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Can we improve children's spelling ability by teaching morphemes through text reading?

An intervention study exploring the relationship between morphological awareness and literacy

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Abstract

Background: The need to improve children's spelling ability remains a key government agenda and is an issue encountered frequently by Educational Psychologists (EPs) in their practice. Recent research has suggested that there is a strong connection between awareness of morphemes and understanding and accurate use of the English spelling system, but relatively little is taught on this subject in school. The aim of the present study was to investigate whether a 5-week intervention can promote the development of 6- to 8-year-olds' morphological awareness and spelling ability.

Method: Through the medium of guided group reading, an Intervention group were taught about the morphological rules that govern the spelling of plural '*-s*' and past tense '*-ed*', whilst a Control group were taught about two phonologically-based spelling patterns. The intervention was compatible with current curriculum demands and was delivered to whole classes by their teachers. Pseudoword spelling tasks were administered at pre-, immediate post-, and delayed post-intervention points to assess the children's learning of the morphological rules in question.

Results: Quantitative analyses suggested that the intervention did not have a significant impact on morphological awareness in spelling. However, a third of participating children showed clear gains, and reasons for variation in response to intervention were explored. The overall picture indicated that those with better literacy skills have better baseline morphological awareness and that they also responded best to the intervention.

Conclusions: The implications of the results are discussed with reference to theories of literacy development and individual differences therein; and in the context of teaching and the profession of Educational Psychology. It is hoped that the study will increase the evidence-base of EP work, and raise awareness that the system of morphemes could be a powerful resource for children learning literacy.

Declaration

I hereby declare that, except where explicit attribution is made, the work presented in this thesis is entirely my own.

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Chapter 1:
INTRODUCTION

1.1 National standards and literacy

In recent years, the need to raise standards of learning has become an increasingly dominant backdrop to the education system in the UK. The DfES's (2004) Five Year Strategy for Children and Learners heeded evidence that the education system was not meeting the requirements of employers and society, which have transformed in the last 60 years with the recasting of industry, employment and technology. In short, standards of education – which are closely linked to a nation's economy(Pearson, Kamil, Barr, & Mosenthal, 2000) – have been slipping. The government has thus recognised the need to take our education system, previously designed to deliver a basic minimum entitlement, and elaborate it to respond to the increasingly sophisticated and rapidly changing demands of modern society. The result has been an emphasis in UK national policy on the use of evidence-based practice to raise standards of educational attainment for all children, and on challenging failure.

Robust literacy skills are a vital cornerstone of educational success and good life outcomes, and are therefore a key component of the output and skills of a country's workforce. There are many reasons why literacy skills are so important for raising standards in education. Firstly, they are essential for access to the curriculum. Children with age-appropriate literacy levels should be able to keep up in school, and remain motivated to learn and to continue attending school. Failure to access the curriculum is likely to reduce opportunities for intellectual stimulation and significantly

increase other risk factors for long-term negative outcomes – for example, being a teenage parent, having a criminal record, and not being in education, employment or training after leaving school (Office of National Statistics, 2001).

Secondly, there are certain groups of children who may operate at a level that is not commensurate with their cognitive abilities. These include children with specific learning difficulties (Frederickson & Cline, 2002); children in public care, and others who are undergoing experiences that impact on their psychological and emotional wellbeing (Social Services Inspectorate, 2002); children living in poverty (DCSF, 2009a; Orfield & Lee, 2005); and children who are learning English as an additional language (Hutchinson, Whiteley, Smith, & Connors, 2003). Good literacy skills might be a factor that enables such children's achievement to remain in line with their ability.

Thirdly, as they mediate academic success, good literacy skills might be a source of self-esteem, which is extremely important during schooling (Wallace, 2008). A child with weak literacy skills is at risk of developing a negative attitude towards education, and others may in turn have low expectations of his/her success – all of which make it very difficult for a child to develop a positive sense of him/herself as a learner and to achieve.

Fourthly, children who come from the lowest social classes or, for other reasons, grow up in impoverished environments, often demonstrate impoverished language (Berridge, 2006). Language development predicts literacy development (Bishop & Snowling, 2004), and in turn influences cognitive development (Nelson, 1996), suggesting that such children could be multiply disadvantaged. However, the relationship between language and literacy has been shown to be bidirectional (see Bishop & Snowling, 2004, for a review). Thus, children at risk of impoverished language will be better equipped if they are supported to develop strong literacy skills.

It is clear that any child who does not possess age-appropriate literacy skills is educationally, socially and economically at risk. Yet in spite of the array of contemporary evidence on the tangible impact of good literacy on a person's life, some reports suggest that the UK has some of the lowest levels of child and adult literacy in the developed world (Leitch, 2006). It is important to set the scene here, though. When one sets out to investigate national literacy standards, it immediately becomes apparent that the data are complex, challenging and ambiguous: some are encouraging; some, very negative. What is clear is that the data need contextualisation, as they do not necessarily reflect like-with-like comparisons. A perceived decline in literacy standards may, for instance, be accounted for by exploring patterns of immigration. Immigration has brought large numbers of children into our primary schools who are in minority ethnic groups and have English as an additional language (EAL). According to government statistics, these children are likely to have lower literacy levels than the national average. For example, 78% of EAL pupils achieved the expected level in Key Stage 1 reading, compared to 86% of non-EAL pupils (DFES, 2006a). Similarly, there are gender differences in literacy standards and in the emergence of literacy skills during development (DCSF, 2009a), awareness of which may be important for understanding the data. These points should be borne in mind when reading the following paragraphs.

The Progress in International Reading Literacy Study (PIRLS 2006) (Mullis, Martin, Kennedy, & Foy, 2007), a comparative study of the reading of 10-year-olds across 41 countries, conducted on a five-yearly cycle, has found that pupils in England achieve significantly below some of their European counterparts, and there has been a fall in performance since 2001 – across the ability range and in both boys and girls(Twist, Schagen, & Hodgson, 2007). DCSF figures show that one in five 11-year-olds fails to reach the expected level in literacy and numeracy at Key Stage 2 (DCSF, 2008). There are many different reasons *why* children struggle with literacy, ranging from special educational needs and reduced opportunities (perhaps resulting from issues like immigration) to low

aspirations. The reasons may also relate to what is taught, and how it is taught; indeed, the difference in achievement across 41 countries found in the PIRLS study could well be an artefact of this.

What is incontrovertible is the importance of addressing literacy, because the picture that emerges from profiles of disadvantaged adult lives points to the prominence of poor literacy skills (National Literacy Trust, 2008; Maughan, Messer, Collishaw, Pickles, Snowling, Yule, & Rutter, 2009). Although the relationship between literacy and other variables may not always reflect direct causal connections, the early development of robust literacy skills is a key first step in helping to overcome other related factors that may in time lock individuals into a cycle of economic and personal deprivation.

Since 1998, the government has worked hard to address this apparently dismal literacy scenario, with the implementation of the National Literacy Strategy (NLS; DfEE, 1998). Developing from dissatisfaction both with pupil standards and the methods of teaching commonly adopted in primary schools, the NLS was described as one of the most ambitious national initiatives for change that primary education in Britain has seen (OFSTED, 1999). The NLS was subsequently rebranded as the Primary Framework (PF) for Literacy (DFES, 2006b), highlighting the role of phonics in the teaching of literacy as a direct consequence of Rose's (2006) Independent Review of the Teaching of Early Reading. Other initiatives include the Waves of Intervention Model (DFES, 2003), and the Making Good Progress Pilots (DCSF, 2010a), both of which guide schools towards more systematic intervention for improving progress in literacy.

There is evidence that the impact of the NLS and PF has been positive. For example, a Canadian research team invited to carry out an external evaluation concluded that, as an instance of large-scale reform, the NLS compares very favourably with other such efforts elsewhere(Earl, Fullan, Leithwood, & Watson, 2000). More recent evidence has suggested that

initiatives aimed at changing the content and structure of literacy teaching have significantly raised pupil attainment, with modest but positive effects from exposure to the literacy hour (a key component of the NLS/PF) that persist to age 16 (Machin & McNally, 2004). On the other hand, when viewed in the European context, such progress seems less impressive, as the findings from PIRLS 2006 have highlighted.

Furthermore, whilst PIRLS focuses only on reading, what is apparent in other analyses is that progress made in spelling is rarely as marked as that made in reading (OFSTED, 1999; DCSF, 2009b). It is this which underpins the current research project: whilst literacy levels overall appear to be improving, spelling remains a significant concern for education professionals, psychologists and the lay public, and presents a hindrance to the success of the government's Standards Agenda. There is a glaring lack of research evaluating effective teaching of and interventions for spelling, accompanied inevitably by a lack of evidence-based practice in this area (Brooks & NFER, 2007). Whilst the PF is having positive outcomes for reading levels, it remains a major challenge to ensure that as many children are enabled to become good spellers. Statistics (DCSF, 2009b) illustrate that while national test results in writing (these include handwriting and expressive writing skills, as well as spelling) at age 11 have improved by 14% since 1997, only 67% of pupils achieved the expected level for their age in 2008. This compares to 86% achieving the expected level in reading. Whilst such statistics could be taken as evidence that expectations and the standards set for spelling are simply too high, it is concerning that many students are making the transition to secondary schools, or even to further and higher education, with limited ability to spell or write coherent sentences.

1.2 The development of spelling

Spelling involves a set of active, conscious processes that are not necessarily required for reading (Crystal, 2000) and, as such, it generally represents a bigger challenge to learners than reading. Throughout the years, a variety of teaching methods and resources have been put to use in the hopes of offering a trouble-free, guaranteed-to-work approach to spelling. Yet, there are children coming through the education system who go on to struggle with spelling their whole lives (Maughan *et al*, 2009). Why might this be? It will be argued that the reason may be, at least in part, due to a lack of awareness of morphology. However, there are of course a wide range of stumbling blocks encountered by children learning to spell, and these can be elucidated through a discussion of the research on the development of spelling ability and the different theoretical perspectives therein. The following section will be a broad review of the most significant pieces of research in this field.

1.2.1 Challenges of learning to spell in an opaque alphabetic writing system

It is first important to consider the principles of writing systems that are likely to affect the process of learning to spell. In all writing systems, a key issue for children is to understand what the system they are learning does and does not represent (Snowling & Hulme, 2007). In general, writing systems ignore the intonation and stress (i.e. suprasegmental) features of speech, and they do not convey information about regional dialect. However, the components writing systems represent vary across languages (Treiman & Kessler, 2007). Whilst the units represented in

written Chinese are words and morphemes (the smallest meaning-bearing unit in language), the great majority of the world's writing systems represent phonological units. These may be syllables or rimes, but most are even smaller: there are separate symbols for each sound segment, or phoneme. Such writing systems are called alphabets, and English is an example (e.g. Olson, 1994; Treiman, 1993). Treiman and Kessler (2007) highlight that each of these types of system in turn requires fewer symbols than the one before, bringing the advantage of having less to learn and remember. However, there are "trade-offs" (p.123) associated with this: as the number of symbols decreases, learners have to insert an increasingly wide range of units into a particular symbol "slot" (Saxton, 2010a: 221). (Whereas Treiman and Kessler (p.123) refer to this as an increase in abstractness of symbol-to-unit mappings, Saxton (p.221) prefers the notion of knowledge shifting from linguistically specific to linguistically general.) This can make the accurate representation of units (i.e. speech sounds) for writing more challenging than in systems where there is one symbol representing one word or morpheme, such as Chinese.

What do children know about the relationship between spoken and written language, and how do they make sense of their writing systems to eventually become spellers? There are several challenges to face – some associated with linguistic skills and some with visual memorisation skills. These all contribute to individual differences in early spelling performance in English (Caravolas, Hulme & Snowling, 2001).

The first step is for children to recognise that spoken words contain a sequence of separate sounds – an ability generally referred to as phonological awareness. Next, they must learn the alphabetic principle: letters and combinations of letters are the symbols used to represent speech sounds. Herein lies one of the greatest obstacles. Languages such as English are opaque alphabetic writing systems (Kucer, 2009): the correspondence between letters and sounds is not one-to-one; there is

variability in sound-to-spelling mappings. For instance, the sound /k/ may be spelled *k*, *c*, *ck*, or *ch,* whilst the vowel sounds in the words *to, too, two, sea* and *see,* or *bow* and *bough*, are all pronounced the same but spelled differently. Likewise, the spelling pattern *-ough* may be pronounced in at least nine different ways, as in *rough*, *dough*, *bought*, *plough*, *Middlesbrough*, *lough*, *cough*, *hiccoughed*, *through.* Thus, the same linguistic unit may be represented in more than one way, or different linguistic units may be represented in the same way. Children must learn which symbols to use, and when. If the choice is arbitrary, they must rely on rote memorisation to spell the unit in question. However, in English at least, the spelling system is less chaotic and unsystematic than is sometimes perceived; there are factors at play which allow children to predict which spellings are used when, thus lessening the burden on memory. These will be discussed later. The third challenge is for children to hone their sound classification skills to their specific writing system – for example, deciding which segments are similar enough that they should be represented by the same symbol (Read, 1975; Treiman & Kesler, 2007).

Of course, learning to write requires visual skills as well as phonological skills: children must learn the shapes and referents of the symbols that are used to represent linguistic units. They must distinguish symbols used for writing from those that are used in other domains, such as drawing and numbers. Chan and Louie (1992) have shown that children pick up on these graphic features quite early but, inevitably, in systems containing some very similar symbols, children can experience confusion – such as lower case *b*, *p* and *d* in English. Furthermore, children must learn variant forms, as with upper-case and lower-case versions; they must learn about disjoint symbols, such as accents in French; and learn about groups of letters that can function as single units, as in English *sh*, which are the source of frequent spelling errors (Treiman & Kessler, 2007).

Having outlined the common challenges faced by children in learning to use a writing system, the review will now turn to the process of spelling

development itself. In contrast to the very large body of research on learning to read, the development of spelling has received less attention (Brooks & NFER, 2007). Nonetheless, consideration of the existing models, theories and relevant evidence on learning to spell makes it clear that a variety of skills is required.

