reading. It is important to note that it is not only the skills used for reading that change but also the process of reading, usually developing from a visual whole word approach

to a gradual and then more extensive use of letter sound information for reading. Therefore the changing nature of the associations between the tasks will be due in part to the different strategies the child uses for reading. Figure 1 summarises those skills found to be contributors and beneficiaries of reading at four different stages of reading development.

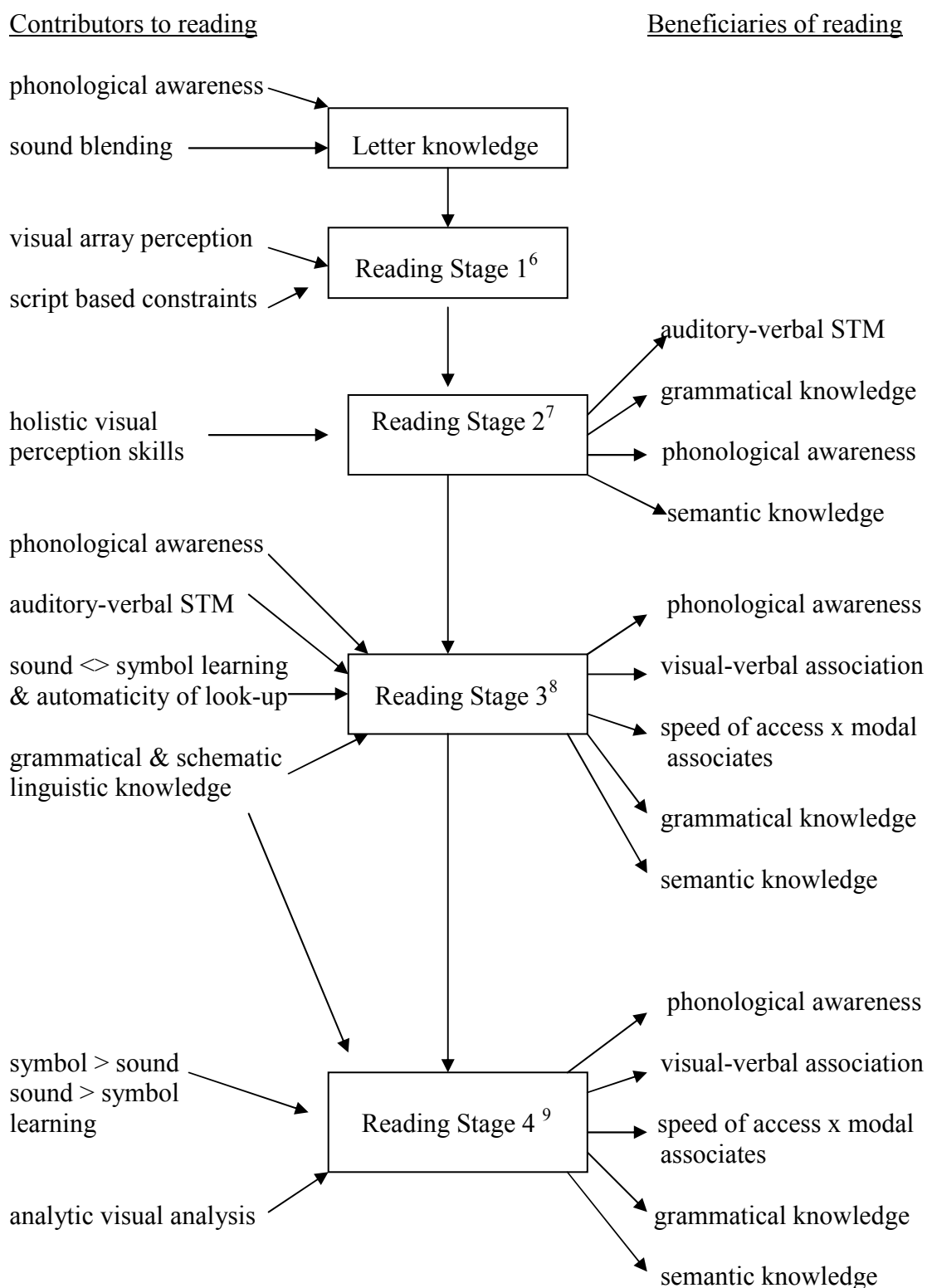


Fig 10.1: The developmental stages of reading skill (Ellis & Large, 1988), p. 70).

⁶ Corresponds to children who could read no words at aged 5

⁷ Whole word approach to reading which can be likened to Frith's logographic phase (Frith, 1985).

⁸ Children apply letter-sound correspondence rules for reading, likened to Frith's (1985) alphabetic phase.

⁹ Use of letter-sound rules is more extensive and child learns more complex rules of orthographic structure, likened to Frith's orthographic stage (Frith, 1985)

Finally, Parrilla et al. (2004) measured letter recognition, phonological awareness (sound isolation and blending phonemes), naming speed, articulation rate and verbal short term memory (word memory span) in kindergarten and Grade 1 and examined the strength of the associations with these skills and Grade 1, 2 and 3 word identification and passage comprehension skills. It was found that kindergarten and Grade 1 measures of letter recognition, phonological awareness and naming speed emerged as more closely associated with word reading and passage comprehension than verbal short term memory. When these variables were entered into a regression analysis (with the exception of letter recognition), both phonological awareness and naming speed accounted for significant unique variance in Grade 1-3 word identification and passage comprehension, however verbal short term memory did not explain any significant variance in either of the reading measures at any Grade level.

The studies reviewed are relatively conclusive that the initial acquisition of reading (i.e., in kindergarten and Grade 1) is strongly reliant on reading-related skills (i.e., letter knowledge and phonological awareness), with the predictive value of other skills being negligible. However, the idea that the associations between these skills change as children develop different strategies for reading and become more fluent readers is an interesting concept, and it is possible that the way in which a child is taught to read may alter the associations and predictive value of these skills as they develop different strategies for reading. Indeed, in the previous study, synthetic phonics appeared to boost children's memory spans and lead to more consistency in this ability.

Indeed, type of reading instruction is found to be important when examining intelligence measures, as the two have been found to interact, with those children scoring poorer on measures of general intelligence (memory, form perception, verbal

understanding) benefiting more from a reading programme which teaches phoneme awareness compared to children with average or high intelligence (Lie, 1991), both in terms of later reading and spelling.

The measures of intelligence discussed in this section are those commonly used to measure intelligence, however many of these have been criticised on the basis that achievement on these some of these tests focuses on content rather than the processes used to achieve the results (Naglieri, 1999; Naglieri & Das, 1990). Indeed, children can achieve the same results on the same test by using different techniques and strategies to do so, therefore there has been a drive towards using process-based assessment to understand underlying cognitive processes and how these relate to achievement, as seen in the previous two chapters. As before, in the current study, the PASS theory was used to investigate underlying cognitive processes. A short review of this theory will be given again in order to recap on some important details.

PASS model of reading

Whilst planning, attention, simultaneous and successive cognitive processes have been linked to reading ability (Naglieri & Das, 1990), simultaneous and successive processes in particular, have been linked to word reading and comprehension (Das and colleagues, 1994a; 1994b; 1995 and Kirby and colleagues, 1977; 1987; 1996). Simultaneous processing allows one to integrate information into a single whole to make sense of it (important in reading comprehension). However, successive processing allows one to work with information in a specific serial order, therefore perceive letters or sounds in sequence which is important for word reading, particularly when taught via phonics. The importance of these skills is useful to consider as they may explain variability in

children's reading ability over and above those skills known to be important in reading (i.e., letter knowledge, vocabulary and phonological awareness), although standard measures of IQ have not done so (Scanlon & Vellutino, 1996; Stanovich et al., 1984b).

By understanding children's weaknesses in processing skills it is possible to create individual specific remediation programmes to improve these skills, which may help towards better reading. Martinussen et al. (1998) examined the effects of instructing at-risk kindergarten children (those with poor successive and phonological processing) in successive-phonological training or meaning-orientated teaching. Both groups received letter sound instruction (5 minutes per session), however whilst the successive-phonological training group received successive training both with and without the context of letters (10 minutes per session) and book reading with a focus on letters and sounds (5 minutes), the meaning-orientated group listened to a story (10 minutes) and took part in literature response activities (5 minutes). Children who received successive-phonological training obtained significantly higher scores in phonological analysis measure and more children attained basic reading skills (although this number was very small, $n = 3/13$ compared to $0/15$ in the meaning-orientated group). This study demonstrates very modest success in improving reading using successive processing skills, however a follow up study at a later date, when the children had had more teaching may have found greater effects. Children were followed up after only 8 weeks of teaching (with two to three 20 minute sessions per week), highlighting the possibility of post-testing too early on, when children are still at a very early stage of learning letter sounds. This study is relevant to the current study as it was carried out with kindergarten children and involved teaching successive skills in the context of reading.

Importance of early reading instruction and intervention studies

Research into early reading instruction is important as it is vital that children receive the best possible instruction, starting from when they first enter school. Research which has examined how predictive the initial progress children make in school have shown varied results. One study found that children who were poor readers at the end of first grade had a .88 probability of remaining a poor reader at the end of fourth grade; however, if the child was an average reader at the end of their first grade, there was only a .12 probability that they would be a poor reader at the end of fourth grade (Juel, 1988). Butler et al. (1985) carried out a seven year longitudinal study, and measured reading ability in Grades 1, 2, 3, & 6 and found that prior reading ability was highly associated with later reading at each stage (from Grade 1 - 2, $r = 0.50$, from Grade 2 - 3, $r = 0.69$ and from Grade 3 - 6, $r = 0.78$). Indeed Butler et al. (1985, p. 359) stated that in their study “students who were the poorest readers in the early years of primary school remained the poorest readers during all 6 primary school years, and nothing in their school experience altered this situation”. This is a very disconcerting observation. However another study which compared reading achievement from first to sixth grade argued that reading ability categories were far more changeable than had previously been argued. Philips, Norris, Osmond & Maynard, (2002) found that there were relatively high probabilities that children who were below average readers in first grade could be average by sixth grade (.53), and that those who were average in first grade could be above average by sixth grade (.48). Whilst these results are encouraging, it is still vital that children receive the best quality of literacy instruction at the start, to stand them in good stead for later years, as for many children, success in the first year of school is often the benchmark for later reading ability.