1.2.2 Relationship between spelling and reading development

Caravolas, Hulme and Snowling (2001) argue that in order to gain the clearest sense of how spelling development occurs, it is crucial to uncover the nature of the relationship between reading and spelling. This would certainly seem logical given that numerous studies have demonstrated a strong relationship between spelling and reading skills (e.g. Bruck & Waters, 1990; Ehri & Wilce, 1987). Does a reciprocal relationship exist from the earliest stages of learning, or does reading typically develop first and provide a foundation for the development of spelling?

Two key researchers to have contributed to the field of early reading and spelling development are Frith and Ehri, with their stage models of word recognition. Frith (1985) claimed that there are qualitative differences in the time-course of children's reading and spelling, and also that there are causal links between these two activities. According to Frith's model, based largely on children's reading errors, children begin to develop literacy skills by first reading words using partial visual cues ("logographic stage"); this then fuels a motivation to write, and children attempt to spell words the way they sound, on a one-letter-to-one-sound basis – thus progressing into an "alphabetic" stage of spelling development. They then transfer their emerging knowledge of letter-sound correspondences to reading ("orthographic stage"). Hence reading becomes the pacemaker: it

is the process through which detailed knowledge of orthographic structure is derived, which children later apply to their spelling.

The work of Ehri, beginning with an exploration of word-reading development (e.g. Ehri & Wilce, 1987) and later of spelling ability (Ehri, 1997), argues for four phases of development. The first "pre-alphabetic phase" occurs prior to any alphabetic knowledge, and uses visual and contextual connections. In the second, the "partial alphabetic" phase, the child uses the most salient letters in words (often the first and last) to attempt pronunciation. When children are able to form alphabetic connections, recognise words they have seen before and read new words, they enter the "full alphabetic phase". Ehri discusses the way that during this phase there is an integral development towards using "sight word reading" over decoding individual letters, and children make use of irregularly spelled words to adopt strategies for handling irregularities (e.g. by noting silent letters such as the *-s* in *island*). Finally, in the "consolidated phase", recurring letter patterns have become consolidated or unitised through continued practice at reading. So, the word *chest* might be processed as only two units in this phase – *ch-est* – compared with four – *ch-e-s-t* in the full alphabetic phase).

Hence, Ehri has converged on a similar developmental progression to Frith, and both conceptualise spelling and reading as stage-type processes. Ehri breaks down and defines the alphabetic phases more clearly than Frith, and she posits that further development falls within the consolidated alphabetic phase as compared to Frith's orthographic stage. Another distinction is that Ehri regards the formation of connections between graphemes and phonemes to be more essential than Frith, who seems to consider sight word reading to be non-phonological.

For Ehri, spelling development is most strongly determined by knowledge of the general alphabetic system, such as segmenting and blending with phonemes; knowledge of letter names and how letters can be grouped

into functional units (graphemes); and knowledge of phoneme-grapheme correspondences. Like Frith, Ehri (Ehri and Wilce, 1987; Ehri, 1997) discusses how reading and spelling have an interactive reciprocal relationship with each other: the process of memorising words in order to read helps children to spell; similarly, having to spell out words while writing further helps the development of reading.

Models such as Frith's and Ehri's have often been criticised for their rigidity, and attempts to verify the timetable of stages, or phases, have met with little success (e.g. Treiman, 1993). The notion that there are qualitatively different cognitive processes involved in each stage, and the failure to take account of complex interactions between different sources of knowledge in word recognition and spelling, have been challenged (e.g. Treiman & Bourassa, 2000). Treiman and Bourassa (2000) therefore suggest that it may be more useful to view "stages" as a period in the child's development wherein a particular strategy may dominate, but other strategies or processes may concurrently be at play.

With respect to the predictive relationship between spelling and reading, the findings are inconsistent. Whereas Foorman, Francis, Novy and Liberman (1991) report a reciprocal, longitudinal relationship between the two skills, several other studies have found early spelling to predict later reading, but a weaker or nonsignificant effect of early reading on later spelling (e.g. Caravolas *et al*, 2001; Ellis & Cataldo, 1990).

A longitudinal investigation by Davis and Bryant (2006) into the effect of reading on spelling, in the case of the split digraph orthographic rule for long vowel words (as in *hope*), would support the causal claims in the later part of Frith's hypothesis: children's reading scores for long vowel words at 7 years predicted their spelling of these words at 8 years significantly better than 7-year spelling scores; and reading scores at 8 years predicted spelling scores at 9 years better than 8-year spelling scores. Davis and Bryant's findings are in line with Frith's (1985) proposal that, initially,

spelling drives the development of reading skill, whereas, later, reading becomes the pacemaker of spelling development.

The fact remains that there is little direct empirical evidence either for or against Frith's and Ehri's models (Caravolas *et al*, 2001). Their models therefore serve more as frameworks, proving useful sources of reference for teachers' observations of pupils' literacy development, than as sets of falsifiable scientific hypotheses (Beech, 2005).

Implicit in these staged reciprocal models of reading and spelling development is an assumption that the frequency of exposure to words through reading increases the likelihood of their being spelled correctly. For a long time this, and related assumptions, were probably the basis for an almost exclusive emphasis on visual recognition and immersion in text reading as a basis for mastering reading (e.g. "Look-and-Say"). The reciprocal emphasis in spelling was on mastering whole-word configurations of letters, learned through repeated visual exposure and sometimes through motor practice in writing (consolidated through methods such as "Look-Cover-Write-Check"). This teaching is still incorporated in literacy teaching programmes today. A detailed analysis of the inadequacies of these approaches when used on their own is not possible here; for a comprehensive discussion, see McGuinness (1998). Evidence has gradually grown for the efficacy of methods which give a central place to the teaching of the structure of words for literacy, rather than the recognition or memorisation of whole words, and this will be the focus of the next two subsections (1.2.3 and 1.2.4).

1.2.3 Role of phonological skills in spelling development

Phonology is the sound system of a language, and phonological awareness is the understanding of the sound structure of language. It is

an auditory skill that includes the ability to recognise, identify and manipulate units of speech, such as rhymes, syllables in words, and individual phonemes (the smallest unit of sound in a language) (Crystal, 2000). It has been acknowledged since the pioneering work of Read (1975) that phonological awareness is critical to early literacy. There is also evidence that young children's letter-sound knowledge is a good predictor of literacy among English-speaking children (e.g. Bruck, Genesee, & Caravolas, 1997; McBride-Chang, 1999). Longitudinal studies have been unanimous in presenting evidence for a strong association between phonological awareness and early word reading and spelling: as children's phonological skills (phoneme awareness) and letter-sound knowledge improve, their reading and spelling become increasingly accurate (e.g. Bryant & Bradley, 1983; Gentry, 1982; Muter, Snowling & Taylor, 1994; Treiman, 1993; Critten, Pine, & Steffler, 20007; Plaza & Cohen, 2007). Without this phonological awareness, it is impossible for children to learn to decode and encode words in an alphabetic language.

Further evidence for the role of phonological skills in spelling development comes from Caravolas *et al* (2001) who carried out a 3-year longitudinal study, in an attempt to correct the dearth of conclusive evidence for reciprocal relationships among the factors affecting spelling development. They monitored the progress in spelling, reading, phonological skills, and letter knowledge of 153 British-English children during their first three years of schooling. Analyses revealed that phoneme awareness and letter-sound knowledge were the precursor skills of early phonological spelling ability (i.e. spelling with phonological plausibility rather than conventional accuracy); in turn, phonological spelling combined with reading to promote conventional spelling ability. Although initial phonological spelling ability predicted later reading, early reading ability did not influence later phonological spelling ability. However, reading was a very strong predictor later in the development of conventional spelling. Caravolas *et al*'s results provide support for Ehri's claim that proficiency in spelling requires a solid foundation in phonological awareness, which then

enables the formation of orthographic representations (Ehri & Wilce, 1987). Their data also suggest that the increasingly complex and specific orthographic patterns demonstrated in children's spelling are learned through experience and instruction in both reading and spelling.

The view of English as having an alphabetic script, and the aforementioned large body of research, has led contemporarily to an approach to the teaching of literacy in which the emphasis is on helping children become aware of the sounds in their language and how to represent these in letters. The Rose Report, drawing on the substantial evidence base from international research, strongly recommended that children should receive regular "high quality phonics work" (Rose, 2006). All principles underpinning this have since been incorporated into the curriculum. Although the growth in evidence-based policy and practice is undoubtedly a positive move, in this paper it will be argued that this focus on letter-sound relations is necessary for helping children learn to spell, but not sufficient.

1.2.4 Role of morphological skills in spelling development

The previous section explored the evidence for a relationship between reading and spelling development, and the role of phonology in literacy development. Phonological awareness and reading are clearly important but in themselves inadequate conditions to foster accurate spelling. Most children master simple letter-sound relations in word reading and spelling within one or two years from the beginning of instruction, but still have a lot to learn to become good spellers (Nunes & Bryant, 2009). The current section will deal with a different set of skills required in the process of learning to spell: morphological skills.

Morphology is the domain of grammar that focuses on the structure of words, and morphemes are the smallest meaning-bearing units of language. All words consist of morphemes. The meaning of any word depends on its underlying structure, or the morphemes it comprises. Content words (nouns, verbs, adjectives and adverbs) can comprise different kinds of morpheme: the root/stem and affixes. The root morpheme is the basic part of the word (e.g. *forget*) and this can be combined with one or more affix morphemes (e.g. *un-* and *-able* are added to make *unforgettable*). Affixes that precede the root are called prefixes; those that follow the root are called suffixes. Languages such as Swahili also have infixes, which are morphemes that are added in the middle of the root. These are very rare in English, but are nonetheless possible (as in *fanbloodytastic*).

Another essential distinction is between derivational and inflectional affixes. Inflectional-affix morphemes, or inflections, tell us about the grammatical status of the words to which they are attached. Two examples of inflectional morphemes are *-s* and *-ed*. Whether a regular noun is plural or not is signalled by the presence or absence of *-s* at the end of the stem; the effect of adding *-ed* to the end of a verb stem is to make it into a past tense verb form. Derivational morphemes, used widely in most languages, have the effect of building new words from old ones, often by changing the grammatical category of the original word (e.g. verb *forget* changes to adjective by adding the morpheme *-able*). In all cases, derivational morphemes change the word's meaning.

Morphemes can therefore have a lexical role, allowing the creation of new words from a root (e.g. affixes *un-*, *de-*, *-ness*, *-ship*), or they can be syntactical, their role being to show how the word must be used in a sentence (e.g. plural marker *-s* and past tense marker *-ed*).

It becomes clear that written English is not merely a system to represent the sounds (phonemes) of its oral language; it also represents meanings,

captured in the internal structure of words and in the grammar. This is why our written language contains nonalphabetic correspondences, wherein one sequence of sounds can be represented by different letter patterns (e.g. the /ks/ sound-ending, with its two spellings in the nouns *box* and *rocks* (Da Mota, 1996; Nunes, Bryant & Bindman, 1997b)), or the same letter patterns can represent different sounds (e.g. *cats* and *trees* end in different sounds, but both are both spelled with *-s*). These sorts of distinction will be the main focus of this project, because they are far from being illogical and unpredictable, and they have pragmatic consequences for teaching and learning. In principle, someone who understands about plurals can learn how plural meanings are marked in written language, even when they are not phonological notations of spoken language (Nunes & Bryant, 2009), because they are often governed by morphology.

The potential significance of knowledge about morphemes to children's literacy is huge. The point is that spelling patterns represent morphemes, as well as sounds, in written English (and in many other written languages). The representation of morphemes often results in spellings that cannot be predicted from the way that the word sounds (such as *box* and *rocks*) or might even contradict what would be expected from the sounds. Yet, once one brings morphemes into the equation, many of the spellings in our language which seem inexplicably to flout grapheme-phoneme correspondence rules can be explained. For example, *magician* is spelled as it is and not as *magishon*, because of morphemes. Even though the letter *-c* in *magician* no longer represents the sound /k/ as it does in *magic*, the first part of the word represents the word's meaning very well. The *-ian* ending is a derivational affix that is called an agentive: it signifies someone who does something. Thus, *magic* plus *-ian* is a good way of representing in writing the meaning "someone who does *magic*". The ending *-ion*, by contrast, (pronounced in the same way as *-ian*) is a derivational affix for nouns that do not refer to a person or animal, as in *education*, and *institution*.

The *-ian* / *-ion* distinction is an example of a morphological spelling rule; once the regularity of the spelling of morphemes is recognised, words that seem highly irregular can be seen as regular. The morphological rule underpinning the spelling of the /ks/ sound is another example: one-morpheme words will always be spelled with an *-x* or *-xe* at the end. For instance, "The ring is in the *box*" (one-morpheme noun) or "They *mix* the ingredients" (one-morpheme verb). Two-morpheme words will always be spelled with *-cks* or *-kes* at the end. For instance, "The beach is strewn with *rocks*" (two-morpheme noun) or "The cashier *takes* the money" (two-morpheme verb). In other words, the morpheme *-s* invariably represents the plural inflection in regular nouns, and the inflection for third-person present verbs. This is an entirely consistent morphological rule.

The morphological rule for the past tense inflectional marker *-ed* is an example of a case where the pronunciation varies but the spelling is always the same. In different regular verbs, this *-ed* ending represents three entirely different sounds which are /t/, /d/ and /ɪd/, as in *kissed*, *killed* and *waited*. According to grapheme-phoneme correspondence rules, none of these endings should be spelled *-ed*. The *-ed* ending is a direct link between morphemes and spelling which has little to do with phonology. If children were aware they were dealing with a regular past-tense verb, they would be able to surmise the correct spelling if they know the rule.

Such rules are consistently valid and can be applied by anyone familiar with the basic grammar of written (and spoken) English – that is, different parts of speech and how they function in writing, as well as the ways in which words can be put together. When there are alternative, seemingly legitimate, spellings for the same sound, morphology often determines which spelling is correct. When the same morpheme is pronounced differently in different words, the way it is spelled is often the same across these words despite the variation in pronunciation. This suggests that morphological awareness is a key sub-skill within literacy development

that should facilitate the complex process of learning to spell. The next section will consider the emerging evidence to support this supposition.

1.2.4.1 Importance of morphemes for language and literacy development

Research shows that children's sensitivity to the way in which words are constructed from morphemes and the progress they make in language and literacy interact and strengthen each other, as will be demonstrated now.

1.2.4.1.1 Morphemes and vocabulary development

Classic studies, such as Berko's wug test (1958) and that of Anglin, Miller and Wakefield (1993), have investigated – respectively – children's application of morphological rules in speech and the growth of their vocabulary in relation to the development of morphological knowledge. This is a large area of research but, as it is not the focus of this thesis, there will be just a brief outline of the principles underpinning the early stages of the relationship.

We know from research by Gathercole and colleagues that children's phonological memory skills are associated with their ability to learn new words, because they must be able to remember the sequences of sounds that form words (e.g. Gathercole, Service, Hitch, Adams, & Martin, 1999). There is now evidence that children also use morphological knowledge in remembering sounds in a new word, whenever it has a morphological structure that they recognise. Nunes and Bryant (2009) report an experimental study in which they compared 9- to 11-year-old children's performance in a non-word repetition task where half of the words did not have a clear morphological structure (e.g. *hampent*) and the other half did

(e.g. *winteriser*). The children's morphological knowledge was assessed with an oral sentence analogy task (e.g. "Tom helps Mary" > "Tom helped Mary"; "Tom sees Mary" > ?). Nunes and Bryant found that the children remembered non-words with a morphological structure significantly better than those without, and furthermore there was a significant (but low) correlation between the children's performances on this task and the sentence analogy task, after controlling for age and phonological skills. They concluded that the better a child's morphological knowledge, the greater will be their ability to remember new words. Similar research exists in the field of Specific Language Impairment (see Van der Lely, 2005, for a review).

Once children have learned sequences of sounds of new words, how do they attribute meaning to them? There is evidence for children's ability to use morphology to infer word meaning (e.g. McBride-Chang, Tardif, Cho, Shu, Fletcher, Stokes, Wong, & Leung, 2008). This seems quite obvious, because large numbers of the words that they have to learn at school are derived (with the help of derivational morphemes) from other words, as in *un-forgett-able*. Children can infer the meaning of new words if these words are combinations of morphemes whose meaning they already understand. They may need explicit teaching on how to do this, however: Nippold (1998) provides examples from an American textbook containing step-by-step guidance on how to determine the meaning of an unfamiliar compound word. The book instructs its readers first to segment the word into its compound roots (e.g. *snowstorm* = snow-storm). Syntax (word combinations and sentence structure) can also aid vocabulary learning. Gleitman (e.g. Gleitman, 1990) used the term "syntactic bootstrapping" to refer to children's use of syntactic context to narrow down the meaning of unfamiliar verbs – in other words, semantics builds on top of syntax – and many studies have provided support for this mechanism. For example, Naigles (1990) reports an experiment in which 25-month-olds who heard the transitive sentence *The duck is kradding the bunny* looked longer at an pictorial event in which a duck acted on a bunny than at an event in which

the duck and bunny acted independently. This suggests that they understood the causative meaning associated with the transitive sentence structure: the appearance of *is kradding* after *the duck* reveals that *kradding* is a verb; furthermore, it is a causative verb, in which an agent (*the duck*) causes something to happen to an object (*the bunny*) (Saxton, 2010a).

1.2.4.1.2 Morphemes and reading development

Turning now to the connection between morphology and reading, researchers have shown that children use morphological knowledge when they read, both for word decoding, and also for comprehension. Tunmer and colleagues were some of the first to put forward this argument (e.g. Tunmer & Bowey, 1984).

With regards to word decoding, Leong (2000) carried out studies using reaction times in computerised lexical decision tasks, in which Canadian children were required to vocalise as rapidly and accurately as possible root words (e.g. *clean*) when primed with complex derivations (e.g. *cleanliness*) embedded in sentences. The reverse procedure was also investigated. Leong found that morphological knowledge – demonstrated by awareness of morphological relationships, as well as morphological, semantic and syntactic correctness – enhances decoding and pronunciation. Rego and Bryant (1993) devised a method to see whether children use the context of sentences to facilitate word recognition, so looking more specifically at syntactical knowledge in reading. They presented children with words in isolation, and later presented the same words, that the child could not initially read, in the context of a sentence. They also measured awareness of syntax. Rego and Bryant found strong support for the existence of contextual facilitation, and later work by Nation and Snowling (1998) confirmed these results with poor readers aged 7 to 10: only poor readers with good syntactic awareness were able to profit from reading the words in context.

Whilst phonological awareness has been shown to be a predictor of early word-level reading, and morphological awareness has not (Muter, Hulme, Snowling, & Stevenson, 2004), Casalis and Louis-Alexandra (2000) found that morphological awareness does become an important predictor of later word-level reading. Such studies provide further evidence that fluent and skilled word reading is not the product solely of decoding through grapheme-phoneme correspondence, but that morphology and syntax also contribute.

Morphological and syntactical knowledge also influence reading comprehension. They were shown by Muter *et al* (2004) to be early significant predictors of reading comprehension, above and beyond vocabulary knowledge. Why? Most longer words in English are composed of more than one morpheme (Nagy & Anderson, 1984). Through the processes illustrated earlier on, morphological knowledge helps children learn new, complex words. If they encounter these words in print for the first time, they can infer their meanings. Various studies have given substance to this claim. In the USA, Carlisle (1995) gave first-grade children a sentence completion task in which they were asked to produce a derived word that was determined by both morphology and syntax. For instance, the children hear *farm* and they are asked to use this word to complete the sentence, "My uncle is a [.....]". In such an example, it was easy to note the connection between the base and derived word; in others, the connection was less transparent, as in *explode* with the sentence, "We heard a terrible [.....]". Carlisle found that scores were quite strongly related to the level of their reading comprehension a year later. Similar correlations have also been found in Canada (Deacon & Kirby, 2004) and France (Casalis & Louis-Alexandra, 2000).

1.2.4.1.3 Morphemes and spelling development

The central premise of this research is that awareness and understanding of morphemes are associated with spelling ability, and there is empirical evidence to support the existence of this association. At present, the direction of causality and the nature of this causal relationship are not well understood, and it is precisely because of this that studies such as the current one are needed. It is necessary to remember that assessments of children's knowledge of morphology are not independent of their knowledge of syntax, since morphemes are related to word class, and different word classes are used in different sentence contexts. Equally, it is important to remain mindful that to be credited with having morphological awareness or understanding of morphemes, children should be required to manipulate morphemes intentionally, as this shows that their knowledge is not simply implicit (Carlisle, 1995). (Explicit knowledge is hypothesised to be more valuable than implicit knowledge in a domain such as spelling because it allows learners to generate and test hypotheses about patterns, regularities or underlying concepts in the language and orthography, to update their mental model of the system accordingly and, importantly, to transfer their learning to novel situations (Robinson & Ellis, 2008)). Suffice to say now that the studies reviewed in the current section follow this criterion.

Fowler and Liberman (1995), and Derwing and Wiebe (1995) were among the first to investigate a connection between children's awareness of morphology and their use of morphology in spelling. Whilst they did find a positive correlation, they both used a general measure of spelling (standardised spelling tests), not a specific measure of use of morphemes in spelling.

Treiman and Cassar (1996) and Bourassa, Treiman, and Kessler (2006) presented evidence that children as young as 7 can use their knowledge of the morphological structure of words to increase the phonetic plausibility of their spelling attempts. In both studies, children were given a spelling test comprising 15 one-morpheme words (e.g. *feast*) and 15 two-

morpheme words (e.g. *faced*) that were matched phonetically for their final consonant clusters. The spellings of the final consonant clusters of one- and two-morpheme words were categorised as correct if both phonemes were represented in a phonetically plausible manner (e.g. *raced* spelled as *rast*). Morphological knowledge was thus measured through whether or not spellings were assembled from their constituent morphemes, regardless of conventional accuracy.

Nunes, Bryant and Bindman (1997a) carried out the first study – with a large sample of children aged between 6 and 8 years – where children's spelling ability was measured at three points over one year, with respect to the correct use of the *-ed* morpheme. This involved spelling: (1) regular past verbs, which are spelled with *-ed* although it is never pronounced; (2) irregular past verbs, which are spelled phonetically, not with *-ed*; and (3) non-verbs that have a /d/ or /t/ sound at the end, so they sound like the other two types of words but are never spelled with *-ed*. Nunes *et al* (1997a) explored whether the children's performance in a variety of morphological awareness tasks at the beginning of the study – sentence analogy, word analogy and a pseudoword inflection task – predicted their correct use of the *-ed* spelling at a later age. They controlled for age, general verbal ability, and correct use of *-ed* at the earlier time. The results of the study showed that morphological awareness continued to be significantly correlated with children's correct use of the *-ed* morpheme.

However, the spelling measures in this initial study were entirely based on real words, which can be spelled correctly using word-specific knowledge. If trying to ascertain whether children are spelling using morphological knowledge, real words can be a 'contaminated' measure and pseudowords are preferable. Nunes, Bryant and Bindman (1997b) therefore carried out a similar predictive study in which spelling ability was measured by means of a pseudoword task created by analogy to real verbs. For example, by analogy to *yell – yelled*, they created *crell – crelled.* The children could have worked out whether the pseudoverbs

were regular or irregular through their stems: in the majority of cases where the verb stem sounds different in the present and in the past, the past form is irregular and is spelled phonetically – i.e. according to letter-sound correspondence rules. (There are, however, irregular verbs which do not follow this pattern, as in *buy – bought*). Short texts were read aloud containing examples of the pseudoverbs in two different tenses to provide sufficient information about stems; the children were then asked to spell the invented words. After rigorous analysis, there was again a significant correlation between the children's scores on the morphological awareness task and their spelling of the *-ed* ending in pseudoverbs.

Nunes *et al* (1997b) acknowledge that their results should be interpreted with caution, as their correlations were weak. However, since that time, various other studies have added support to the theory that morphology is important for spelling acquisition (e.g. Nagy, Berninger & Abbott, 2006). It has been found not only in English but also in Hebrew (Levin, Ravid, & Rapaport, 1999), Dutch (Rispens, McBride-Chang, & Reitsma, 2008) and Greek (Bryant, Nunes, & Aidinis, 1999).

Larkin and Snowling (2008) tried to replicate the findings of Treiman and Cassar (1996), and extend them to even younger children, using the same spelling stimuli and scoring system. They predicted that because children typically master the regular past tense in spoken language by around 5 years (Rice & Wexler, 1996), children aged between 5 and 6 will be able to use their understanding of morphology to aid their spelling attempts. However, their results provided no evidence that these children were using a morpheme assembly process to spell two-morpheme words. In discussing possible reasons for this disparity in findings, Larkin and Snowling refer to Rubin's (1988) theory that it may be due to poor attention or limited processing capacity that children fail correctly to spell the second morpheme of a word, rather than to unawareness of the word's constituent morphemes.

Larkin and Snowling (2008) suggest that their findings could support Frith and Ehri's stage models of spelling development, where children progress from relying on phonetic spelling strategies to more global orthographic strategies.

1.2.5 The process of learning morphological spelling rules

In the preceding discussion, evidence was presented for how knowledge of morphemes and morphological rules makes the mastery of literacy and language an easier task. This naturally prompts the question: do children learn the morphological rules that can aid their spelling and other important components of literacy and language learning? Until recently, there was general agreement that the rules are acquired by most children at some stage in their development. Some authors proposed that this starts as early as age 6 (Treiman & Cassar, 1997), whereas others report data pointing to later acquisition between the ages of 8 and 10 (e.g. Bryant, Nunes, & Bindman, 2000). However, Kemp and Bryant (2003) and Mitchell (2004) challenged the assumption that morphological spelling rules are universally acquired in learning to spell.

Kemp and Bryant used the paradigm of pseudoword completion tasks pioneered by Berko (1958). In an extension to Berko's paradigm, which used the medium of oral language, they asked children to spell words that are unfamiliar to them, but whose morphological structure is clear from the context. They looked at the use of the plural *-s* ending, which is governed by the morphological rule that regular plural endings in English are spelled as *-s*. This holds true whether they are pronounced with a final /s/ or a final /z/, whereas nonplural /z/-endings can be spelled *-z*, *-zz*, *-ze* or *-se*. Kemp and Bryant hypothesised that children may use *-s* for /z/-ending

plural words like *dogs*, in which the stem ends in a consonant, because nearly all words in which the /z/-ending is preceded by a consonant are plural; the few exceptions (e.g. *bronze*, *adze*) are infrequent words. If this is so, children and perhaps adults should find it harder to spell plural words, such as *trees*, in which the /z/-ending is preceded by a vowel, since many words with this pattern of sounds are one-morpheme words where the /z/-ending is spelled as *-zz* or *-ze* or *-se*, such as *jazz*, *freeze* and *please*.

Results confirmed the hypotheses. Children apparently do not base their spellings of plural real and pseudo-words on the morphological spelling rule concerning plural *-s*. Instead, children seem to use awareness of complex but untaught spelling patterns, based on the frequency of co-occurrence of certain letters in written English. Mitchell (2004) replicated these findings with young adults, extending the investigation to include nouns and verbs ending with /ks/. Mitchell, like Kemp and Bryant (2003), concluded that the assumption that most people acquire explicit knowledge of morphological spelling rules at some stage during their education, and subsequently use them when spelling unfamiliar words, is incorrect. Such studies provide clear evidence that most children (and adults) rely on frequency-based knowledge (based on associations and frequencies), rather than morphological rule-based knowledge, when spelling. (This is not to imply that frequency-based and rule-based knowledge are always distinct concepts and always in conflict, however. Papers such as Kemp and Bryant's (2003) argue that *both* systems are acquired by children in this particular aspect of learning, with large individual differences in the extent of each. It has also been suggested that some types of frequency-based, distributional learning could actually be considered the manifestation of rules (Maratsos, 2000; Saxton, 2010b). In-depth discussion on this and the psychological reality of these two types of knowledge systems is beyond the scope of this work; see Piaget & Inhelder (1969) and Tomasello (2006) for more details.)