Intervention studies are a valuable approach for evaluating the success of a particular method of reading instruction against another method. Whilst comparisons can be made between different types of reading instruction used in different schools, there will always be factors such as teacher variables, school variables, classroom environment and socioeconomic status which cannot be completely controlled for apart from in intervention studies. Previous research has shown that these factors may account for considerable variation in results which are not due solely to the effect of reading instruction (McDonald-Connor et al., 2005; McLoyd, 1990; White, 1982)

Whilst previous studies have found that a synthetic phonics method of teaching produces children with better reading ability and fewer underachievers (Johnston & Watson, 2004a; 2004b; Watson & Johnston, 1998), it would be of interest to examine whether synthetic phonics alters the cognitive skills associated with reading through its strong focus on sounding and blending in sequence for reading. Indeed, in the previous study, children taught to read by synthetic phonics had better memory spans and were more consistent in this ability than those taught by National Literacy Strategy guidelines who showed great variation in memory span skills. Teaching children to sequentially blend letter sound sequences to read words is likely not only to change how children recognise words, but also to change the cognitive substrate underpinning the approach they take to word recognition. Indeed, Stuart et al. (2000) found that children use different strategies for recognising words which require different cognitive skills, and that this depends on the actual skills they possess.

The purpose of the current study was to investigate the effect of reading programme on children's cognitive processing skills and reading development in their first half year of school. As previously mentioned, children often arrive at school with a mixed range of

abilities, due to differences in their home environment and experiences at preschool or nursery. Whilst it was not possible to control for these variables, all children were tested as soon as they started school and prior to any reading instruction. Children were tested on a number of standardised intelligence tests to measure intellectual ability (vocabulary, memory span, visual discrimination and visual-spatial abilities), in addition to tests related to skills important for reading to develop (letter knowledge, rhyming skills, phoneme awareness and word reading). Finally, children were also tested on cognitive abilities which have been found to be related to reading skills (simultaneous and successive processes).

By carrying out pre-tests it was possible reduce the effect of uncontrolled variables which may impact on or interfere with the effects of reading instruction, and to check that neither group was at an advantage over the other prior to reading programme. If there were differences in intellectual ability or reading skills, these could be controlled for statistically using the pre-test scores. In addition, the intervention was carried out to eliminate the effects of teacher, school or socioeconomic status.

Hypotheses

It was predicted that children who learn to read by a method heavily reliant on serial processing (synthetic phonics) will show an association between their word reading skills and successive/serial order memory tasks.

It was predicted that those who are taught to read initially by a more whole word approach (National Literacy Strategy programme) will show an association between word reading skills and visual skills.

In addition, it was predicted that after the intervention, those taught to read by a synthetic phonics approach would have better word reading skills and better phonemic awareness skills than those taught by analytic phonics.

Finally, due to results from an earlier study (see Chapter 9), it was predicted that children taught to read by synthetic phonics would perform better on tests measuring successive processes (including memory span measures).

Method

Participants

Thirty seven children took part in this study. Nineteen children (10 boys) were taught to read by the National Literacy Strategy programme, and eighteen children (8 boys) were taught to read by synthetic phonics. The children were from 2 different intakes, but had the same teacher in the same classroom. The normal class method was the National Literacy Strategy programme 'Progression in Phonics', which was basically an analytic phonics programme. In the subsequent year, the teacher adapted a synthetic phonics programme following new Government guidelines. This school was in an area of severe deprivation (0.5 on a scale where 0.7 is the most deprived and where 47.4% of children were entitled to free school meals).

All children were pre-tested during their second week of school, prior to any literacy teaching. They were then post-tested following 18 weeks of teaching. See Tables 10.2 and 10.3 for means and standard deviations. Although letter learning is more rapid in synthetic phonics, by the time of post-testing, the National Literacy Strategy taught children had similarly learnt all 26 letter sounds and also some consonant digraphs and vowel digraphs.

Table 10.1. Letter sounds taught to analytic and synthetic phonics children at time of post- testing.

	Analytic Phonics	Synthetic phonics
Individual letter sounds	All	All
Consonant digraphs	th, sh, ch	th, sh, ch, wh, ph, ng, nk
Consonant-vowel digraphs	qu	qu
Vowel-consonant digraphs	er	ar, er, or
Vowel digraphs	ou	ee, oo, ai, oa, ie, ue

Note: Table 10.1 illustrates the number of letter sounds that both groups had been taught at the time of post testing. Whilst those taught by synthetic phonics had been taught more digraphs at the time of post-testing, the words on the BAS word reading test contained few of the extra digraphs learnt by the synthetic phonics group. In fact, the words in the test that the synthetic phonics children performed better on did not include any of the additional digraphs which they had been taught but the analytic phonics children had not. This is with the exception of one child in the synthetic phonics group who correctly read one word using the vowel digraph ‘oo’ (‘wood’), which would have little impact on mean performance for the group. Therefore the letters needed for the BAS word reading test had equal coverage for both groups at the time of post-testing.

Details of teaching

At the time of post-testing, the teacher was asked to report the amount of time spent teaching literacy in the two conditions (analytic and synthetic phonics), how this time was allocated, and what they had covered throughout the 18 weeks. There were differences in terms of the amount of time spent in literacy activities and how this time was allocated. When the teacher taught using analytic phonics, 7 hours a week were

dedicated to literacy activities, however when using synthetic phonics, children spent 5 hours and 15 minutes in literacy based activities. In the analytic phonics condition, most time was spent on big book and story time activities, whilst in the synthetic phonics condition, most time was spent teaching phonics. In addition, there were differences in the way word reading was taught to children; whilst analytic phonics used flash cards and games for whole word teaching, synthetic phonics focused on sounding and blending for reading. However, at the time of testing, children were being taught how to sound and blend in the National Literacy Strategy group. See Appendix 5 for more information.

Materials

All children completed the following tests:

Letter knowledge

Children were shown an A4 card with letters of the alphabet written in lower case. Each letter was individually presented within a box to set it apart from the other letters. One response was given for each letter, however if children gave the letter name they were asked if they knew the letter sound. Knowledge of letter sounds was scored. Letters were presented in a random order (however all vowels were presented first).

Rhyme Generation

Children were required to generate words which rhymed with a word given by the examiner. The examiner practiced this test beforehand with the child, using the word 'cat', providing examples such as mat, sat, hat, fat and asking the child to think of other words which sound the same. Other practice examples given were 'hot' and 'cow'.

There were 12 items in the test in total. Children received one point for every word they managed to generate a rhyming word for.

Yopp Singer Test of Phonemic Segmentation, (Yopp, 1988)

Children were required to segment words into individual phonemes. Words contained either 2 phonemes (10 trials) or 3 phonemes (12 trials), therefore there were 22 trials in total. Prior to the test, the examiner gave examples using the words 'cat' into k/a/t and 'me' into m/ee. Children received one point for every word segmented completely correctly.

Word Reading tests:

British Ability Scales Word Reading, (Elliott, Murray & Pearson, 1977)

Test A was used. A series of unrelated words of increasing difficulty were presented to the child on a card. The examiner tested the child on these items one by one.

Clay Ready to Read, (Clay, 1979)

A series of words were presented in the centre of a card, one on each line. The examiner tested the child on these items one by one.

Intelligence tests:

British Ability Scales II, (Elliot, Smith & McCulloch, 1996)

Vocabulary knowledge: British Ability Scales II Naming Vocabulary

Children were asked to name a series of pictures presented in a booklet. Pictures were presented one at a time. This test is a measure of expressive language through knowledge of names.

Memory Span: British Ability Scales II Recall of Digits (Forward)

Children were required to repeat a series of digits said by the tester. Digits were said at the rate of two per second, and the number of digits increased as the test proceeded. This test is a measure of short term auditory memory and oral recall of sequences of numbers.

Visual discrimination: British Ability Scales II Matching Letter Like Forms

Children were required to find an identical match to an abstract figure from a choice of six options. The five distracters represented rotations or reversals of the original figure. This test is a measure of visual discrimination among similar shapes.

Non-verbal and spatial visualisation: British Ability Scales II Pattern Construction

Children were timed on their ability to accurately construct a pattern to match a pattern presented in the test booklet. This test is a measure of non-verbal and spatial visualization in reproducing designs with coloured blocks.

PASS Cognitive Processes

Tests measuring simultaneous and successive processing were devised for the appropriate age group. Both the simultaneous and successive tests were composed of two parts (a & b). See Appendix 4 for these tests.

Simultaneous

Part a - embedded figures task

In this task, the child was asked to identify a triangle embedded within various other shapes. The size and orientation of the triangle varied across each group of shapes. A practice session (2 trials) was carried out prior to the task to ensure the child understood the nature of the task. Children were timed on their speed to find the triangle on 17 trials. The task was made relatively easy so that children would be able to find all the triangles, therefore it was only speed and not accuracy that was measured.

Part b - shape relation task

In this task, the child was tested on their ability to understand the relationship between shapes; whether a shape was presented in front of or behind another shape. Different combinations of a circle, square and triangle were presented to the child in different positions and the examiner asked questions such as 'Which picture shows a square in front of a circle?' The child had to choose between two or three different options, and only their first response was accepted. Initially, the child practiced this test with the examiner present (2 trials), to ensure they understood it. The test was marked based on the number of correct responses (10 trials).