1.2.5.1 Implicit awareness of morphemes in spelling

Children do appear to have some implicit knowledge of morphemes, however. From their third year on, children master the system of roots, prefixes and suffixes with relative ease, and indeed most young schoolchildren fluently speak and effortlessly understand words that are quite complicated from a morphological point of view (Brown, 1973). The same usually occurs in a gradual way in spelling too.

Bearing in mind that children seem to learn to spell familiar words using frequency-based knowledge, how long does it take them to get to grips with writing words whose spelling is (without their explicit awareness) determined by morphological rules? The answer is, on the whole, a long time. One of the reasons may be that they are thrown off course by the conflict with grapheme-phoneme rules which they have worked so hard to master (Nunes & Bryant, 2006). The past-tense inflection in verbs is a powerful example, and an interesting one, because it is one of the few connections between morphemes and spelling about which teachers do teach their pupils something at school. Varnhagen, McCallum and Burstow (1997) found that over 75% of Canadian 6-year-olds wrote the past-tense ending phonetically (e.g. *helpt* for *helped* and *grabd* for *grabbed*) and that none of them at all used the *-ed* spelling correctly. More recently, Walker and Hauerwas (2006) showed that American children of the same age only managed this ending correctly in around 25% of the past verbs that they were asked to spell. Interestingly, these children performed twice as well at spelling the present progressive *-ing* inflection, which is probably because this ending never flouts phoneme-grapheme principles.

How does children's spelling of morphemes develop over time? Nunes *et al*'s (1997a) large-scale longitudinal study looked at how 350 children's spelling of the *-ed* morpheme changed as they grew older. The children's

ages at the beginning of the study ranged from 6 to 9 years so, by the end, the youngest children were 9 and the eldest were 12. At different times during the project, Nunes *et al* asked the children to spell words that end either in a /t/ or a /d/ sound, some of them one-morpheme nouns (e.g. *field*), some irregular verbs that do not conform to the *-ed* spelling rule (e.g. *slept*), and some regular past-tense (two-morpheme) verb forms (e.g. *kissed*). Nunes *et al* found that during this period, spelling of the past-tense inflections changed radically and it followed a similar pattern for each child. The very youngest children began by spelling the endings phonetically and, therefore, incorrectly. The nouns and irregular past verb endings were much easier for the children than the regular past *-ed* endings which, the authors conclude, can only be because the children have a far better understanding of the link between sounds and letters than of the link between morphemes and letters. The *-ed* ending transgresses phonological principles, so they ignore it.

Later on, this changes. Although it is hard to assign a particular age to this change, because it varies between children, Nunes *et al* (1997a) found that usually children begin to put the *-ed* ending on past-tense verbs some time between the ages of 7 and 8. However, even at the age of 9 and 10 years, the average score for the correct spelling of regular past verbs still fell well below 80%, showing that the *-ed* ending continued to cause many of the children a lot of difficulty, despite their having had so much education and experience of reading and writing.

The past tense ending is thus a striking example of the problems that children have with the connection between morphemes and spelling, and it is not a unique case, as we have already seen from Kemp and Bryant's (2003) evidence of the difficulty children face spelling /z/-ending plural words. Even the performance of the oldest and most proficient spellers in Kemp and Bryant's study was not perfect: only 82% of their spellings were correct, which is hardly impressive given that the rule is so simple and the group's mean spelling age was above 9 years.

These studies demonstrate that children at the early stages of learning to spell are unaware of some of the most basic and pervasive of all the connections between morphemes and spelling, and it is not until the age of about 10 that the majority of children seem to take them firmly (but implicitly) on board. Part of the difficulty is that children rely too heavily on grapheme-phoneme correspondences, which often clash with grapheme-morpheme correspondences. As children develop an increasing body of word-specific knowledge, they appear to make inferences about the morphological relationships among familiar words whose spelling they have learned by rote (Chliounaki & Bryant, 2007). Even when children's spellings are eventually morphologically correct, however, we have seen that what most are actually doing – in the case of plural *-s* at least – is developing frequency-based knowledge of English spelling patterns, rather than understanding morphological principles.

1.2.5.2 Explicit awareness of morphemes in spelling

Whilst most children eventually learn *something* about the connection between morphemes and spelling, consistently only a small minority of children and adults learn enough to score significantly above chance-level on pseudoword tests. Such a score cannot be attained unless participants are explicitly using morphological rules. Among others, Kemp and Bryant's (2003) study, and one by Bryant and Mitchell (2007), have shown convincingly that the individual scores of two different samples of young adults fall into two distinct groups: those who definitely know the target morphological rules, and those who seem to respond randomly in pseudoword tasks. What is startling is the relative size of the two groups. In each study, the group that definitely knew the rules comprised only 20-30% of the sample. This suggests that explicit knowledge of basic

morphological spelling rules is far from universal among adults. What is particularly interesting, and of significant concern, is that the educational careers of the two diverging groups of adults tend also to be very different.

Dawson (2005) and Mitchell (2004) suggested that adults who complete secondary education and proceed to university score significantly higher in morphological awareness tests than those who do not continue their education after school. Both Dawson and Mitchell used pseudoword choice tasks similar to those used by Nunes and Bryant in their studies, requiring participants to choose the correct spelling of the pseudoword after it has been read aloud to them in the context of a sentence. Such findings suggest that when we leave it to individuals to infer the connection between morphemes and spelling, most do not succeed. Yet there is a suggestion that the developmental paths of the two groups vary, with those who do understand morphological rules going on to achieve greater educational success.

1.2.5.3 Individual differences in the learning of morphological rules

It has thus been shown how, consistently, a small minority of children and adults do score above chance-level on pseudoword tasks. This suggests they have successfully developed an explicit understanding of morphemes because they are using morphological rules to make their spelling choices. Why are some able to achieve this and others not? Central to this project is that whilst there is much evidence to suggest that children who understand morphological rules have many advantages in literacy and language over those who do not, there is now increasing evidence to suggest that this cause and effect relationship travels in both directions:

Nunes and Bryant (2009) hypothesise that the more literate one is, the more aware one becomes of morphology.

To reiterate, morphological spelling rules are part of the deeper connection between oral and written language. Using morphological knowledge must therefore require a certain degree of linguistic awareness and be a more advanced and cognitively demanding type of strategy – hence, presumably, why those who go on to higher education are also more likely to have morphological awareness. Nunes and Bryant (2009) point out that the hypothesis that becoming literate affects the way we think about language is far from new. Scribner and Cole (1981) provided pioneering evidence that becoming literate in an alphabetic script improves learners' awareness of phonemes, and it has been confirmed since by other researchers (e.g. Burgess & Lonigan, 1998; Dickinson, McCabe, Anastopoulos, Peisner-Feinberg, & Poe, 2003; Hulme, Snowling, Caravolas, & Carroll, 2005).

There is relatively little evidence for the effect of literacy on awareness of morphemes (but see Fowler & Liberman, 1995, for the role of phonology and orthography in morphological awareness). Nunes, Bryant and Bindman (2006) explored this relationship and found that, after controlling for children's age and verbal ability, spelling abilities were a significant predictor of their awareness of morphology. So it is a two-way street: the more children learn about spelling, the more aware they become of morphology, which would seem to make sense given the hypothesis discussed above that morphological awareness develops from word-specific knowledge.

This initiates an exploration of the reasons behind the individual differences in people's awareness of morphemes. An additional possibility, also related to the range of experiences and abilities in the different groups, is that those who are significantly above chance-level become aware of morphological spelling rules through having greater

reading experience than others. It has already been argued that children's success in inferring morphological spelling rules depends on the strength and extent of their word-specific knowledge of spelling. This bank of knowledge presumably varies greatly between individuals in terms of its size and organisation (Nunes & Bryant, 2009). Some children read a lot of books, magazines and internet publications, and others do not. This variation may be a matter of the children's intrinsic interests or their abilities, or it may be determined by issues such as the amount of encouragement to read that they receive from their parents and/or parental levels of literacy. Socio-economic factors, too, may well affect availability of reading materials at home, highlighting the relationship between home environment and literacy. Early literacy development is known to be socially patterned (Hecht, Burgess, Torgesen, Wagner & Rashotte, 2000), with positive effects of more advantaged social backgrounds on outcomes (e.g. Maughan, 1995; Maughan *et al*, 2009).

Whatever the cause, differences in reading experience undoubtedly affect children's word-specific knowledge which, according to Nunes and Bryant's (2009) argument, then determines how well they form inferences about morphemes and spelling. The children who develop extensive word-specific knowledge are in a good position to make these inferences, and they are likely to go on to understand morphological spelling rules. There may thus also be a relationship between children's reading experiences on the one hand, and the developmental paths that they take at school and afterwards.

So, the hypothesis is that the more rich and varied a child's experience of reading, the more they are exposed to words and their spelling patterns in context. This will contribute to the development of morphological awareness, and they will become better spellers. Until recently, aside from Cunningham and Stanovich (1991), who looked at print exposure as a predictor of spelling, the majority of research on the cognitive correlates of exposure to print has focused on vocabulary development and other

verbal skills, reading ability, and declarative content knowledge (Stanovich & West, 1989; Cunningham & Stanovich, 1990; Stanovich, Cunningham & West, 1998). It was established that print exposure does indeed account for variance in these outcomes, even when controlling for differences in general ability and phonological awareness. New research by Maughan *et al* (2009) reports longitudinal data for a cohort of individuals with persistent spelling difficulties, suggesting that the scale of adolescent/early adult print exposure added to prediction about adult spelling skills, as did literacy demands in the workplace. Dixon and Kaminska (2007) explored whether exposure to correct/incorrect orthography affects 10-year-old children's spelling accuracy, and found a significant beneficial effect on spelling output of presentation of a correct spelling, but no measurable effect of a misspelling. They suggest this points towards children using explicit processing of prior information, rather than some form of implicit priming mechanism.

Stanovich and colleagues, to carry out their investigations, developed a Titles Recognition Test (TRT), where children had to detect real book titles embedded among false book titles. The reasonable assumption behind this task is that the more widely a child reads, the more familiar he/she will be with the titles of famous children's books. The task, though a fairly crude measure, had the advantages of relatively low cognitive load, freedom from subjective judgements, and objective assessment of response bias.

Colchester (2006) set out to address the question of a specific link between morphological awareness (measured by a pseudoword task) and reading experience (measured by a TRT). The study aimed to establish what proportion of Year 5 and 6 children, assumed to be of normal reading ability, showed awareness of morphological rules, and how this related to reading experience and general spelling ability. Analyses of covariance showed that the small minority of children who *did* show awareness of morphological rules (by scoring above chance-level on the pseudoword

task) performed significantly better than the rest of the sample in the TRT and on the real-word spelling test. This was a preliminary attempt to investigate individual differences in morphological awareness, providing some tentative evidence to suggest that print exposure is associated with morphological knowledge as well as word-specific learning. However, in order to draw real conclusions and enable generalisations about such findings, we need to learn more about the relationship between children's literary exposure and their spelling ability – and this is one of the rationales for the current project.

1.3 Evidence from intervention studies for spelling

1.3.1 Evidence from phonology-based interventions

Given the evidence presented in 1.2.3 for the importance of phonological awareness for early spelling development, it is pertinent to wonder whether children with spelling difficulties benefit from phonology interventions. The study of the nature of literacy disorders has made great progress, leading to the definite identification of children's difficulties with phonological awareness and learning phoneme-grapheme correspondences (as in dyslexia) as a cause of many children's problems (Snowling & Hulme, 2007). Effective interventions based on this have been developed, implemented and evaluated by research teams in many different parts of the world (see Nunes & Bryant, 2009, for a review). Yet, whilst there is a large body of published research reporting well-controlled evaluations of phonology interventions for reading difficulties (see Torgerson, Brooks, & Hall, 2006, for a review), there are very few studies

evaluating them for spelling specifically. Those with control groups have usually focused on reading, but included a spelling measure at pre- and post-test. Whilst significant positive gains in spelling have been reported, longer-term follow-up testing has typically shown disappointing results with washout of immediate effects (e.g. Hatcher, Hulme, & Ellis, 1994; Torgerson *et al*, 2006).

Until recently, there was no systematic evidence on the efficacy of interventions that are concerned exclusively with spelling. Singleton's (2009) review of international evidence for interventions for dyslexia clearly demonstrates the very small number of studies in publication. The DCSF publication entitled "What Works for Pupils with Literacy Difficulties?" (Brooks & NFER, 2007) evaluated those few that do exist in the UK, and schools are referred to this when making decisions about interventions for literacy difficulties. Brooks remarks that most approaches to improving spelling take either a phonological approach or a visual one, or some combination, but only two of these had better than modest effect sizes. Brooks reviews one intervention that he describes as the "wild card" due to its different approach: Nunes and Bryant's (2006) morpheme intervention study, which will be discussed in 1.3.2.

One growing body of literature in the area of literacy difficulties has developed from the fact that not all children respond well to phonological interventions (Torgesen, 2000). Researchers have thus sought to establish what distinguishes this sub-group of children from their counterparts, in terms of both organic characteristics and environmental factors, in order to find ways of improving their educational prospects (see Rose, 2006, for a review). The issue of specific language impairment (SLI) versus dyslexia has become a focus. Whilst dyslexia is characterised by severe difficulties with written language, SLI is a severe impairment in oral language development (Leonard, 1998). Despite their intrinsic differences, there are commonalities between these disorders – primarily, both may manifest with weak phonological skills and literacy

difficulties. However, key distinguishing features of SLI are syntactic and semantic deficits (Bishop & Snowling, 2004), and another hallmark is the omission of morphemes from speech (De Bree & Kerkhoff, 2010; Rice & Wexler, 1996). These latter researchers claim that SLI children's difficulty with morphology is due to delays or difficulty in acquiring a specific underlying linguistic mechanism – for example, the rule that verbs must be marked for tense and number.

Children's spoken language skills are usually related to their developing written language skills (Berninger, Proctor, De Bruyn, & Smith, 1988; Brice, 2004). (However, see Bishop *et al*, 2009, for exceptions to this.) It is unsurprising, therefore, that there is co-morbidity between dyslexia and SLI (McArthur, Hogben, Edwards, Heath, & Mengler, 2000). It may be that some of the children who do not respond well to a phonology-based literacy intervention have an overlapping SLI, and therefore that they would derive greater benefit from a wider language-based intervention that focuses on grammatical, morphological and semantic principles, as well as phonology and, presumably, vocabulary. Bowyer-Crane, Snowling, Duff, Fieldsend, Carroll, Miles, Gotz, & Hulme (2008) reported positive gains on reading levels and correct use of grammatical forms for such a subgroup when they received training in oral language skills. Whilst this training did not directly target morphology (the children in their study were at school-entry age – 4-years-old on average – so presumably too young to understand about morphemes), Bowyer-Crane *et al*'s (2008) was one of the first studies of its kind to address the wider oral language weaknesses present for some children with dyslexia and SLI.

1.3.2 Evidence from morphology-based Interventions

We have seen that, whilst a small percentage of children eventually work morphological rules out for themselves and use them effectively, most never do. Moreover, it has been suggested that children with literacy and language disorders might be particularly at risk. It is therefore essential to develop the knowledge base so that it can be used in a proactive and preventative way to help this population. The conclusion that children could benefit from being taught about morphemes seems inescapable. The questions are whether it is possible and, if it is, what is the best way of doing it?

Psychologists have begun to study what, if anything, children can learn about morphological spelling rules, based on intervention experiments (Lyster, 2002; Nunes, Bryant, & Olsson, 2003). An intervention methodology is required to provide a more rigorous test of causality between two variables. Typically, they target pupils identified with literacy difficulties and compare their response to intervention to a control group. However, some recent studies have examined the impact of intervention on whole classes of children to examine whether the intervention leads to better progress than that resulting from standard classroom teaching for reading (e.g. Hatcher, Hulme, & Snowling, 2004) or spelling (e.g. Nunes & Bryant, 2006).

Both Lyster (2002) and Nunes *et al* (2003) aimed to disentangle the effects of teaching about morphology and about phonology, and to establish whether it was as worthwhile to teach children about morphemes as about sounds. These studies involved randomly dividing normally developing school children aged between 6 and 8 into groups, with some receiving teaching on phonology, some on morphology. There was also a control group in each study, who were taught nothing special or unusual.

The design of both studies followed the familiar pre-test, intervention period, post-test sequence.

In the first of these studies, by Lyster (2002), the intervention lasted for 17 weeks with one session per week. The Phonology group was taught about sounds in words using rhyme and phoneme tasks, whilst the Morphology group was taught about the relationship between prefixes and suffixes and the meanings of words and the grammar of sentences. Lyster's (2002) results showed that the intervention had been successful in significantly improving both the Phonology and Morphology groups' scores in the tasks, compared to the control group's, but there was very little sign of effects specific to each intervention. For example, both intervention groups did better in post-test phonology tasks than the control group children. However, at pre- and post-test, Lyster mainly looked at children's awareness of phonology and syntax, and took no direct measures of use of morphemes (such as prefixes and suffixes) in reading and spelling. This is a methodological shortcoming since, whilst there was some indication that the morphology training made children particularly aware of syntax, she was unable to show specific effects of teaching morphology. Furthermore, Lyster did not include a standardised test of spelling at pre-test, so it is not known whether the groups were well matched in spelling ability at the start.

In Nunes *et al*'s (2003) study – one of the most relevant as background for the current research – the intervention period lasted for 12 weeks, with one half-hour session per week. There were four intervention groups, each consisting of about 55 children. Participants received explicit instruction on phonological and morphological rules, and some were asked to complete written activities as well to see if this helped to consolidate their learning. The exact content of each group's teaching was as follows:

1. Phonology Alone – phonological spelling rules, with delivery and response entirely oral;

2. Phonology with Writing – same rules, but with children writing words that conformed to these rules;
3. Morphology Alone – morphological spelling rules, with delivery and response entirely oral;
4. Morphology with Writing – same rules, but with children writing examples of these rules.

An example of a game used with the Phonology groups was children being asked to make phonological transformations to words that were analogous to those made by the researcher (e.g. *hat* : *hate* > *cap*: ?). A parallel game for the Morphology groups was children being asked to make morphological transformations by adding derivational morphemes called agentives (e.g. *sing* : *singer* > *magic* : ?). Some of these were agentives that are added to verbs (as in *-er*), and some were agentives that are added to nouns (as in *-ian*, *-ist*). The explicit objective of the morphological analogy task was to assess whether children understand the way that adding an agentive changes the meaning of a word, and whether they can think of the equivalent transformation of meaning in other words (it did not require them simply to use morphological information by analogy which, as Saxton (2010c) points out, would lead them wrongly to add the *-er* suffix to *magic*). The difference for the "Morphology with Writing" groups was that they were shown cards with these words written on them, and they had to write down their answers.

In the pre- and post-tests administered by Nunes *et al*, the researchers devised tasks to assess children's knowledge of morphological spelling rules (e.g. use of spelling inflections and derivational suffixes) and phonological spelling rules (e.g. use of split digraphs), which included asking them to spell pseudowords. The tasks related to the specific rules that were taught during the intervention. The researchers also administered standardised tests to measure spelling and reading abilities.

Nunes *et al* (2003) presented results showing that for each intervention group, there was a significant positive impact ($p<0.01$) on performance in a standardised reading test, as compared to the Control group. There were no significant differences in the post-tests between the morphological and phonological groups, nor between those who completed written activities during the intervention and those who did not. And what about the effects of the intervention on spelling? There were definite signs that teaching morphology had worked: both morphology intervention groups did significantly better than the others in post-test measures of use of morphological spelling rules (although not on the standardised spelling test). The phonology intervention groups did not seem to have learned about phonological spelling rules better than the other groups; however, the possibility was raised that the rules targeted were not developmentally appropriate for the participants. The authors conclude that teaching morphological rules improved children's reading ability as much as teaching phonological rules did and, furthermore, learning about morphological rules aided their ability to spell words determined by morphemes.

The study by Nunes *et al* (2003) therefore supported the same general conclusion as that by Lyster (2002): teaching children about morphemes may benefit both their reading and their spelling as much as teaching them about phonemes, and it enables them to learn about morphological spelling rules which otherwise they would find hard to learn. The apparent effectiveness of these morphology interventions is central to the rationale of the current study. There is a clear need for further research in this area, including the effects of teaching children about other types of morphemes, and including follow-up testing in the methodology, since both aforementioned studies leave unanswered the question of whether the intervention effects were sustained.

Neither of the studies described so far has provided a truly detailed analysis of the effects of teaching morphemes, although they certainly

contribute some converging evidence. In their book, "Improving Literacy by Teaching Morphemes", Nunes and Bryant (2006) describe their own set of intervention studies that aimed to rectify this situation. They engaged a few hundred children over several years in a variety of problem-solving activities requiring them to perform operations on morphemes. The tasks included:

(i) analogical reasoning (e.g. "read" > "reader"; "magic" – "?");

(ii) counting the number of morphemes in particular words (e.g. *unforgettable*);

(iii) putting morphemes into categories – e.g. sort words into those that contain suffixes that form 'person words' and those that form other words;

(iv) subtracting morphemes from pseudowords – e.g. "spamters" or "montists".

All these tasks developed by Nunes and Bryant (2006) demand that children think explicitly about the morphological structure of words, rather than simply use them. Some of the interventions were delivered by the researchers and some were administered by teachers in their own classrooms, using materials provided by the researchers. This was to increase the ecological validity of the studies: the researchers recognised that what goes on in the quiet and well-ordered setting of a laboratory with one or two children might be quite different to a classroom setting with up to 30 children.

It is this latter set of interventions – involving teachers and children in their own classrooms – that relates most closely to the current study in terms of aims and methodology. The methodology adopted by Nunes and Bryant (2006) in their classroom intervention project was to administer pre-testing and post-testing to measure 9-year-old children's use of morphological spelling rules, and to assess their vocabulary and understanding of the morphological structure of spoken words. The intervention materials were two different CD-ROM-based programmes for two different classes,

divided into seven sessions each. Both programmes were highly visual games, dealing with syntax and parts of speech, and derivational and inflectional affixes. Much of the material used pseudowords: children were asked to write the words involved and therefore the morphemes. Since the earlier studies mentioned above had demonstrated that it is possible to teach children about morphemes and spelling in general, Nunes and Bryant focused on some of the most difficult morphological spellings, that are never normally taught in the classroom but are governed by valuable rules – the distinction between the *-ion* and *-ian* endings. The two programmes for two whole-class intervention groups were as follows: (i) a "Morpheme only" oral intervention, which focused on the way spoken words are constructed from morphemes; and (ii) a "Morpheme with Spelling" intervention, which focused on the morphological structure of words and, in addition, its relation to spelling (i.e. morphological spelling rules). There was also a control group who received no intervention.

It was up to the teachers to determine the intervals between sessions, and decide how to administer the various tasks. Nunes and Bryant's rationale for this flexible scenario was that if they were ever eventually to advise schools to teach about morphemes, different settings would vary greatly in the way they did this.

As with the other intervention studies carried out by Nunes and Bryant (2006), the results obtained from this classroom intervention suggest that it is possible to teach children about spelling principles based on morphemes and that they learn these principles quickly. Comparison of measures taken pre- and post-intervention showed that both intervention groups improved in their spelling more than the children in the control group. The effect size was quite small: 0.3 for both groups. Although the "Morpheme with spelling" group improved slightly more than the "Morpheme alone" group (not surprising given that the tests themselves were about spelling), the difference was not significant.

Nunes and Bryant (2006) claim from this that explicit instruction about morphemes improves children's spelling by teaching them about rules which they had not learned for themselves by 9 years of age. But how robust is this learning? In their earlier laboratory-based studies, Nunes and Bryant (2006) measure the performance of the intervention groups against that of the control group after 8 to 10 weeks, and conclude that, by and large, children show maintenance of these gains. However, they did not examine possible washout effects of the classroom intervention at a delayed follow-up point, which would further increase the utility of these findings. Regardless, Brooks' DCSF report (Brooks & NFER, 2007) concludes that Nunes and Bryant's interventions deserve to be developed and are potentially of useful educational significance.

As mentioned earlier, morphology intervention research may be particularly relevant also to the field of developmental disorders of language and literacy, which are at the heart of EP research and practice. An intervention study by Tijms, Hoeks, Paulussen-Hoogeboom and Smolenaars (2003) addressed the needs of poor readers. This involved a computer-based intervention which helped participants learn to recognise and make use of the phonological and morphological structure of Dutch words. The study shows a general effect of the intervention on young people's (aged 10 to 15 years) reading and a more specific effect on spelling, suggesting that teaching of morphology may be well worth including as a basic part of literacy instruction, whether for normal readers or those with reading difficulties. The relevance of the Tijms *et al* findings to the current study is limited, however, because they only included a group that received a combined intervention of phonology and morphology, and did not compare the improvement in this group with parallel groups receiving only one type of intervention. Perhaps the true value in reporting this study lies in the fact that Tijms and colleagues were mostly interested in the long-term effects of this combined treatment, which sets them apart from most other short-term research projects in this field. The results of the paper seem to suggest that whilst not all

participants benefited significantly from the treatment, there were extensive and steady increases in performance at reading and spelling, when compared to age-level norms at pre- and post-test. Disappointingly, however, the effects on spelling declined over time, even though reading gains were maintained over a four-year period.

We have seen, therefore, that there is increasing recognition that phonological impairment is not the only risk factor for children with persistent literacy difficulties, and that interventions may be enhanced by training on wider aspects of language, such as morphology. The fact remains, though, that to date there has been very little research on the link between morphology and reading/spelling, and there are no known interventions specifically designed to promote morphological ability in those who struggle with literacy because of SLI. Other aspects of the connection between spoken and written language skills have received considerably more attention, ranging from a huge emphasis on the relationship between speech processing (phonology) and word level reading and spelling; to a small body of work on the role of vocabulary knowledge in reading comprehension (Muter *et al*, 2004), and on the role of semantic knowledge on word level reading (Nation, 2009).

To summarise, the morphology intervention studies described above suggest that it is possible, through explicit instruction, to increase children's ability to use morphological principles to aid their spelling, and that this type of instruction may also benefit reading. The evidence suggests that it is as worthwhile to teach children about morphemes as about sounds, and that it may be helpful both to children with normally-developing literacy skills and those experiencing literacy difficulties. Research on morphology and literacy is therefore not only of general importance, but it has specific implications for the field of Educational Psychology. EPs have to offer specialist guidance to schools when making decisions about specific, targeted interventions for pupils with reading/spelling difficulties who have not responded well to previous

support interventions. But furthermore, as professionals within Local Authority children's services, EPs are in a position to apply this evidence-base (themselves and through supporting teachers) generally across the whole school population, thus having a much wider impact on current teaching and learning.

The morphological skills that children have been successfully trained in include analysis of words into morphemes, analogous reasoning using morphemes, and spelling of affixes. The success of such interventions seems to apply both in tightly controlled experimental settings and in real classrooms. However, more support for these findings is needed, as the evidence is quite mixed and the picture is puzzling. Nunes and Bryant's (2006) is also the only known morphology-based classroom intervention for spelling to date, and their project focused on the *-ion* / *-ian* distinction only. Only Nunes and Bryant's projects use the critical test of spelling pseudowords at pre- and post-intervention testing, progress in which indicates the acquisition of a spelling principle, rather than the learning of specific words.

Gaps in the evidence base include whether it is possible to teach children in their classrooms, as part of the day-to-day teaching schedule, about different morphological rules – such as inflections that underpin more well-known and frequently-occurring spellings. There are important issues of how long children remember this new learning, and how to maximise the extent to which it is cognitively embedded. Are there alternative ways to teach explicitly about morphemes, which are perhaps even easier for teachers to incorporate into the curriculum? Such questions must be answered if the evidence-base for the curriculum, teaching, specialist support, and EP practice in the area of spelling is to develop.