Successive

Part a - word order task

In this task, the child was asked to repeat a series of words in the same order as they were said by the examiner (i.e., a serial order recall task). This test consisted of 6 one-

syllable high frequency words; bed, cat, dog, fox, man & school. An ascending staircase procedure was used and each series of words read to the child ranged in length from 2 to 5 words (the same word never appeared twice in a sequence). In total there were 11 trials; two trials (2 words), three trials (3 words), three trials (4 words) and three trials (5 words). Words were presented at the rate of two per second. The child was asked to listen to the whole sequence of words and then repeat them after in the same order. The child was told that the order was very important. Initially, the child practiced this test with the examiner present (2 trials) to ensure they understood it. The words used were chosen as a result of their high frequency, as indicated by the Children's Printed Word Database (Masterson et al., 2002). Each of the following values indicates the words frequency per million across a large range of reading schemes for children aged 5 - 9; bed (771), cat (1187), dog (1052), fox (919), man (1439) & school (1393). In addition, the words were easy to distinguish from each other aurally, were easy to pronounce and were likely to be within the scope of the child's vocabulary.

Part b - sentence repetition task.

In this task, children were asked to repeat a number of nonsense sentences said by the examiner. An ascending staircase procedure was used as sentences increased in length with duration of the test. The sentences had no semantic meaning and were about the relationships between colours. Initially, the child practiced this test (2 trials), to ensure they understood it. The test consisted of 13 trials; 5 trials (2 target words), 5 trials (3 target words) and three trials (5 target words)

Procedure

All tests were carried out individually in the child's school with only the child and tester present. Where applicable, tests were carried out in accordance with manual instructions. All tests were carried out at pre and post testing (with the exception of pattern construction which was only carried out during the pre-tests due to time constraints in post-testing). All children took part in three testing sessions (never on the same day), each session lasting approximately 15 minutes. In the first session children were tested on letter knowledge, rhyming skills, phoneme segmentation and word reading (BAS and Clay). In the second testing session children were tested on BAS II intelligence tests (naming vocabulary, recall of digits, matching letter-like forms and pattern construction). In the final testing session children were tested on tasks measuring simultaneous and successive processes (embedded figures, shape relation, word order and sentence repetition tasks).

Results

The results section will be sub-divided into three different areas of analysis; 1) reading programme differences at pre and post-testing, 2) the effect of reading programme on the strength of the associations between reading and reading related skills and 3) regression analyses; the effect of reading programme.

1) *Effect of reading programme on reading related skills: pre and post-tests*

Table 10.2. *Analytic and Synthetic Phonics taught children prior to reading instruction.*

	Analytic Phonics		Synthetic Phonics	
	(n= 19)		(n = 18)	
	Mean	S.D.	Mean	S.D
Chronological Age	4.85	0.21	4.96	0.10
Reading skills				
Clay Reading (%)	0.38	1.64	0.00	0.00
BAS Reading (age)	4.95	0.23	4.90	0.00
Reading related skills				
Letter knowledge (sounds)	3.63	5.68	3.44	5.46
Phoneme Aware. (%)	0.00	0.00	0.00	0.00
Rhyme Generation (%)	4.75	6.25	1.40	4.25
Intelligence test scores				
BAS Vocabulary ¹⁰ (age)	4.82	1.24	4.13	0.96
BAS Digit Span ¹¹ (age)	4.51	1.14	4.46	1.09
BAS Match Forms ¹² (age)	4.82	0.91	4.07	0.46
BAS Pattern Cons ¹³ (age)	4.79	0.76	4.82	0.44
PASS (raw scores)				
Simultaneous (a & b)	66.26	20.33	58.89	21.43
Successive (a & b)	44.05	13.90	47.71	11.53

¹⁰ Vocabulary: measure of vocabulary knowledge

¹¹ Digit Span: measure of memory span

¹² Matching Letter-like Forms: measure of visual discrimination

¹³ Patter Construction: measure of non-verbal and spatial visualisation

Note. All ages are in decimal places. A basal score of 4.9 is given to children on the BAS reading who score 0. The BAS reading age starts at 5.0 (child must read 3 words to score this).

At pre-test there were few differences between the groups. There was a significant difference in chronological age, with synthetic phonic taught children being slightly older; $F(1, 34) = 4.29, p > .05$ (partial eta squared effect size 0.11). In addition, the children in the analytic phonics group had significantly better visual discrimination, $F(1, 34) = 8.87, p = .005$ (effect size 0.21). All other comparisons were non-significant.

Table 10.3. *Analytic and Synthetic Phonics taught children after reading instruction.*

	Analytic Phonics		Synthetic Phonics	
	(n= 19)		(n = 18)	
	Mean	S.D.	Mean	S.D
Chronological Age	5.39	0.10	5.38	0.10
Reading skills				
Clay Reading (%)	7.52	15.33	12.94	16.44
BAS Reading (age)	5.10	0.43	5.45	0.54
Reading related skills				
Letter knowledge (sounds)	17.26	5.67	21.17	4.71
Phoneme Aware. (%)	23.42	28.25	59.61	29.46
Rhyme Generation(%)	40.33	47.25	24.08	34.33
Intelligence test scores				
BAS Vocabulary (age)	5.13	1.14	4.52	1.14
BAS Digit Span (age)	5.00	1.24	4.89	1.23
BAS Match Forms (age)	5.38	0.95	4.45	1.00
PASS (raw scores)				
Simultaneous (a & b)	78.63	21.72	71.67	23.22
Successive (a & b)	51.84	14.00	49.83	13.64

Note. All ages are in decimal places. A basal score of 4.9 is given to children on the BAS reading who score 0. The BAS reading age starts at 5.0 (child must read 3 words to score this).

At post-test the groups did not differ in age. However, synthetic phonics taught children had significantly better knowledge of letter sounds, $F(1, 34) = 5.41, p < .05$ (effect size 0.14). They also had better word reading on the BAS word reading test, $F(1, 34) = 4.34, p < .05$ (effect size 0.11) and better phonemic awareness on the Yopp-Singer test of phoneme segmentation, $F(1, 34) = 16.71, p < .001$ (effect size 0.33). As before, analytic phonics children had better visual discrimination, $F(1, 34) = 7.38, p = .01$ (effect size 0.18). All other comparisons were non-significant. After controlling for chronological age and visual discrimination at pre-testing using analysis of covariance (due to the differences between the groups at this stage), children in the synthetic phonics group still had better letter sound knowledge; $F(1, 33) = 6.21, p < .05$, word reading on the BAS; $F(1, 33) = 4.01, p < .05$ and phonemic awareness; $F(1, 33) = 15.34, p < .05$. No other comparisons were significant.

Table 10.4. Percentage of children reading at pre and post-testing on BAS Word Reading Test.

	Analytic Phonics	Synthetic Phonics
Pre-testing		
0 words	95	100
1-2 words	0	0
3 + words	5	0
Post-testing		
0 words	58	22
1-2 words	21	17
3+ words	21	61

Table 10.4 illustrates that a much larger percentage of children in the synthetic phonics group were reading words independently following reading instruction.

2) Effect of reading programme on the strength of associations between reading-related skills and reading.

The effect of reading programme on the relationship between reading and reading related skills was investigated through a series of correlations. This was carried out in order to investigate which skills were most highly related to reading ability, and to see if the way in which children had been taught to read influenced the strength of these associations.

Table 10.5. Correlations between BAS word reading and all tests at post-testing for analytic and synthetic phonics groups.

	1	2	3	4	5	6	7	8
AP	.55*	.30	.45	.33	.33	.47*	.18	.07
SP	.52*	.28	.58*	.25	.56*	-.05	.62**	.37

1 - letter knowledge; 2 - phonemic awareness; 3 - rhyming skills; 4 - BAS vocabulary; 5 - BAS digit span; 6 - BAS matching letter like forms; 7 - simultaneous processing; 8 - successive processing

Both groups' word reading correlated highly with their letter knowledge. Differences between the groups were examined and whilst the analytic phonics group had higher correlations between visual discrimination and BAS word reading, the synthetic phonics

groups' word reading was more highly related to their digit span and simultaneous and successive processing scores.

The correlations (Pearson's r) were then converted into a corresponding Fisher's z coefficient in order to see if there were significant differences between the groups' correlations. There were significant differences in the strength of the relationship between reading ability and two other skills; BAS matching letter like forms (visual discrimination), $p < .01$ and simultaneous processing, $p < .01$. The analytic phonics group showed a significantly higher correlation with the former, and the synthetic phonics group with the latter.

3) Regression analysis; investigating the effect of reading programme.

Regression analysis was carried out to predict later reading (BAS word reading) using predictor variables at pre-test, before the children had experienced any differences in reading instruction. This was to examine the predictive power of these skills before any formal teaching. Reading-related skills were entered into the analysis first, however phoneme awareness was taken out of the regressions due to floor effects at pre-testing. In addition, vocabulary was entered first to control for this factor in both groups.

Table 10.6. Hierarchical regression analysis with analytic and synthetic phonics group, using BAS reading at time 2 as criterion variable and pre-test scores on all tests as predictors.

		Analytic Phonics				Synthetic Phonics			
Enter	Variable added	ΔR^2	R^2 ch.	p	Final β	ΔR^2	R^2 ch.	p	Final β
BAS word									
reading (t2)									
1	BAS vocabulary	.189	.234	.04	.112	-.049	.016	.63	-.260
2	Letter knowledge	.593	.404	.00	.050	.219	.300	.03	.579
3	Rhyming skills	.878	.260	.00	.867	.247	.072	.24	-.047
4	BAS visual disc.	.873	.003	.52	.049	.186	.001	.87	.039
5	BAS digit span	.893	.021	.08	.173	.446	.230	.03	.712
6	Simultaneous	.889	.004	.45	-.069	.481	.056	.22	.278
7	Successive	.881	.001	.75	-.041	.451	.016	.52	-.250

In the analytic phonics taught group, vocabulary, letter knowledge and rhyming skill contributed significant variance to explaining later word reading. In the synthetic phonics group, a child's letter knowledge and digit span when they first started school explained significant variance in later word reading. In the analytic phonics group, 88.1% of the children's word reading could be explained by their ability in the measured skills at the earlier date. In the synthetic phonics group, 45.1% of the children's word reading could be explained by pre-test performance.