1.4 Educational implications and the current role of morphemes in literacy teaching

As we have seen, the ability to spell, like the ability to read, is a key aspect of children's development. It is required for educational success and for increasing the possibility of good life outcomes. The ability to read may seem somewhat more urgent in order for a child to access information, knowledge and the curriculum, and to enrich minds with ideas and shared experiences (Manguel, 1997) – both from books and the internet. This is presumably why improving reading appears to have received greater focus from policy makers, for example with the government's Every Child A Reader initiative (KMPG Foundation, 2006), aimed at providing targeted early reading intervention to reduce long-term literacy difficulties. But spelling is so obvious, so visible, that it often assumes the role of a proxy for literacy (Templeton & Morris, 1999). Good spelling is required for successful writing and, as children progress through their school careers, this is a crucial means by which they express themselves and demonstrate their ability and potential. Every Child A Writer, aimed at ensuring age-related expectations in writing attainment for pupils in Years 3 and 4, is still being piloted in primary schools at the present time – and its prime target does not even appear to be spelling, but improving higher level composition abilities (DCSF, 2009b).

All the literature reviewed above raises important theoretical and practical issues about the role of teaching. What is current practice on teaching about morphemes? Is the education system responding to evidence of the value of morphological knowledge, by incorporating appropriate material and guidance into literacy policies and practice?

The answer is that children are not explicitly taught enough about morphology at school. For several years now, as mentioned already, the emphasis in Key Stage 1 and 2 classrooms has been on phonology-based

teaching for reading and spelling. This is a positive development since it heralds an increase in evidence-based policy-making in education, with the Primary Framework for Literacy (DCSF, 2006) taking account of significant research developments since the 1990s (reviewed in Rose, 2006) and of the best practice seen in the most successful primary schools. However, the complexities of English orthography have been discussed, supporting our understanding of why spelling is challenging for so many children, and making it apparent that phonological awareness is not the only skill required for accurate spelling. We have seen how an understanding of morphology can remove some of the difficulty associated with the English spelling system.

Yet, citing the example of the morphological rule governing the *-ian* / *-ion* ending, Nunes and Bryant (2006) note that remarkably little attention is paid to the morphological reasons behind these different spellings in any of the works on English spelling, educational textbooks, or accounts of the psychology of reading and spelling – despite children continuing to make frequent spelling mistakes when writing words that ought to have one or other of the two endings.

Hurry, Curno, Parker and Pretzlik (2006) explored the degree to which the teaching establishment explicitly identifies morphological strategies as important aids to spelling. They point out that, since the English system of teaching literacy is defined through the National Curriculum, the place of morphology is reasonably transparent. The NLS documentation identifies morphemes as one of the principles underpinning word construction and they are seen as having a place in teaching spelling (DfEE, 1998; DfES, 2001, 2003). However, Hurry *et al* (2006:135) note that as teacher guidance becomes more detailed and practical, the place of morphemes in the teacher's repertoire becomes less clear, and the word "morpheme" is not used. This, they say, reveals the lack of research and theorising in this area available to the authors of the model lesson plans.

Since Hurry *et al*'s study, the process of using research evidence such as that of Bryant and colleagues to transform teacher practice has continued with the introduction of the PF for Literacy (DFES, 2006b). Teaching objectives, and examples, prescribed in the Framework about the role of morphology in spelling are shown below (taken from DFES, 1999, and the DCSF website, 24/03/2009).

Year	Objectives and Examples
1	➢ Use knowledge of common inflections – e.g. *-s* (plural), *-ed* (past tense), *-ing* (present tense).
2	➢ Draw on word recognition, word structure, and spelling patterns including common inflections and use of double letters. ➢ Use common prefixes – e.g. *-un*, *-dis*, to indicate the negative, and common suffixes – e.g. *-ful*, *-ly*.
3	➢ Spell unfamiliar words using known conventions including grapheme-phoneme correspondences and morphological rules. ➢ Investigate and identify basic rules for changing the spelling of nouns when *-s* is added. E.g. Most words just end in *-s*, but add *-es* if word ends in hissing/buzzing/shushing sound; if word ends in *-y* and final letter is not preceded by a vowel, change *-y* to *-i* and add *-es*. ➢ Build spellings from other words with similar patterns and meanings – e.g. *medical*, *medicine*. ➢ Use knowledge of suffixes to generate new words from root words – e.g. *proud/proudly*, *hope/hopeful/hopeless*.
4	➢ Use knowledge of phonics, morphology and etymology to spell new and unfamiliar words. ➢ Learn how verb spellings alter when *-ed* or *-ing* are added. E.g. When a single syllable verb ends with a consonant preceded by a short vowel, you double the final consonant when adding *-ed*; if a word ends in *-e*, avoid double *-e* by dropping one as necessary; if a word ends in a consonant plus *-y*, change *-y* to *-i* before adding *-ed*. ➢ Distinguish between the spelling and meanings of common homophones, e.g. *to/two/too; they're/their/there; piece/peace.* ➢ Investigate compound words and recognize that they can aid spelling even where pronunciation obscures it.

This policy document clearly identifies the role of morphology in teaching spelling, prescribing that both morphemes of interest to the current study (plural *-s* and past tense *-ed*) are taught in the first term of Year 2. However, as far as is known at the present time, the teaching tends to be about spelling sequences, vocabulary formed through derivation, and phonology-based rules for applying morphemes, rather than about meaning and sentence context. So, teaching deals with the lexical role of morphemes, but not with the grammatical and syntactical role of morphemes, which is what underpins morphological spelling rules. For example, although 7- and 8-year-old children are taught that adding *-s* to a noun makes it plural, it is not made clear to them how to use a rule based on the context and meaning of a sentence to aid their spelling when a word's sound-ending might confuse them (as in the case of words ending with /ks/ or /z/). Yet these are points which teachers should be able to put across to their pupils with relative ease.

It is plain to see that awareness of morphemes matters in today's literate societies. Children's progress in spelling and their exposure to and experiences of reading could predict their growth in morphological awareness which will, in a cyclical way, further promote their literacy and language development. Studies such as that of Nunes *et al* (1997a) show that whilst children make progress in the spelling of morphemes in primary schools, their performance does not reach a level of accuracy that we would expect good spellers to reach after five or six years of schooling. Furthermore, and most significantly, it is apparent that the majority of children without direct instruction will never manage to learn the morphological spelling rules that can make literacy and language development easier and more meaningful – and those with disorders of literacy and language are at even greater risk. As Nunes and Bryant argue: "Research has shown that this is a powerful linguistic skill [which] should not be ignored by education planners and policymakers" (2009:215).

1.5 Designing interventions in educational settings: lessons learned from previous research

The current research thus takes as its vehicle a focus upon intervening in children's spelling competency, with the objectives of bridging the aforementioned gaps in the evidence-base on morphology teaching and, ultimately, of finding ways to incorporate such teaching into the curriculum. But how does one go about designing an educational intervention? In order to answer this question, the preceding literature review on content of teaching and learning must be supplemented by a broader exploration of research into the instructional and environmental variables that contribute to effective pedagogy. This research has provided a rich and diverse knowledge base that can be a useful tool for those designing educational interventions, as well as for teachers and educational psychologists who consult with them, to ensure that learning is maximised (Gettinger & Stoiber, 1999). The objective of this section is to address the lessons learned from such research that should inform the design of future educational interventions.

Haring, Lovitt, Eaton and Hansen (1978) provided evidence to support the hypothesis that there is a hierarchy of stages through which a child progresses in learning a new skill. The four essential levels of learning, generalised to all areas of the curriculum, are Acquisition, Proficiency, Generalisation and Adaptation. The pedagogical implications of the delineation of the various stages of learning are that teachers have a way of organising tasks so that they lead more directly and efficiently to the desired skills. With the learning hierarchy framework, teachers can implement instructional methods which facilitate progress, and avoid those which hinder it – for example, reinforcement is inappropriate during acquisition because, unless the pupil has the basic knowledge, he will never become proficient. Haring *et al* (1978) point out that systematic

procedures need to be devised to teach generalisation and adaptation; whilst many children seem to be able to do this on their own, such expectations are not realistic for all children.

The learning hierarchy may be particularly useful in the domain of literacy, because successful reading and spelling are blends of many separate skills; if one skill or cluster of skills is missing, the entire process breaks down (Haring *et al*, 1978). Indeed, Haring *et al* describe the teaching of reading and spelling as extreme examples of global instructional tasks which require attention to order and sequence. The model has been used as a conceptual model for understanding the effective components of reading interventions (e.g. Daly, Lentz & Boyer, 1996) and serves as a useful tool for the design and replication of future interventions in educational settings. Results of studies with children would be accurately interpreted only if it was known which phase of learning the children were in, and the studies would be more accurately replicated if there was information regarding which phase of learning was being investigated.

Another approach which provides a useful starting point when designing interventions is that of instructional psychology. Instructional psychology (IP) analyses the learning environment – that is, analysing what needs to be taught and identifying the critical skills required by learners (Solity, 2000) – rather than pupils' cognitive development and individual differences, or their abilities or home backgrounds. In a similar way to the work of Haring *et al*, IP aims to organise the curriculum, teaching approaches and patterns of classroom organisation in such a way that children are able to generalise their skills from one context to another (Solity, 2000).

Central issues that have been explored within instructional psychology, and which are particularly relevant for literacy intervention research such as this, deal with frequency of occurrence and duration of teaching sessions. How do we arrange tasks so that they lead most directly and

efficiently to the desired skills? The benefit to memory of distributing learning (spacing out presentations of material) rather than massing learning (presenting material in concentrated blocks in a single session) is well established in research (see Seabrook, Brown & Solity, 2005, for a review). People are more likely to retain what they practise and recall frequently. This has been found with a variety of materials and topics, in a range of remembering and learning contexts, and at all ages from preschool children through to adults. Furthermore, Brown (1998), Haring *et al* (1978) and Seabrook *et al* (2005) have stressed the importance of "interleaved learning", whereby children's skills acquisition is promoted, and forgetting is minimised, by practising newly-taught information alongside older and more familiar items.

Seabrook *et al* (2005) posed the question of whether different degrees of distribution are influential in learning. In a laboratory-style experiment, they compared a few long sessions of teaching (which they described as clustered) with many short sessions (more highly distributed). There was little difference in the overall duration of the schedules; the difference lay in the arrangement of practice within that time period. Results showed that highly distributed presentations resulted in significantly better recall than more clustered presentations. Seabrook *et al* replicated these results in a classroom experiment. Their findings have important implications for the Primary National Strategy (PNS), which requires literacy to be taught in a single, hour-long session each day, thereby using clustered presentations.

Solity and colleagues (Solity 2000; Shapiro & Solity, 2008; Solity & Vousden, 2009) have compared the effectiveness of the PNS with a literacy-teaching strategy called Early Reading Research (ERR), which stipulates that participating teachers teach reading in three 12 minute sessions per day (thus distributed throughout each day). These whole-class studies, in which the interventions were delivered by the children's regular classroom teachers, have had encouraging results. Children

taught according to the ERR strategy have substantially out-performed those taught within the PNS, illustrating the positive potential of applying distributed practice in the classroom. Hence, ideally, future research interventions should aim to implement many short teaching sessions per day, rather than fewer longer sessions.

ERR has also demonstrated the benefits of delivering interventions on a whole-class basis, supporting the findings of Fuchs, Fuchs, Thompson, Al Otaiba, Yen, Yang, Braun & O'Connor (2001) and Hatcher, Hulme and Snowling (2004), as opposed to implementing additional training outside the classroom or to relative small teaching groups, which has widely been thought to be the best means of delivering phonological training to poor readers (Foorman, Breier & Fletcher, 2003). The whole-class training in ERR, which was highly focused and involved teaching only a few core skills, both reduced the incidence of literacy difficulties and also raised the attainments of normally developing readers. Shapiro and Solity (2008) point out that if literacy interventions can be incorporated into children's normal whole-class teaching, the need for supplementary training would be minimised, creating savings in time and resources and allowing space for alternative activities.

This leads to a discussion about the content of literacy interventions – in particular, what does IP tell us about the number of skills that should be taught? The theory of optimal instruction states that there is an optimal amount of information to teach that will lead to maximum generalisation. Too little will not provide a sufficient basis for generalisation; too much may require the child to retain information that is either perplexing or of little use (Solity & Vousden, 2009). Relating this theory to literacy, the question is, is it possible to identify an optimal amount of information to teach children? There is a view (Brown, 1998) that the cognitive abilities of skilled adult readers develop in such a way that performance is statistically optimal with respect to the English sound-to-spelling mapping system – i.e. they retain what occurs frequently, because it is seen to be

useful, and forget what occurs infrequently. The implication of this and the aim within IP is thus to design curricula and teaching approaches that enable students to adapt more quickly to their environment. This means teaching strategies and information (e.g. vocabulary, grapheme-phoneme correspondences, morphological rules) that can be applied to the words that children are exposed to most frequently. According to Solity and Vousden (2009), useful items should therefore be presented frequently and explicitly so that children infer that the information is useful and needs to be retained. In this way, information will be learned at a statistically optimal level.

Solity and Vousden (2009) point out that when exploring the best materials to use in literacy teaching, consideration should be given to providing beginning readers with appropriate representations of written English which allow them to extract the relevant structures to facilitate maximum levels of generalisation (Brown, 1998). If the endpoint of reading instruction is to enable children to develop statistically optimal behaviour, then the material they read should be representative of the structures contained within written English as a whole. Solity and Vousden analysed high-frequency words and grapheme-phoneme correspondences across reading schemes and real books, and found that real books reflect the statistical properties of the spelling-to-sound mapping system in English as much as reading schemes do. This leads them to favour the use of real books over reading schemes, as it has been shown that reading schemes, with their restricted, controlled vocabulary, can impact on children's enjoyment and motivation for reading, whereas real books encourage reading for context and meaning (see Solity & Vousden, 2009). It seems likely that real books will also be well representative of the grapheme-morpheme mapping system, and therefore that real books may be the best material through which to teach children about morphemes and facilitate generalisation of new morphological knowledge.