As differences between the two reading programmes were being investigated, and due to results that emerged from the correlations, visual discrimination, digit span and simultaneous and successive processes were entered into the regression analysis before those commonly associated with reading ability (i.e., letter knowledge and rhyming skills). Again, phoneme awareness was taken out of the regression due to floor effects at pre-testing and vocabulary was entered first to control for this factor in both groups. Initially all predictor variables were inserted from the pre-test scores.

Table 10.7. Hierarchical regression analysis with analytic and synthetic phonics group, using BAS reading at time 2 as criterion variable and pre-test scores on all tests as predictors.

		Analytic Phonics				Synthetic Phonics			
Enter	Variable added	ΔR^2	R^2 ch	p	Final β	ΔR^2	R^2 ch.	p	Final β
BAS word									
reading (t2)									
1	BAS vocabulary	.189	.234	.04	.112	-.049	.016	.63	-.260
2	BAS visual disc.	.248	.097	.15	.049	-.087	.033	.50	-.039
3	BAS digit span	.199	.001	.89	.173	.198	.300	.03	.712
4	Simultaneous	.157	.012	.63	-.069	.230	.074	.24	.278
5	Successive	.106	.010	.66	-.041	.211	.035	.42	-.250
6	Letter knowledge	.638	.404	.00	.050	.504	.232	.02	.579
7	Rhyming Skills	.881	.169	.00	.867	.451	.001	.85	-.047

In the analytic phonics group, as before, vocabulary, letter knowledge and rhyming skills of children first starting school contributed to significant variance in their word reading at a later date. Indeed, letter knowledge and rhyming skills accounted for a high level of significant additional variance in word reading, even after entering in all other predictors. In the synthetic phonics group, digit span and letter sound knowledge contributed significant variance to later reading ability, even after entering vocabulary and visual discrimination.

Following from this, word reading was predicted using concurrent scores on each of the tests carried out, to examine whether, at the same point in time, some skills act as better predictors of reading than others based on the way in which children have been taught to read. Phonemic awareness was also included as this is known to be an important predictor of reading and at this stage children were demonstrating varying levels of phonemic awareness (whereas all children scored zero at pre-testing).

Table 10.8. Hierarchical regression analysis with analytic phonics and synthetic phonics group, using BAS reading at time 2 as criterion variable and post-test scores on all tests as predictors.

		Analytic Phonics				Synthetic Phonics			
Enter	Variable added	ΔR^2	R^2 ch.	p	Final β	ΔR^2	R^2 ch.	p	Final β
BAS word									
reading (t2)									
1	BAS vocabulary	.046	.102	.20	.251	.005	.063	.31	-.068
2	Letter knowledge	.295	.276	.02	.491	.176	.210	.06	.012
3	Phonemic Aware.	.324	.063	.22	.151	.118	.000	.97	.098
4	Rhyming Skills	.274	.002	.83	-.092	.272	.170	.07	.321
5	BAS visual disc.	.293	.056	.27	.223	.211	.000	.99	.034
6	BAS digit span	.263	.022	.49	.296	.277	.089	.17	.519
7	Simultaneous	.194	.003	.81	-.040	.375	.101	.13	.363
8	Successive	.142	.020	.55	-.243	.322	.009	.65	-.205

When concurrent skills were entered into the regression analysis to predict word reading (BAS), letter sound knowledge explained significant variance in word reading in the analytic phonics groups. In the synthetic phonics group, no skills explained significant variance in word reading. In the analytic phonics group, 14.2% of the variance in word reading was explained by all these tests. In the synthetic phonics group, 32.2% of the variance in word reading was explained by all tests.

A further regression analysis was carried out entering visual discrimination, digit span and simultaneous and successive processes before those commonly associated with reading ability (i.e., letter knowledge and rhyming skills).

Table 10.9. Hierarchical regression analysis with analytic phonics and synthetic phonics group, using BAS reading at time 2 as criterion variable and post-test scores on all tests as predictors.

		Analytic Phonics				Synthetic Phonics			
Enter	Variable added	ΔR^2	R^2_{ch}	p	Final β	ΔR^2	R^2_{ch}	p	Final β
BAS word									
reading (t2)									
1	BAS vocabulary	.046	.102	.19	.251	.005	.063	.31	-.068
2	BAS visual disc.	.185	.179	.07	.223	-.057	.004	.80	.034
3	BAS digit span	.228	.083	.20	.296	.234	.301	.02	.519
4	Simultaneous	.169	.000	.94	-.040	.423	.190	.03	.363
5	Successive	.101	.001	.89	-.243	.396	.015	.53	-.205
6	Letter knowledge	.275	.166	.07	.491	.357	.010	.61	.012
7	Phonemic Aware	.221	.010	.65	.151	.310	.010	.63	.098
8	Rhyming Skills	.142	.004	.78	-.092	.322	.047	.31	.321

In the analytic phonics group, despite a high correlation between word reading and visual discrimination in post-test scores, visual discrimination did not explain significant variance in word reading after controlling for vocabulary (although this was

almost significant). In addition, letter knowledge was almost significant. In the synthetic phonics group, once vocabulary and visual discrimination had been entered into the model, digit span and simultaneous processing accounted for significant additional variance in word reading. However, unlike the previous analysis, letter knowledge was not a significant predictor.

Discussion

After the intervention, the synthetic phonics children were better at reading, knew more letter sounds and had superior phonemic awareness skills, despite having fewer hours of literacy teaching. There was also a larger percentage of children in this group reading independently. Interestingly there were clear differences in the cognitive skills predicting reading using pre and post-test scores for both groups. For those taught to read by synthetic phonics (a method which is heavily reliant on serial processing for reading), pre-test scores on digit span and letter knowledge predicted later reading ability, whilst post-test digit span scores and simultaneous skills predicted concurrent reading ability. However, analytic phonics taught children's reading was strongly predicted by their pre-test scores on vocabulary, letter knowledge and rhyming skills, and post-test letter knowledge. The analytic phonics children also showed significantly closer associations between word reading and visual discrimination, whereas the synthetic phonics children showed significantly closer associations between simultaneous skills and word reading (memory span and successive were almost significant). Whilst scores at post tests culminated in predicting 32.2% of synthetic phonic taught children's word reading ability, only 14.2 % was predicted by these tests in the analytic phonics group. Interestingly, pre-tests culminated in predicting 88.1% of analytic phonics children's later reading ability, however only 45.1% was predicted by synthetic phonics pre-test scores. These results indicate that analytic phonics taught children's initial progress in word reading is highly predictive from what they learnt before arriving at school (in particular their vocabulary, letter knowledge and rhyming skills). On the other hand, synthetic phonics provides a fast introduction to letter sounds, and teaching children blending skills for reading, which appears to allow all

children a better opportunity to learn to read early on, regardless of how little or how much they have learnt at home.

As a number of different analyses were carried out on the data, the discussion will focus initially on the most important results. Firstly, there have been numerous studies highlighting the importance of letter knowledge and phonological awareness skills for later reading (for reviews see Adams, 1990; Castles & Coltheart, 2004; Wagner & Torgesen, 1987). Indeed, in a study measuring thirty nine variables as later predictors of reading achievement, letter knowledge and phonological awareness (phoneme segmentation) emerged as the two most powerful predictors (Share et al., 1984). In the current study, in the analytic phonics group, letter knowledge and phonological awareness were by the far the strongest predictors of later reading despite entering all other tests into the model as predictors beforehand. In addition, pre-test scores from all tests (but in particular letter knowledge and rhyme) were able to predict a huge percentage (88.1%) of variance in children's reading ability at a later date. It follows therefore that for children taught by analytic phonics, the skills a child brings to school sets limits for their later reading ability, as most of the variance is explained by these initial scores (and not by later scores, which have much lower predictive values). However, in the synthetic phonics group, all skills at pre-test predicted only 45.1% of a child's later reading ability, suggesting that the way in which they have been taught to read plays a significant role in their later reading ability. The predictive power of pre-test scores indicates that when children learn to read by analytic phonics, those who performed well on pre-test skills are better readers later on. With synthetic phonics, the initial knowledge and skills that children have when they first start school is less predictive of their later reading skill. Children taught to read by synthetic phonics arrived at school with approximately the same level of skills as those taught by analytic

phonics (the analytic phonics group showed superior visual discrimination but this was the only significant difference). However only digit span and letter knowledge contributed significant variance to later word reading, even after phonemic awareness (phoneme segmentation) was entered into the analysis. The importance of digit span is inconsistent with previous studies which have found that only reading-related skills are important predictors for later reading in the initial stages of learning to read (Scanlon & Vellutino, 1996; Stanovich, et al., 1984b), in particular letter knowledge and phoneme segmentation skills (Share et al., 1984). Indeed, Dally (2006) found that whilst blending and rapid naming had a significant and direct influence on first grade word reading, and phoneme deletion had a significant direct influence on second grade reading comprehension, verbal memory appeared to have no significant relationship with either. This is consistent with Rohl & Pratt (1995) who found that the effect of verbal memory is typically subsumed by phonological awareness when the two variables are included simultaneously as predictors of reading.

This finding that synthetic phonics children's later reading was not as limited to their prior experience to school is a very important result, as those children who have very little pre-school reading-related knowledge have a better chance of success in early reading if they have been taught by synthetic phonics. This is consistent with the "Matthews effect" (Stanovich, 1986), whereby individuals who have advantageous early educational experiences are able to utilize new educational experiences more efficiently. Indeed, the results from the analytic phonics group appear to be quite typical, as Stevenson & Newman (1986) found that pre-school scores are highly correlated with later reading (even as late as Grade 5 and Grade 10). Whilst pre-test scores in the synthetic phonics group predicted less variance in word reading, post-test scores predicted more, suggesting that the synthetic phonics method was drawing more

upon these cognitive skills for reading. This is in line with Evans & Carr (1985) who compared a phonics taught group with a language orientated group and found that there was greater coherence between intelligence tests, language and reading achievement in the phonics group. This suggests that the phonics approach was better at drawing upon these skills for reading. Whilst both groups in the current study were taught phonics, there was a stronger emphasis on phonics in the synthetic phonics group (see Appendix 5).

An examination of the strength of correlations between the two groups revealed that at post-testing, for those taught by analytic phonics, word reading was significantly more highly correlated with visual discrimination, whereas for those taught by synthetic phonics, word reading was significantly more highly correlated with simultaneous processing. For children taught to read by analytic phonics, those with better visual discrimination may be better readers as they may be relying more on visual processes for detecting differences between whole words, or recognising distinctive visual features within words, in order to identify the word they have been taught. In synthetic phonics, those children who are good at simultaneous processing may be better readers, as children need to understand the position and relationship of all the letters or sounds in sequence and integrate this information in order to read accurately. It is likely therefore that children who have better simultaneous skills will be better readers as they are applying this ability to word reading. Analytic phonics teaching however does not draw on this skill to the same extent, as initially words are processed as visual wholes or only using initial letter sounds.

In addition, for those taught by synthetic phonics, there was a closer relationship between word reading and digit span (this was almost significant), suggesting that

children rely more on this type of skill for word reading. The better a child's ability to keep sequences of stimuli in order so that they can be blended together, the better their word reading ability. As synthetic phonics requires children to process letter sequences from left to right and blend them for reading, this relationship would be expected. During testing it appeared to be memory span which was limiting the children's ability to read longer words, rather than their ability to blend sounds. Whilst children had mastered sounding and blending, they were struggling to keep all the sounds in their memory in order to read the word. Most children could only sound and blend 3 phoneme words (e.g., sh/i/p), however two children could blend 4 phoneme words (e.g., c/l/o/ck). These two children had digit span scores 6 and 7 months above their chronological age (amongst the highest scores), providing evidence that good short term memory was needed as a foundation for reading these longer words. Some children in the synthetic phonics group could sound out all the letters but could not blend them together, this being a more sophisticated skill which they will shortly acquire. This highlights the possibility of post-testing too early on, something which has been observed in previous research (Martinussen et al., 1998) and which minimises differences between comparison groups.

From observing the synthetic phonics and analytic phonics children during post-testing on the BAS word reading test, one would probably speculate that the children taught to read by synthetic phonics would be able to read a much larger range and number of short words than were included in the BAS test. On the other hand, those taught to read by analytic phonics would only be able to read words they recognised by sight (which would be far fewer). The actual differences found in word reading ability (approximately 4 months) between the two groups are likely to be smaller than the actual differences, due to the relatively sharp increase in word length and difficulty in

the BAS word reading. This is consistent with Evans & Carr (1985) who found that children in a more phonics based classrooms performed only slightly better than those in language orientated classrooms (which taught whole words) on sight word reading tests, due to the test containing familiar words on which the language orientated groups had been drilled. However, much greater gains were made for the phonics group when reading unfamiliar words and in more complex reading tests involving reading comprehension. Also, if a child did not score anything on the BAS Word Reading Test (and there were far more of these in the analytic phonics group), they were still given a notional reading age of 4.9. Overall there were a much higher percentage of children able to read when taught by synthetic phonics, this provides strong evidence for using this method over an analytic phonics method for the initial teaching of reading. The importance of a strong emphasis on phonics for early reading has also been found by Evans & Carr (1985). Indeed instruction which is orientated more towards phonics produces more rapid or substantial early achievement than look-say instruction (Chall, 1983; Evans & Carr, 1985). In addition, children taught to read by synthetic phonics had better letter knowledge and phonemic awareness; skills which are very important for reading (for reviews see Adams, 1990; Castles & Coltheart, 2004; Wagner & Torgesen, 1987). It should be noted that letter sounds are taught much faster by a synthetic phonics method, however at the time of post-testing, all children had been taught all the letter sounds they were tested on. In addition, the digraphs which were contained in the BAS items of the word reading test had been taught to both groups, with the exception of 'oo' for 'wood' and 'ee' for 'heel', which had only been taught to the synthetic phonics group. However, as no child could read 'heel' and only one child managed to read 'wood' in the synthetic phonics group, the differences in word reading scores cannot be attributed to speed of letter learning or knowledge of letter sounds and digraphs.

What evidence was there that children have been learning to read in ways that reflect their reading instruction? Firstly, children taught to read by synthetic phonics had better phonemic awareness skills. As synthetic phonics instruction focuses on the smallest sound unit (the phoneme) and teaches sounding and blending phonemes for reading, this result is consistent with what would be expected by this method. Children taught to read by analytic phonics had better rhyming skills at post-testing, and again this is consistent with the way in which they are taught to read; using rhyming games and onset-rime teaching for awareness of initial letter sounds. Also, during post-testing clear differences could be seen in the reading strategies of the children taught to read by the two different reading programmes. Those taught by analytic phonics predominately used the first letter sound and guessed the word based on the first sound, sometimes using word length as a cue (e.g., ‘juice’ for ‘jump’). This is in line with Ehri’s (1995) partial alphabetic phase of reading development (see main introduction). In addition, many could read high frequency words which they had been taught as visual wholes and so were more easily recognised (i.e., ‘the’). Even though children had started to learn to sound and blend, at this stage there was no evidence of sounding and blending; usually the child was silent until they said what they thought the word was, or would sometimes repeat the initial letter sound until they guessed the rest of the word. Some children would use completely inappropriate guesses for word reading, e.g., ‘biff’ ‘chip’ and ‘floppy’ were guessed by two children for reading the first three items on the BAS (these words are actually ‘the’ ‘up’ and ‘on’). The words ‘biff’ ‘chip’ and ‘floppy’ are amongst the first words which they have been taught as they are characters in their first reading books. This shows a clear neglect of all the letters and corresponding sounds in the words, in addition to the word length. Children taught to read by synthetic phonics were sounding and blending for reading on all words using all letter sounds within the word (which can be likened to Ehri’s full alphabetic phase of reading development, see

main introduction). The words within the BAS reading test are a combination of regular and irregular words, and whilst the synthetic phonics children performed better on the regular words, they were attempting to read the irregular words in the same way; by using the letter sounds within all parts of the word. This gave them a cue to working out the word and at times, children correctly read irregular words by adjusting their pronunciation to the best fitting word, although this did not happen very often. However, this is perhaps quite a sophisticated ability which children will not be able to perform accurately until they have had more experience with words and reading. Indeed, Chall (1987) estimated that the average six year old knows about 5,000 words, indicating that they have the vocabularies in place to adjust their pronunciation to the best fitting word. However, by sounding out the word, it shows that the child is paying attention to the orthographic and phonological information within the word, which may allow them to recognise it more easily and accurately at a later date. Some children who read no words knew many of the letter sounds and could sound them out in the correct order, but had not yet mastered the technique of blending together the sounds. It is expected from both observational and experimental past research that once children master this skill their word reading will progress very quickly (Johnston & Watson, 2004a). This was observed prior to the synthetic phonics study carried out by Johnston & Watson (2004a), who noticed that when children start sounding and blending, their reading ability increases dramatically, and was the rationale behind teaching this technique from the beginning. Indeed, it was the reason why synthetic phonics was initially tested as early sounding and blending is an important principle of synthetic phonics (Johnston, personal communication). Unfortunately, the examples of errors given above were noted by the examiner during the testing phase whenever something particularly noticeable happened (i.e., the children reading the words as ‘biff’ and

‘chip’). The errors made by the children in word reading were not recorded consistently enough in order for any analysis to be carried out.

There are important implications from this type of research, as it is vital that children receive the best possible reading instruction, in the hope that this will reduce the frequency of reading problems in later school years. Whilst some children may learn to read by any method, perhaps due to a highly literate environment at home or having the necessary cognitive skills to underpin reading, many children do not have such advantages. As Morais, Alegria & Content (1987) argued “the possible advantage of one approach over the other is probably the most important for the backward learner (p. 434). The importance of learning a method to read individual words when children first start school, lies in its highly correlated or predictive relationship with later reading comprehension (Dally, 2006; de Jong & van der Leij, 2002; Muter & Snowling, 1998).

It is only through carrying out well designed and controlled studies, using quantitative measures that the results of different types of reading instruction can be measured. Unfortunately, this study had to be discontinued after five months as the next analytic phonics teacher refused to allow further testing. In addition, the analytic phonics group later started the synthetic phonics reading programme and so the two groups could no longer be compared as separate programmes.

Future research needs to be carried out on a larger sample of children over a longer time period. In the current study it would be very beneficial to follow up these children later in school to determine how their initial skills predicted later reading. Butler et al. (1985) found that predictor measures collected in kindergarten more accurately predicted reading achievement in the later years than the earlier years (consistent with the fan

spread effect), however the results of this study offer other potentially interesting ideas for future research. One possibility would be to examine the cognitive processes underpinning different types of reading instruction (i.e., phonics versus language orientated approaches), and also to take into account other skills such as language based measures, executive function tasks, planning & attention, spatial perception and phonological tasks. Whilst phoneme segmentation was used in the current study, very low or no performance on this task at pre-test meant that it suffered from floor effects. However an easier measure of phoneme awareness such as phoneme oddity or phoneme isolation may provide a better indicator of a child's phonemic awareness at pre-testing and should be included in future studies. Indeed Stahl & Murray (1994) found that phoneme segmentation was the most difficult task for kindergarten and Grade 1 children, with phoneme isolation, phoneme blending and phoneme deletion being easier, therefore for future research, a different phoneme awareness task should be used. Ideally, the same stimuli should be used to measure both onset-rime and phoneme awareness (as in Hulme et al., 2002) in order to have a very tightly controlled experiment. This study has found that variables other than those directly measuring reading-related skills can predict later reading (inconsistent with other research studies such as Scanlon & Vellutino, 1996; Stanovich et al., 1986b), but that this is dependent upon the method in which a child has been taught to read (something which has not been considered before).