Are there other factors helpful in promoting generalisation? Like Haring *et al* (1978), a key principle of IP and an important prerequisite to generalisation is that skills should be taught to high fluency levels (Solity & Bull, 1987). This requires that progress is assessed regularly – for example, through the use of precision teaching (Lindsley, 1990), which stresses fluency and the value of giving children detailed feedback on their progress. It is also stressed within IP that the goals and purposes of teaching, and instructional principles, are explained and made explicit to the children. This encourages metacognitive awareness, so that children can appreciate the rationale for the way they are taught. Only then may generalisation occur.

The intervention research reviewed above has suggested that there are certain instructional principles, features of curriculum content and ways of teaching which benefit all children, irrespective of their individual differences in ways and rates of learning, and ultimate levels of achievement reached. This research can be complemented by looking at the findings of Hattie (2009), who provides support for many of the instructional psychology principles described above. Hattie's detailed meta-analyses convert statistics from studies describing specific effects of student achievement into effect sizes. Spaced vs massed practice, feedback to students and meta-cognitive strategies were all domains which achieved good effect sizes – i.e. where "real world" differences could be observed in achievement. Perhaps the over-riding implication of Hattie's work, however, is that teacher quality – encompassing domains such as teacher clarity, classroom management, student-teacher relationships, as well as teacher knowledge and the use of effective teaching strategies – is a key link to student achievement.

The work of Watkins (e.g. 2009; 2010) and of Gettinger and Stoiber (1999) supports the same general conclusion as Hattie and the instructional psychologists about influences on learning. Gettinger and Stoiber set out to review instructional and environmental variables that contribute to

excellence in teaching, and propose that teaching should be successful if the following sound pedagogical principles are adhered to: (a) encouraging students' active engagement in learning; (b) promoting teachers' sense of self-efficacy (which can affect general orientation towards the educational process as well as their specific instructional activities (Bandura, 1995)) and teachers' beliefs about student success (e.g. high vs low expectations); (c) exploring innovative approaches to grouping and organising classroom instruction; (d) making learning meaningful by keeping it enjoyable, interesting, goal-directed and learner-centred (i.e. attentive to the needs and interests of individual learners); (e) fostering self-regulated and independent learning (students set goals for themselves and they have metacognitive awareness of what they are doing); and (f) teaching to promote understanding, rather than rote learning and memorisation of facts.

Future intervention studies should seek to bear in mind these important aspects of how children learn, models for the teaching of literacy and the principles that underlie them, as well as specific structures necessary for effective pedagogy.

1.6 Summary and the current research

The key messages from this literature review will now be summarised, before moving on to the aims of the current research project.

In English and many other languages there is a system of relationships between morphemes and spelling, and it will help children to know what this system is. It is hypothesised, and some research evidence has suggested, that children require explicit knowledge about morphemes to acquire robust spelling and reading skills, and to keep to an age-

appropriate level of vocabulary growth, as well as to facilitate their learning of other languages. Yet, without direct instruction, many children do not seem to learn or understand about morphemes and their role in spelling – and those with disorders of language and literacy are even more at risk. The government and education professionals are striving to improve children's standards of learning, and one of the core aspects of this agenda is the need to promote better literacy development. There are early indications that it is possible and practicable to teach children about morphemes in spelling, and it is highly positive that some of this research is already filtering through to practice via the National Curriculum. However, there is a strong need for further studies reporting consistent findings, as well as examining the maintenance of gains in morphological awareness, in order to consider the most effective ways of implementing this into policy and teaching.

Bearing in mind the premise that the experience that leads most effectively to the acquisition of morphological knowledge may be reading experience, it is pertinent to wonder whether we can increase children's potential to learn about morphemes through the exposure that they necessarily have to books at school. The current research intends to address this, investigating whether a short-term intervention of special guided reading can significantly improve children's understanding and use of two morphological spelling rules: the rules governing the inflections of the past tense morpheme *-ed*, and the plural marker *-s*.

The consistently sharp division in performance on pseudoword tests involving morphemes – with a small group of people clearly knowing the rules, but the majority not – suggests strong individual differences in the way that children (and adults) cope with spelling morphemes (Chliounaki & Bryant, 2007; Kemp & Bryant, 2003; Bryant & Mitchell, 2007). These do not appear to be just within-child differences; they also relate to external factors, such as reading experience, teaching, the conduciveness of a child's home environment to language and literacy development, and

parental levels of literacy. Such issues certainly deserve further study. It is hoped that this paper will replicate and extend the research base as a whole, and specifically Colchester's (2006) earlier study, which was an initial attempt at explaining individual differences in morpheme awareness.

This is a particularly pertinent brief for an Educational Psychologist, much of whose work is with vulnerable children and their families, including those with specific learning difficulties, such as dyslexia or SLI. Families living in poverty, or with low levels of parental literacy, or who are from different socio-cultural backgrounds, may not have access to books or visit libraries. Are their children at risk of becoming poor spellers as well as poor readers, and thereby cognitively disadvantaged in more ways than is currently thought? Maughan *et al* (2009) report that family socio-economic background was predictive of adult spelling levels among normally developing readers, suggesting that the key to individual differences in spelling at mid-life may be variability in ongoing involvement in reading-related activities. And if, as discussed above, those who do not have solid literacy skills are at risk of poor life outcomes, will we have further evidence that less exposure to print outside of school is another risk factor for children's progress through the National Curriculum – and, in the broader context, a risk factor for our national profile of educational standards?

Such issues are complex and, if they are to be addressed, patterns and relationships between outcomes need to be identified and clarified. It is hoped that this project will present some clarification with regard to spelling ability. It is also hoped that the study will increase the evidence-base for EPs, and start to address the challenge of using such information strategically to inform wide-impacting and cost-effective practice. Finally, the project may help EPs to give clearer messages to education professionals and the other agencies with whom they collaborate about the importance of promoting access to literature for all children including the most vulnerable children in society.

1.7 Research questions and predictions

The primary research question was as follows:

Research Question 1: Can we significantly improve children's morphological awareness and spelling skills by explicitly teaching them about morphemes in the context of text reading, and can improvements in morphological awareness be sustained?

Years 2 and 3 were chosen as participants, because previous research has shown that children aged 6- to 8-years should be entering the morphological stage in spelling – i.e. becoming more aware of conventional spellings and employing visual and morphological information in spelling. The targeting of two age groups would allow exploration of predictors in developmental variation. The plural *-s* and past tense *-ed* morphemes, governed by two of the simplest and most frequently-used morphological spelling rules, should be developmentally appropriate, and provide a range of sound endings to manipulate.

Based on the idea that reading experiences may be optimal conditions in which to learn about morphemes, the intervention tried to mimic these conditions in a teachable framework. It was hypothesised that teaching children about morphological rules in context would help them learn how to use grammatical information to spell specific morphemes correctly (measured through pseudoword spelling tasks). Longer-term, it is hoped that such an intervention would help children reach a higher level of spelling, as well as of general literacy and language abilities. It was predicted that the Control group, who were to receive phonological rather than morphological training, would not show improvements in their spelling of the two target morphological rules.

The secondary aims were as follows:

Research Question 2: Which children benefit most from a morphology intervention, in terms of their literacy and language skills, and reading experience?

It was hoped that all children receiving the morphology intervention would make significant gains in their ability to apply morphological awareness to spelling, provided that they were able to read and follow the story texts. However, given the level of linguistic awareness required to understand morphological concepts, and the pace and nature of group teaching sessions, it was hypothesised that pupils with the most developed literacy and language abilities and greatest reading experience might benefit most.

Research Question 3: What proportion of children in this age group show baseline morphological awareness, and how does this relate to their wider literacy and language skills, and reading experience?

The final research question aimed to establish how many children at this age have developed awareness and understanding of morphemes, prior to any intervention, and to construct a clearer profile of them. In line with previous research, it was predicted that a small minority of participants might demonstrate baseline morphological awareness, but that the majority would not. It was expected that the morphologically-aware minority – who presumably came to abstract morphological rules themselves through a greater level of metalinguistic awareness and/or word-specific and frequency-based learning, rather than explicit teaching – would be those with better literacy skills, the widest reading experience, and the most conducive home learning environments.

Chapter 2:
METHODOLOGY

2.1 Ethical considerations

Ethical clearance was provided from the Institute of Education's Ethics Committee. In considering the ethical issues inherent in undertaking research with children, close reference was made to the British Psychological Society's (BPS) Code of Ethics and Conduct (2009). This highlights the importance of ensuring ample opportunity for participants to understand the nature, purpose, and anticipated consequences of their involvement, so that they may give informed consent to the extent that their capabilities allow. Consent was viewed as a continuous process (Lloyd, Gatherer, & Kalsy, 2006), with consent sought, and the possibility of withdrawing reiterated, at the beginning and end of each testing session. The parents of each child were also provided with an information sheet about the project, and given the opportunity to opt out by returning a form to school. Every effort was made throughout the duration of the study to maintain ethical behaviour, attitudes and judgements, and the protection and respect of participants and their data were held paramount.

2.2 Epistemology

The research questions point to the quantitative stance adopted by the researcher in this study, underpinned by a positivist epistemology. Quantitative methods, with a pre-, post-test and follow-up design, were

chosen because they lend themselves to testing hypothesised relationships or causal explanations, and measuring degree of generalisability across samples (Elliott, Fischer, & Rennie, 1999). It was judged that this approach would provide the most meaningful and useful answers to the questions that motivated the research.

2.3 Participants

Participants were identified through the researcher's position as a Trainee EP. After permission was gained from Headteachers, all pupils from the Year 2 and Year 3 classes from two Primary Schools (which will be referred to as School *X* and School *Y*) were recruited through informed consent. Children's parents were given the opportunity to opt out on behalf of their child but none did. Both schools have very similar demographic profiles: they are located in a predominantly middle-class area of the Midlands; Ofsted reports that the majority of their pupils are from White British backgrounds, and the proportions with learning difficulties and/or disabilities are close to the national average. According to Key Stage 2 league tables available through the DCSF website, both schools currently have "contextual value added" (CVA) scores very close to the national average (CVA is a government statistic that refers to the progress pupils have made whilst attending a school, taking into account circumstances such as prior attainment and levels of deprivation). It was clear from class-by-class breakdowns of both schools' demographic data, shown to the researcher by Headteachers, that the classes participating in the study were representative of the rest of their schools in these respects.

At the outset, 88 children were successfully recruited to take part in the project. However, by the end, data from three children had to be

discounted due to them not having been present for all testing sessions. The sample size was therefore 85, with 37 from Year 2, and 48 from Year 3. Participants consisted of 43 girls and 42 boys.

The mean age at the time of initial testing was 7 years 6 months; the age range was 6 years 5 months to 9 years 1 month. Approximately half the participants (N = 45) received an intervention aimed at raising morphological awareness, whilst the other half (N = 40) formed the Control group. In School *X*, Year 2 were the Intervention group and Year 3 were the Control group; in School *Y*, Year 3 were the Intervention group and Year 2 were the Control, in order to ensure an equal spread of ages in each group.

2.4 Background measures

2.4.1 Materials and procedure

A variety of background measures were taken by the researcher before the intervention began in January 2009, as follows:

(1) **Spelling assessment.** The Single Word Spelling Test (Sacre & Masterson, 2000) was chosen as it is intended for group administration and it yields a standardised score for each participant. It comprises a series of tests designed to assess the attainment in spelling of 5- to 14-year-olds. The Year 2 test consists of 35 target words; the Year 3 test consists of 45 target words (with many words common to both age groups). The tests took approximately 30 minutes each to administer.

Each participant was provided with an answer sheet (the manual includes photocopiable masters). The target words were dictated orally by the researcher, at first alone, then in the context of a defining sentence, then repeated alone. For example: "*LIFT. The strong man could lift heavy weights. LIFT*". Participants were asked to write down their spellings in the boxes provided. A point was given for each word spelled correctly, the total of which was then converted into a standardised score. Both raw and standardised scores were subsequently used.

(2) **Assessment of reading.** Measures of participants' reading abilities were obtained from pre-existing school data. Both schools monitored pupil reading levels through routine testing, using the Group Reading Test 6-14, Second Edition (GRT-II; NFER-Nelson, 2005). This measures both word and sentence reading ability through sentence completion tasks, as well as context comprehension, in a multiple-choice format. The GRT-II is designed for administration in a whole-class context, lasting around 30 minutes, and it yields individual standardised scores. In the case of both schools, the reading assessments had been carried out in Autumn Term 2008 (two months prior to the start of the study); the standardised scores from these were kindly provided by the participating Headteachers.

(3) Assessment of vocabulary. This measure was adapted from the British Picture Vocabulary Scales, Second Edition (BPVS-II; Dunn, Dunn, Whetton & Burley, 1997). It was not used in a standardised way, due to time constraints, which may have impacted on its reliability and validity. The BPVS is a standardised picture-based test of receptive vocabulary, designed for individual administration, whereby the participant is required to respond by pointing to the correct image (from a set of 4) corresponding to the target word spoken by the test administrator. However, instead of

administering the BPVS on an individual basis, it was administered to a group – a procedure used in other research studies (e.g. Bignell & Cain, 2007; Cain, 2007; Stanovich & Cunningham, 1992). Raw scores were used instead of standardised scores.

With the images of each test item having been scanned on to the computer, it was possible to project them in enlarged form on the interactive whiteboard. For each item, pupils were required to circle on their worksheets the number corresponding to the appropriate image (i.e. 1, 2, 3 or 4). Children sat spaced-apart to minimise any risk of copying. For Years 2 and 3 respectively, the start point was that recommended in the test manual. The end point was determined by the researcher remaining alert to the children's feedback during testing: the test was stopped when it was clear that the vast majority of pupils could not answer any more test items.