This study has highlighted the role of memory span in a synthetic phonics method of teaching (i.e., a sequential method whereby focus is on sounding and blending phonemes sequentially for all reading). Much research has already been carried out looking at the role of working memory in reading ability and comprehension (Cain et al., 2004a; de Jonge & de Jong, 1996; Seigneuric & Ehrlich, 2005; Swanson & Berninger,

1995). Seigneuric & Ehrlich (2005) found that from Grades 1-3 (age 7-9 years) working memory capacity was a direct predictor and important determinant of reading comprehension. In addition, Cain et al. (2004) found that working memory predicted unique variance in reading comprehension after word reading ability, vocabulary and verbal ability had been controlled for. However, Swanson & Howell (2001) found that short term memory and working memory are more highly correlated with word recognition than reading comprehension. This depended on the means of testing however, as verbal measures of STM and WM were more closely related to reading ability than visual measures. Those studies examining short term memory, for example, Ellis & Large (1987), found that auditory digit span, alongside vocabulary and rhyming skills, emerged as an important variable discriminating between IQ matched children who either had reading problems or were skilled readers. A later study by Ellis & Large (1988) showed cross-lagged predictions between short term memory (auditory & visual digit span, auditory word and auditory sentence span) and reading one year later (for 5 > 6 year olds and 6 > 7year olds). The cross-lagged correlations between reading and these measures were roughly the same in both directions at age 5 > 6. At aged 6 > 7, associations were stronger between STM and reading, with auditory STM skills showing stronger predictions. The authors concluded that the nature of reading skill changes throughout the first three years of acquisition, with some skills being more important than others at different levels of development. Finally, phonological short term memory has been found to be involved in the acquisition of new vocabulary in children (Gathercole & Baddeley, 1989), which in turn may benefit reading comprehension, highlighting the importance and influence of memory beyond reading.

The results of this study confirm that short term memory (as measured through digit span) plays a role in the reading ability of children, however its importance appears to

be influenced by the way in which children are taught to read, an issue which has not been considered until now. Memory span appears to play a particularly important role for those children who are taught to process letters and sounds sequentially for reading rather than processing them as visual wholes. In addition, there appears to be a more important role for visual discrimination in reading when children are initially taught via a whole word approach. Future research could examine further the importance of reading instruction and reading strategies, and their mediating role between memory and reading.

Conclusions

The results of this study support synthetic phonics as opposed to analytic phonics in early literacy teaching, and confirm that children who have just started school are developmentally equipped to learn to manipulate phonemes and use them to sound and blend for reading. The results indicate that for children taught to read by analytic phonics, initial progress in word reading is highly predictive from their pre-school experience (in particular their vocabulary, letter knowledge and rhyming skills). However, synthetic phonics allows all children a better opportunity to learn to read early on, regardless of how little they have been taught at home, through a fast introduction to letter sounds and blending skills for reading. Interestingly, this study highlights how the way in which a child is taught to read changes the importance of other factors in reading. For those taught by synthetic phonics, word reading was better predicted by a child's memory span, letter knowledge and simultaneous processing skills. In addition, whilst visual discrimination skills were more closely related to word reading when children were taught by analytic phonics, simultaneous skills were more closely associated with synthetic phonics children's word reading. These results represent an important discovery in early reading research, and may be of useful application in schools.

GENERAL DISCUSSION

The research carried out for this thesis represents a number of topics relating to reading, all with their own distinct literatures. When beginning this investigation into gender differences and the effects of reading programme, it became clear that these differences were not solely in terms of ability and achievement, but rather spanned a wide variety of topics, all of which may impact on school achievement and experience. In order to have a more comprehensive overview of the factors relating to children's reading, the thesis branched off into three distinct areas; reading strategies, attitudes to reading and cognitive processes.

In this final discussion, the main results from all the studies will initially be summarised in three distinct sections; reading strategies, attitudes to reading and cognitive processes. These areas will then be integrated together for a discussion on gender differences and the effects of reading programme on the areas researched. Following this, directions for future research will be suggested and discussed, and final conclusions will be drawn.

Reading strategies

In Chapter 4 and 5, the effects of reading programme and gender differences in reading strategies were investigated. It was found that a synthetic phonics reading programme produced better readers (word reading and comprehension), with better phonological reading skills and a more phonological approach to reading. Whilst the groups were matched on high frequency words, those taught by synthetic phonics were better at

reading low frequency irregular words, and it was suggested that they were utilising the regular components of those words to read them accurately. This theory fits with connectionist models of word reading which propose that words are quasi-regular, and that all words contain phonological information, the differences lying in the relative consistency of the letter sound relationships. The study examining gender differences found no differences on any of the ability tests; vocabulary, reading skill or phonological reading skill. However, the results showed a trend towards a greater regularity effect for boys, in addition boys were poorer at reading low frequency words, however these differences were not significant.

Attitudes to reading

In the sixth and seventh chapters, gender differences and the effects of reading instruction were examined in relation to attitudes to reading. It was found that whilst girls were better at reading, this difference was small in comparison to the gender differences in attitudes to reading, school and frequency of reading. Another area of significant and interesting gender differences was in the relationship between the factors measured. Boys' attitudes to reading and school were more closely related to their reading achievement, therefore it was suggested that boys' attitudes depend to a greater degree on their success. It was proposed that interventions with poor reading boys should be partially achievement focused, with realistically set goals, so that boys are constantly feeling success with their progress, and this in turn should foster more positive attitudes. The effect of reading instruction on attitudes was also examined, and it was found that whilst a synthetic phonics programme produced gains in reading skill, there was no significant effect of programme on attitudes to reading or school; this was consistent with many large scale studies which have found no effects of reading instruction on attitudes to reading.

In the eighth and ninth chapters, underlying cognitive processes were measured in accordance with the planning, attention, simultaneous and successive framework of cognitive processes. Whilst boys and girls were matched on several tests of ability (vocabulary, word reading and comprehension), girls were found to have better planning and attention; these skills are necessary for intentionality, impulse control, self-regulation, focus, and attending to important information whilst inhibiting distracting information. It was suggested that this may help to explain differences in classroom behaviour, with girls being able to stay focused on a specific topic for longer. This is important for all types of teaching instruction, as perhaps shorter lessons would be more beneficial to maintain boys' attention, and more instruction could be given to the planning elements of tasks. In the ninth chapter, it was found that whilst synthetic phonics was associated with better vocabulary and reading skill (single word reading and comprehension) than the National Literacy Strategy programme, these gains did not transfer to cognitive processes. However, those taught via synthetic phonics did have better memory spans (successive process), this theoretically could have been developed by the instruction these children received for reading (sequential sounding and blending for all word reading). In addition, synthetic phonics children more consistently had better memory spans, with less variation in scores compared to those taught in accordance with National Literacy Strategy guidelines. However, as no pre-testing had been carried out, it could not be concluded that synthetic phonics developed other skills (i.e., memory span) in addition to those specifically related to reading (vocabulary and reading), as the synthetic phonics children may have had better memory spans prior to any type of reading instruction. Therefore an early intervention study was devised to investigate this further.

In Chapter 10, the early intervention study controlled for any differences between the groups in terms of pre-school reading skills, reading ability and intellectual ability. It was found that half way through the first year of formal teaching, a higher percentage of those taught by synthetic phonics were reading independently. In addition, they had a greater knowledge of all letter sounds, were better readers and had superior phonemic awareness skills. There were also clear differences in the cognitive skills predicting reading, using pre and post-test scores for both groups. For those taught to read by synthetic phonics (a method which is heavily reliant on serial processing for reading), digit span, letter knowledge and simultaneous skills predicted reading. However, analytic phonics taught children's reading was strongly predicted by vocabulary, letter knowledge and rhyming skills. The analytic phonics children also showed significantly closer associations between word reading and visual discrimination. In addition, analytic phonics taught children's initial progress in word reading was highly predictive from what they knew before arriving at school. However, synthetic phonics, through a fast introduction to letter sounds and blending skills for reading, allowed all children a better opportunity to learn to read early on, regardless of how little or how much they had learnt at home. This study highlighted very clearly that the way in which children are taught to read changes the cognitive substrate underlying reading, and represents a very interesting avenue for further research.

Gender differences

It is widely accepted that girls are better at reading, both in national and international assessment (NLS statistics, 2007; PIRLS 2001). However, the studies in the current thesis found that significant gender differences in reading ability are either non-existent (Chapters 5 & 8) or relatively small ($d = 0.28$ for reading comprehension in Chapter 6). The type of analysis used in the current studies however is different to that used in

national tests of assessment. In national tests (NLS key literacy statistics), it is the percentage of children who achieve a particular standard that is compared (i.e., in 2007, 88% of girls and only 80% of boys were achieving the standard expected for their age in reading at Key Stage 1, NLT 2007). However, as results are measured by categorising children into bands of performance, the actual differences in scores and effect sizes may be small, however no meaningful comparison using a normal distribution curve can be carried out. In the study of international comparisons (PIRLS, 2001; 2006), when effect sizes were calculated using means and standard deviations in the relevant comparisons with English speaking countries, relatively small effect sizes (range 0.17 - 0.29) were found according to Cohen's *d*, where 0.20 is considered small (Cohen, 1992). This is consistent with Davies & Brember (1999) who carried out a large study (*n* = 1488) assessing the reading ability of boys and girls in every year at school. They found no significant gender differences on the standardised test of reading (Primary Reading Test) at any age group, however the two oldest year groups also did the National Tests, and consistent with the national pattern reported, there was a greater percentage of boys than girls below Level 4 (the expected level), despite the standardised tests showing no significant gender differences. From where do these consistent perceptions of meaningful gender differences in reading arise?

The gender differences perceived in reading could be due, in part, to gender stereotypes, but may also result from perceived or actual differences in classroom behaviour or interest in school activities. It is generally reported by teachers that boys have poorer behaviour in class (Cullingford, 1993), and are less task orientated and more verbally aggressive (Datta, Schaefer & Davis, 1968). However reports from boys *and girls* state that boys are often unfairly treated, and that girls may display the same poor behaviour but without the negative consequences, with boys being more likely to be "picked on",

whilst girls “get away with” bad behaviour (Cullingford, 1993, p. 559). Also, questionnaire data and self-report studies revealed that a higher proportion of both boys and girls believe that teachers complimented girls more often, preferred to be around girls and thought that girls were smarter (Wiens, 2006). Stevenson and Newman (1986) found that when teachers were asked to rate children individually on their ability to learn, follow instructions, remember information and relate experiences, the girls’ overall score was consistently significantly higher than that of the boys (from kindergarten to Grade 5). This is in contrast to the parents’ rating of their children, where overall gender differences were much smaller, and in most cases not significant. In addition, boys, in general, are given more attention in class than girls (Einarsson & Granstrom, 2002; Irvine, 1986) and tend to be criticised more frequently than girls (Datta et al., 1968; Dweck & Bush, 1976). Boys also receive more negative feedback (Irvine, 1986), however they also receive more feedback in general than girls do (Irvine, 1986). When boys do receive feedback however, it has been found that a large proportion (45%) appears to be attributed to their lack of effort (i.e., neatness), compared to girls who almost always receive feedback relating to the intellectual adequacy of the work (Dweck & Bush, 1976). Finally, whilst boys are more likely to initiate negative interactions with teachers (Irvine, 1986), they are also more likely to initiate positive interactions.

These studies cumulate in showing that boys tend to receive more attention in class (whether negative or positive). It may be that these factors combined lead to the perception that boys are not achieving the same standard as girls. In pre-school aged children, stronger associations have been found between behaviour problems and lower academic skills for boys than for girls (Stowe et al., 2000), however this is not conclusive (Friedman-Weieneth Harvey, Youngwirth & Goldstein, 2007) but allows the

suggestion that poor academic achievement and behaviour are more closely related in boys in particular. In addition, Stowe et al. (2000) found that difficulties in language development tended only to be seen by teachers when paired with behaviour problems. In fact, what predicted the referrals to special services most strongly was not a child's language development, but rather how difficult the teacher found the child to manage in the classroom. This highlights the possibility of confusing the actual source of the problem as it could be academic or behavioural in nature.

The attitudes questionnaire indicated that boys had more negative attitudes to reading and school; these differences were larger than the gender differences in reading ability. More importantly, however, there was a significantly closer association between attitudes to reading and school and reading ability in boys. Boys' attitudes appear to be more strongly influenced by their success, an issue which is particularly problematic if they are underachieving. If boys attitudes towards reading depend to a greater extent on their actual achievements, it is important to provide the best possible instruction so that boys' better ability is reflected in more positive attitudes to reading and school. It is also crucial that any assessment and feedback is provided in a way that boys feel they are making constant progress in their work.

One study which is particularly striking from a gender differences perspective is that carried out by Johnston & Watson (2004b). In this study it was found that a systematic synthetic phonics method produced consistent gender differences in reading, favouring boys. This is a very unique result, as it is consistently found that girls are better at reading (NLT 2007; PIRLS, 2001; 2006). It has been proposed that boys have a more phonological approach to reading, this being a naturally inherent strategy (Thompson, 1987), therefore a programme which is strongly focused on phonics for reading may be

particularly beneficial for boys. This may be true for beginning readers, however, there is arguably relatively little evidence to indicate that there are meaningful consistent gender differences in reading strategies; no gender differences were found in the current study (Chapter 5). Thompson (1987) found that in the early stages of learning to read (aged 6 - 7), when children were taught by a 'book experience' approach (which does not include any systematic instruction on the correspondences between letters and sound segments of words), that boys relied more on the phonological segments of words for reading, even when they were matched with girls on reading skill. The magnitude of the gender differences leading to this conclusion are small, and are restricted to children first learning to read by a specific method. In Chapter 5, no significant gender differences were found in terms of reading strategies. Therefore, this does not appear to be a consistent finding, rather one which may be specific to younger children. Rather, it was proposed that the pattern of results from Chapter 5, could be explained by the frequency with which older boys and girls read (Coles & Hall, 2002), with girls reading more and therefore having a more substantial and wider range of sight vocabulary. This could also explain why boys rely more on the phonological segments of words, as with unfamiliar words, it is necessary to rely more on the phonological aspects of these words (Waters et al., 1984). Therefore if gender differences in reading strategies are not consistent and the limited research has shown only small gender differences, it is important to investigate alternative explanations which may have contributed to boys better reading with synthetic phonics. One other explanation of why boys have learnt to read so well with synthetic phonics may be that it was the systematic and repetitive nature of the programme that benefited boys. Soderman, Chhikara, Hsiu-Ching & Kuo (1999) argue that because the brain is a pattern-seeking organism, in early childhood classrooms, children's experiences should be "ripe with action, repetition and meaningful hands on activities" (Soderman et al., 1999, p. 11). This systematic method

of building up words to read them and breaking down words to spell them using letter-sound rules may suit boys' style of learning in particular. This method of teaching contains repetition; children repeat the same strategy for reading all words. In addition, daily lessons follow the same format so children know what to expect. Also, in the initial stages particularly it is hands-on and uses actions; children build up words using magnetic letters on boards, or drag letters across the white board to spell words. Jolly Phonics is also a popular method of teaching children the letters of the alphabet (a method which matches a letter sound to a hand/arm action), the letters of the alphabet being an important basis for sounding and blending. Finally, boys have been found to have poorer attention (Chapter 8), and as synthetic phonics lessons are short but focused, and teach only one strategy for reading, they may be less demanding of attention as children are not confused by learning different and perhaps conflicting strategies. The short lessons may suit their style of learning very well. Indeed, it was found that attention span was significantly more correlated with reading comprehension in the National Literacy Strategy group than the synthetic phonics group (Chapter 9), suggesting that attention plays a greater role in the development of their reading skill. It is possible that the source of boys' better reading through synthetic phonics is not due to just one factor, but rather a culmination of these different factors.

The finding that boys have poorer planning and attention is consistent with other studies (Naglieri, & Rojahn, 2001; Warrick & Naglieri, 1993) and represents a possible source of improving teaching within school. Improving skills in planning and attention may help to improve behaviour and performance in class, and may in addition benefit achievement. Teaching in classes is usually directed on acquiring certain skills that can be tested according to the curriculum guidelines. However, perhaps teaching children critical basic skills such as planning and attention will provide a good foundation on

which to aid reading and other skills in class, and may go towards improving behaviour and the classroom environment. Skills in planning involve teaching the child to think about the task ahead, to choose between alternative strategies and select the most appropriate strategy. This requires the child to be more reflective about what they are doing and why they are doing it. Attentional skills on the other hand involve teaching the child to become more focused on what they are doing and ignore distracting or irrelevant information. This may require shorter time spans in lessons or getting the children more interested in what they are doing to increase their attention. Torgesen, Wagner, Rashotte, Rose, Lindamood, Conway et al. (1999) found that attention and behavioural problems made it difficult for some children to benefit from teaching instruction, even when it was provided in a one to one setting. It follows then that if a child's behaviour problems in an individual setting with good teaching (i.e., under optimal conditions) significantly influence their later reading, then it is likely that these attention and behavioural problems will have even greater effects when instruction is provided in whole class environments. In addition, Samuels & Turnure (1974) found that attentiveness in class was significantly related to word reading in Grade 1 children. Finally, Dally (2006) found that inattentiveness predicted word reading (which then predicted later reading comprehension), to the same level as knowledge of letter names, rapid naming and prior word recognition. These studies highlight specifically the importance of tackling attention problems.

Effect of reading instruction

The second focus of this thesis was to examine the effect of reading instruction on reading strategies, attitudes and cognitive processes. It is important to note that neither group being tested (synthetic phonics or National Literacy Strategy) was part of an intervention or experimental study (with the exception of Chapter 10). The synthetic

phonics groups were tested in Clackmannanshire, Scotland, in 2005 and 2006, where this is now the normal method of instruction. These children started school 2 and 3 years after the original study and it is possible the initial fast pace of letter sound teaching had been slowed down. However, it is clear that this programme focuses more on phonics for reading, as these children had a more phonological approach to reading (Chapter 4), which is characteristic of a synthetic phonics programme. It was found that children taught to read by synthetic phonics were better readers and there were fewer underachievers. In addition, their more phonological approach to reading benefited their irregular word reading in addition to regular word reading. Those taught by synthetic phonics had a similar level of attitude to reading and school compared with the National Literacy Strategy taught children, despite debates that phonics focused approaches produce more negative attitudes to reading. They also had better reading comprehension, despite further debates that phonics focused programmes teach children to decode words but do not teach them to understand what they have read. This may be because learning to read individual words is highly correlated and a good predictor of reading comprehension (Dally, 2006; de Jong & van der Leij, 2002; Muter & Snowling, 1998). In addition, these children had a better memory span, and there was far less variability in their memory span scores. In the early stages of learning to read, whilst the synthetic phonics group received far less literacy instruction (approximately 30 hours less), there was a much larger percentage of synthetic phonics taught children reading independently and they had significantly better reading overall. These children also had a better foundation on which to develop their reading skills; greater letter-sound knowledge and superior phonemic awareness skills. The results of this study indicate that the teaching of synthetic phonics is more effective at teaching reading than the programme previously recommended by the National Literacy Strategy, in terms of both reading development (Chapter 10) and later reading ability (Chapters 4, 7 & 9). In

particular, it appears to be very effective in reducing numbers of underachievers (Chapter 7 & 9). However, as of this year, the National Literacy Strategy has introduced synthetic phonics in England via the new programme Letters and Sounds (DfES, 2007), but as yet no conclusions can be drawn about the results of these changes.

In the early intervention study (Chapter 10) it was clear that synthetic phonics gives children more independence in reading early on, as they have sufficient skills to read (i.e., good letter knowledge and blending skills for reading). Share (1995) suggests that these skills represent an efficient self-teaching mechanism, allowing children to teach themselves to read through recoding the letter sound string. One important objection, however, is that English is an irregular language, therefore children will require more than purely decoding strategies for reading all words. However, as seen in Chapter 4, a phonological approach to reading benefits irregular word reading as well as regular word reading, as children have a partial cue to the words pronunciation, but may need to adjust the pronunciation to fit the context in which the word is read. This again is a strategy that children will improve with practice, but even having a partial cue to the word's pronunciation provides them with more information than no cue. This early independence in reading, and the short focused repetitive lessons in phonics, has been shown to benefit children's academic outcomes, but it may also improve classroom behaviour, as children who are struggling in class to keep up with their literacy instruction may become bored, disinterested and as a result possibly more distracting to the whole class. Cameron et al. (2007) highlight the importance of establishing rules and routines early in school, then sharply decreasing this instruction (in synthetic phonics this would come after children have learnt all letter sounds and mastered blending skills). This had been found to lead to significantly better academic outcomes

than classrooms with little initial organisation, as children are more likely to take ownership over their own learning, and are able to work more independently.

Published research papers consistently point to the importance of letter knowledge and phonological awareness in the early stages of learning to read (Adams, 1990; Castles & Coltheart, 2004; Foy & Mann, 2006; Muter, 1994; Muter & Snowling, 1998; Muter et al., 1998; Share, 1995; Waters et al., 1984). These two factors are widely accepted as being crucial in reading development, whether children are taught via a phonics method or even an initial whole word approach. For example, Stuart et al. (2000) found that children with good letter knowledge and phonological skills were more successful in acquiring new sight vocabulary than those with poor letter knowledge and phonological awareness. However, the influence of reading instruction appears to change the importance of certain skills for reading, a systematic synthetic phonics approach in particular draws upon memory span for reading development whilst visual discrimination is more strongly associated with the National Literacy Strategy taught children's word reading.

Research comparing the effects of reading programme tends to focus on those skills very closely associated with reading, for example, word reading, spelling, comprehension and writing skills. However, as shown in Chapter 9, when cognitive processes were measured also, there appeared to be a positive effect of synthetic phonics on memory span in particular (there were no effects of reading programme on planning, attention, simultaneous or the other successive skill). As synthetic phonics focuses on sequential left to right sounding and blending for reading on all words, with the amount of practice (i.e., seven years of primary school teaching and reading) that these children will have had using this technique, it is possible that it has been

developing their memory spans as well. Other main results found in the reading programme studies will be discussed further as they represent interesting avenues for future research.

Directions for future research

Whilst this thesis branched off in different directions throughout the three years of research (i.e., reading strategies, attitudes and cognitive processes), there are two potentially interesting avenues to direct future research. Firstly, to further study the PASS model of reading and its relationship to lower and higher level language skills necessary for reading. Secondly, and arguably the most exciting, is to examine the effects of reading instruction on cognitive processes. First of all, ideas for future research regarding the PASS model will be suggested.

Firstly, it is important to carry out more studies to validate many of the claims made by the authors of the PASS model of reading. Planning and attention are argued to be drawn upon increasingly with task complexity, however no research has been carried out to study this. In addition, successive processes are argued to be most the important for decoding unfamiliar words, however there is little evidence to support this (the Joseph et al. 2003 study tested children with poor phonological skills, which may have confounded the relationship between successive skills and nonword reading). Finally, the importance of simultaneous skills in reading comprehension needs to be tested through comparing its relationship between that and other reading related tasks (i.e., nonword reading).

Research examining the relationship between the PASS model and those skills known to be linked to reading (e.g., inference, integration, comprehension monitoring) could be

carried out to examine whether the PASS model offers an alternative method of assessment of both higher and lower level language skills that does not require reading. Tests measuring inference, integration and comprehension monitoring skills have been carried out in the past through reading tasks (Cain et al., 2004a). In these tasks, children have been required to read short stories and their inference, integration and comprehension monitoring skills have been evaluated through the quality of the answers they give based on what they have read (Cain et al., 2004a). However, the PASS model may still tap children's abilities on these skills, but without the requirement of reading. In order to assess the association between PASS and those skills outlined by Cain and colleagues (2004a, 2004b), planning, attention, simultaneous and successive skills, in addition to word reading, inference, integration and comprehension monitoring would need to be measured in the same individuals. If high correlations were found in the associations predicted, this would provide more evidence for the validity of the PASS model and its use as a tool in understanding the skills involved in reading. It is important to recognise that in doing so, this will not provide a completely comprehensive account of the skills required for reading; for example, working memory (Cain et al., 2004a) has also been found to play an important role in reading comprehension, something which PASS does not measure.

A second area of research would be to examine the effects of reading instruction on cognitive processes. This is an exciting new area to investigate and research examining cognitive processes in reading might branch off in three different directions.

The first direction would be to examine whether different types of reading instruction develop not only those skills that they are designed to develop (i.e., reading and spelling skills), but also train and develop other cognitive skills (as was suggested in Chapter 9).

Reading programmes would need to be analysed initially to examine the different types of cognitive skills that they are developing and then these skills need to be tested. Synthetic phonics appears to be developing memory span, as children are required to keep all the sounds in a word in their memory and blend them together for reading. As they use this technique for all word reading (at least when words are unfamiliar), this practice and rehearsal may be improving memory span. Whole language (whole word) approaches could theoretically be developing visual memory, as children are required to remember a huge number of words as wholes, using the visual form of the word as their cue. In addition to this they may be developing visual discrimination, as children may be using visual cues to distinguish between different words. If research was to lead in this direction, pre-test measures of these skills would need to be carried out with the children to rule out any differences before reading instruction. In addition, this research would need to be carried out with a larger sample of children and include a variety of cognitive measures to investigate whether only those specific to the reading programme were being developed.

The second direction would be to examine the cognitive substrate underpinning learning to read when children are taught by different methods. If clear differences are found (and Chapter 10 suggests they are), then this may have an effect on the types of skills teachers may teach alongside literacy which may improve the quality of teaching of reading. Letter knowledge and phonological awareness are consistently found to be critical for early reading to develop. This was shown in the National Literacy Strategy group who were taught to read by a method that is typical throughout England (and so may explain why the results confirm what other researchers in England have found (Hulme et al., 2002; Muter & Snowling, 1998; Muter et al., 1998). However, letter knowledge and digit span (and simultaneous skills at post-test) were seen to explain

significant variance in word reading, when the phonological awareness measures did not. This may be because children had a rapid introduction to phonics, which does not require them to be able to hear the sound units within spoken words (as phonological awareness does) but rather make the link between the printed form (grapheme) and its corresponding sound (phoneme). Indeed, children do not need this initial phonological awareness teaching prior to phonics, but can learn to read very well with the initial teaching of phonics (consistent with Johnston & Watson, 2004a; 2004b). It is the way in which phonics is taught however which should be examined, to understand better the different cognitive substrates which may underpin children's reading development when taught by different methods. This research fits with that of Stuart et al. (1999; 2000) who proposed that children use different methods for remembering sight words depending on the level of their phonological skills. Those with good phonological skills rely far less on visual memory than those with no phonological skills. Likewise, as level of phonological skills may change the cognitive substrate underpinning recognition of sight vocabulary, reading instruction may also change the cognitive substrate underpinning reading.

Finally, if we can understand better the cognitive processes involved in reading, and how they may manifest themselves in reading difficulties, the source of reading difficulties with children may be more easily found and interventions with poor reading children could be more individually tailored. For example, one child's reading may be limited by their poor memory span, as they may find it difficult to hold all the sounds of words in their memory for blending. Alternatively a child may have poor visual discrimination which may be impairing their ability to distinguish between similar looking letters or words when reading. Research regarding this has already been carried out (Naglieri & Gottling, 1995; 1997; Naglieri & Johnson, 2000) and it has been found

that children poor in planning benefit specifically from instruction designed to make them more planful compared to children who are not poor in planning. This is an alternative way to think about reading remediation, as usually children are re-taught letter sound knowledge, phonological awareness and phonics if they are having reading difficulties.

Final note:

The aim of the thesis was to produce a relatively comprehensive account of many of the factors that may affect children's reading and has therefore drawn on different areas in the educational and psychological literature. One very important point to note is that no factor exists in isolation. There is a very fluid relationship between a large number of factors affecting children's reading. It is the job of reading researchers to pinpoint specific areas of interest and examine them by limiting any effects of confounding factors. At the same time however, it is crucial to remember that in reality, many of these factors will causally affect each other. It is through acknowledging this second point that the ideas in this thesis have been developed, but through adhering to the first point that the methods have been devised. It is also important to note that discussions formed following each of the experimental chapters are based on the results found in each of the studies. However, interpretations are not facts. Rather they were seen as the best interpretation for the data that was found, in addition to what has been found previously. Through future research, some of the ideas that have been suggested in this thesis can be examined in more detail in order to find more evidence for *or against* it.

Conclusions

The results of this thesis strongly support the teaching of synthetic phonics as opposed to the previous National Literacy Strategy's guidelines approach using analytic phonics. Synthetic phonics taught children become more independent in reading early on and better readers later on. In the current thesis, one of the greatest benefits of synthetic phonics for older children was that there were fewer underachievers and fewer extremely low performers. The results also show that a programme strongly focused on phonics does not disadvantage children learning to read a non-transparent language such as English. Rather, their better phonics skills boost their ability to access the phonological parts of irregular words and read them more accurately. The studies have also highlighted the discrepancy between the large gender differences perceived to exist in reading ability, and the relatively small differences that actually exist in the statistical analyses. Gender differences that exist in planning and attention and in attitudes and its relation to achievement, all highlight greater sources of differences between boys and girls, which should be taken into account in the teaching of reading.

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APPENDICES

Appendix 1.

Regularity task items for Chapters 4 & 5

Appendix 2.

Questionnaire for Chapters 6 & 7

Appendix 3.

Cognitive tests devised for Chapters 8 & 9:

Planning: Trail making task and Visual search

Attention: Stroop and Letter pairs

Simultaneous: Picture selection and Picture drawing

Successive: Number relation and Word order

Marking guidelines for PASS tests.

Appendix 4.

Cognitive tests devised for Chapter 10:

Simultaneous: Embedded figures and Relation between shapes

Successive: Word order and Sentence repetition

Marking guidelines for simultaneous and successive tests.

Appendix 5.

Teachers report of literacy activities with National Literacy Guidelines and synthetic phonics in Chapter 10.