(4) **Assessment of exposure to print.** Cunningham and Stanovich's (1990) Titles Recognition Test (TRT) was modernised with the aid of the webpage "Most Popular Kids' Books in England" (Fact Monster/Information Please®, 2009), and through consultation with the participating Class Teachers, who were knowledgeable about current trends in children's literature. An Authors category was also added to make the test more robust. The test consists of 20 children's book titles in one column and 20 children's authors in another; half of each category were genuine and half were foils (see Appendix 1). For example, *Jabberwocky* was included as a genuine title, and *Jacqueline Wilson* a genuine author; *Hot Top* and *Sonia Sage* were foil stimuli.

This assessment was a checklist measure, with participants instructed to put a tick beside titles and authors they thought were real and a cross beside those they thought were "made-up". The test was administered orally. If any child experienced difficulty

keeping up, support was provided for them by the Class Teacher or Teaching Assistant. No time-limit was set, but administration lasted around 15-20 minutes.

(5) **Questionnaire about children's home learning environments and literary experiences.** The final background measure was a questionnaire for parents/carers of participating children, entitled Learning to Read Survey. This was adapted from a questionnaire used in the Progress in International Reading Literacy Study (Mullis *et al*, 2007). It aimed to elicit a range of information regarding the extent and frequency of occurrence of home activities that foster literacy development – for example, the likelihood of parents engaging their children in early literacy activities (reading books, playing with alphabet toys and word games); the presence of children's books in the home; parents' own attitudes and habits regarding reading. There were also questions regarding potentially sensitive issues such as level of parental education and parental occupations.

The questionnaire comprised a combination of simple "yes - no" questions and Likert scale questions, on which participants were required to specify their level of agreement to a statement. The questionnaire can be viewed in Appendix 2a.

Questionnaires were passed on to parents through the Class Teachers in June 2009, and they were returned via the same means prior to the summer holidays. Parents were assured that they should only answer those questions they felt comfortable answering, and that all completed questionnaire data would remain confidential.

2.4.2 Results from background measures

The background measures of spelling, reading, vocabulary and TRT provided information about the characteristics of the sample in terms of their literacy and language levels. Table 1 shows mean ages and scores on the four background measures, organised by Group and broken down further by Year. Separate tables for each Year group's data can be found in Appendix 3.

Table 1: Means and SDs for Age and Background Measures

GROUP	SCH-OOL	YEAR		AGE (years)	SPELLING (SS)	READING (SS)	VOCAB (% correct)	TRT (% correct)
			Range	6.42 - 9.17	69 - 131	68 - 143	12 - 100%	5 - 83%
Inter-vention	***X***	**2** (N=19)	*M*	7.05	99.85	97.55	81.33	61.13
			SD	4.6	10.25	14.88	11.79	11.79
	Y	**3** (N=26)	*M*	8.03	104.92	108.00	89.82	61.83
(N = 45)			*SD*	6.73	14.08	16.36	9.36	3.73
Control	***Y***	**2** (N=17)	*M*	7.03	102.56	107.06	80.1	52.2
			SD	6.09	14.34	25.14	6.87	6.47
(N = 40)	***X***	**3** (N=23)	*M*	7.94	101.40	103.24	99.1	67.2
			SD	4.27	12.51	11.17	6.75	3.35

Note: The tests used were the Single Word Spelling Test (population mean = 100), Group Reading Test 6-14 (population mean = 100), British Picture Vocabulary Scales, and a version of the Titles Recognition Test. Vocabulary and TRT scores are percentages (not percentiles), and the maximum possible scores were 100%.

Table 1 shows that the two research groups performed to a very similar level on the four background measures. T-tests indicate that the groups were matched in spelling (t (1,85)=0.31, p=0.76), reading (t (1,85)=0.35, p=0.73), vocabulary (t (1,85)=1.59, p=0.11) and the TRT (t (1,85)=0.07, p=0.94), as well as in age (t (1,85)=0.12, p=0.9). Spelling and reading scores were normally distributed, demonstrating that the sample showed average literacy abilities relative to standardised score expectations. Participants in Year 3 fared better than Year 2 in the tests of vocabulary

and titles/authors recognition – i.e. performance improved with age. This was most evident in the Control group, as opposed to the Intervention group.

It was hoped that information from the questionnaire would reinforce TRT data and, later, contribute to the explanation of individual differences in the development of morphological knowledge. Unfortunately, despite the Headteachers' efforts to chase the questionnaires up, the response rate was only 36%, meaning that this additional data were only available for 31 of the participants. The distribution of these across experimental conditions was also unbalanced: 11 from Intervention group parents and 20 from Control group parents. This meant that there would be little value in exploring trends in intervention response in relation to the questionnaire data. A summary of the existing questionnaire data can be found in Appendix 2b.

2.5 Pre- and post-test assessment of morphological awareness

The pre-intervention assessments were administered in January 2009 by the researcher (Time 1). Post-intervention assessments were administered at two points: immediately following the end of the intervention in March 2009 (Time 2), then repeated in July 2009 after a delay of around four months (Time 3). The objective of this design was as follows:

> **Time 1**: to assess children's baseline morphological awareness (using a pseudoword task) and measure background literacy and language skills;

Time 2: to assess whether the morphology intervention had made an observable difference to participants' knowledge and understanding of two target morphological spelling rules.

Time 3: to determine the longer-term impact of the intervention by assessing whether any significant gains in morphological awareness had been maintained.

The research therefore combined elements of an intervention study and a four-month longitudinal study.

Baseline morphological awareness was assessed using a pseudoword sentence task developed by the researcher. A similar version of the task had been used in her earlier research (Colchester, 2006), which was useful as a pilot. This had provided evidence of a correspondence between the results from children's performance on pseudoword tasks, and their ability to spell real words using the morphemes in question, enabling the assumption to be made in the current study that good spellers will score highly in the task. The assumption was backed up by key findings from other studies, such as Dawson (2005) and Mitchell, Kemp, Dawson and Bryant (2010).

64 pseudoword pairs were used, in order to have sufficient data within each spelling sub-category. Each pseudoword pair comprised two words that were phonologically similar but graphically different: one contained one morpheme; the other contained two morphemes. A full list of stimuli can be found in Appendix 4a. 32 of the pseudoword pairs were nouns designed around the plural *-s* morpheme rule, incorporating 16 /z/-sound endings, and 16 /ks/-sound endings. The other 32 pseudoword pairs were verbs designed around the past-tense *-ed* morpheme rule, incorporating 16 /t/-sound endings, and 16 /d/-sound endings (/d/ following a voiced consonant or vowel, /t/ following an unvoiced consonant or vowel).

The word pairs were matched with appropriate sentences that provided contextual information. One of the pseudowords in the pair was correct in the context of its sentence, and one was incorrect. Of the correct choices for the /z/-ending pseudo-nouns, half were two-morpheme words spelled with final *-s* (e.g. *prees*, *droes*), and the other half were one-morpheme words spelled with final *-ze* (e.g. *frooze*, *zaze*), with equal numbers of nouns and verbs. Of the correct choices for the /ks/-ending pseudonouns, half were two-morpheme words spelled with final *-s* (e.g. *snocks*, *blucks*), and the other half were one-morpheme words spelled with final *-x* (e.g. *plex*, *zix*). Of the correct spelling choices for the /d/-ending pseudoverbs, half were two-morpheme past-tense verbs spelled with final *-ed* (e.g. *larned*, *wurfed*), and half were one-morpheme infinitives (e.g. *trard, crund*). Similarly, of the /t/-ending pseudoverbs, half were two-morpheme past-tense verbs spelled with final *-ed* (e.g. *gopped, wurfed*), and the other half were one-morpheme infinitives or first-person present-tense forms spelled with final *-t* (e.g. *keft, bast*).

Within each sound-ending category, the pseudoword trials were analysed for their sentence complexity (e.g. clauses), sentence length (e.g. number of words and Mean Length of Utterance), syllable structure of words, and frequency of occurrence of vocabulary items within each trial. This was to ensure that the trials for each category of target pseudoword were comparable in terms of their syntactic, morphological and lexical complexity, since these factors might impact on children's responses (details of these analyses can be found in Appendix 4b).

The trial format was consistent for all categories of pseudoword. Almost every trial contained two sentences, or clauses, that were read aloud by the researcher: the first introduced the word to show it was a regular noun or verb, and the second included the word transformed into an alternative form, the correct spelling of which was determined by the context of the sentence. Participants were provided with a written version of the pseudoword pairs only, as it was thought that their choice of spelling could

be facilitated by seeing the root form of the word in the initial sentence/clause. For example, if participants had been shown "*I love bupting. When would you like to [**bupt** / **bupped**] with me?*", it may have been more obvious that *bupt* was the correct choice because its root is visible in *bupting*.

For past tense trials, half the trials introduced the verb in its one-morpheme form in the first sentence, showing it was of regular conjugation (i.e. with a common stem for present and past tenses which would indicate an *-ed* past tense ending). The second sentence required the participant to transform it into its two-morpheme past tense form by choosing the appropriate spelling from the two alternatives given. To increase the validity of the pseudoword tool, the other half of past tense trials introduced the verb in its two-morpheme form, and participants were required to transform it into its one-morpheme form.

For plural trials, in the first sentence, half the trials introduced the noun in its one-morpheme (singular) form, and the other half introduced the noun in its two-morpheme (plural) form. In the second sentence, the noun was presented in the opposite form, and participants were required to transform it into the correct form by choosing the appropriate spelling from the two alternatives given.

Plural trials were read out to the whole class as in the following examples (with only the pseudoword pair provided in written form). The correct answers are underlined:

These greezes are very sharp, but my **[grees / greeze]** is blunt.	*1 morpheme /z/*
Here I have one foo, but in the park there are many **[foos / fooze]**.	*2 morphemes /z/*
Those zaxes are heavy. Can you lift a **[zacks / zax]**?	*1 morpheme /ks/*
You'll need this key for the crick. There are two **[crix / cricks]**.	*2 morphemes /ks/*

Past tense trials were read out to the whole class as in the following examples:

I love bupting. Would you like to [**bupt** / **bupped**] with me?	*1 morpheme /t/*

I want to wurf but I don't know how! Jim has just [**wurfed / wurft**].	*2 morphemes /t/*
I've never liked brunding, so I won't [**brunned / brund**] today.	*1 morpheme /d/*
Freddie loves to snin. Yesterday he [**snind / sninned**] all day long.	*2 morphemes /d/*

The sequence of presentation of the 64 sentences was randomised using the website http://www.random.org/, to avoid presentation order effects.

The pre- and immediate post-intervention pseudoword tasks were administered through means of a worksheet containing the 64 pseudoword pairs, provided for each participant. Participants were seen in their classroom settings, one class at a time, with all class members completing the tasks simultaneously. The instructions delivered, both orally and on worksheets, were "*I am going to read some sentences. These sentences contain pretend words, which can be spelled in two different ways. The two different spellings are written down for you below. Please listen to the sentences, then CIRCLE which spelling of the pretend word you think is CORRECT*". To ensure that all participants understood this, a teaching example was provided and talked through, as follows:

Yesterday my friend [**snigged** / **sniggd**] as she was walking along.

The task was then administered orally: the sentences were read aloud by the researcher, leaving a few seconds for participants to mark their response. This served to pace the group, as well as to demonstrate pronunciation of the pseudowords and help any participants who were struggling to read the words. The task lasted between 30 and 40 minutes. At the end of each testing session, participants received a debriefing appropriate to their intellectual level, questions were answered, and they were thanked for their cooperation and efforts.

By the end of administration of the immediate post-intervention pseudoword task, it was clear the task had lost some of its novelty. Perhaps because of a lack of understanding, or because there was no tangible feedback or reward for their endeavours, many participants grew

visibly weary as the task progressed. Therefore, in an attempt to reduce any effects of reduced engagement or effort, as well as to reduce the extent of imposition and disruption to the normal schedule of events at one of the busiest times of the school calendar, the decision was taken to cull the number of pseudoword sentences by half for delayed post-intervention testing. Thus, there were 32 sentences and word pairs in the task, instead of 64 (see Appendix 4c for reduced set), thus reducing the data considerably but perhaps more appropriate given the age of the sample. Results on each spelling rule sub-category from pre- and immediate post-testing were put through a rigorous correlation procedure, to ensure that the pseudoword trials retained for delayed post-testing were well representative of the whole set administered previously. For example, mean scores on the four retained two-morpheme /d/-ending items had to correlate highly with scores from the original set of eight /d/-ending two-morpheme items. All correlation coefficients were greater than 0.75, and were at or below the p=0.01 significance level. (See Appendix 4c for details.)

2.6 The intervention

2.6.1 Overall design and aims of intervention

The intervention consisted of whole-class group reading sessions. Age-appropriate real-book stories were delivered through an interactive Powerpoint presentation, led by the teacher and requiring the active participation of pupils. The aim was to promote explicit understanding either of two specific morphological rules (the Intervention group) or of two

specific phoneme-grapheme correspondence rules (the Control group) through the medium of text reading.

Since the Control group was provided with another type of intervention, rather than no intervention at all, it would be more technically accurate to call it a "Treatment Control" or "Alternative training group"; however, for ease of reference, "Control group" is the label used. The rationale behind this aspect of the study's design was primarily an ethical one. It was important to plan that all participants would derive equivalent benefit from participation in the project, in terms of use of the interactive story-text resources, positive teacher attention, and the learning of new equally valuable knowledge.

The proposed design of the intervention differed from that which was ultimately agreed with Headteachers. In terms of duration, as Nunes and Bryant's (2006) seven-week morphology intervention had shown success, it was originally decided that this intervention should take place over a similar period. In order to maintain the optimal engagement and concentration of children as young as 6 in a quite cognitively-demanding task, each session was designed to last around 20 minutes each. The proposed design aimed to take into account the instructional principles reviewed in Section 1.5 of the Introduction, namely by having two or three such sessions per week in order to ensure distributed learning. However, the issue of minimising disruption to the usual teaching schedule, and thus retaining the full co-operation of participating schools, was a major factor that had to be taken into consideration. Hence, the design negotiated with Headteachers was a five-week intervention with one 20-minute session per week, as this was all that fitted with schools in terms of time, resources and other curricular pressures.

In January 2009, an hour of targeted training was delivered to the four recruited teachers by the Trainee EP and a Professor of Developmental Psychology with expertise in the area. The training covered the

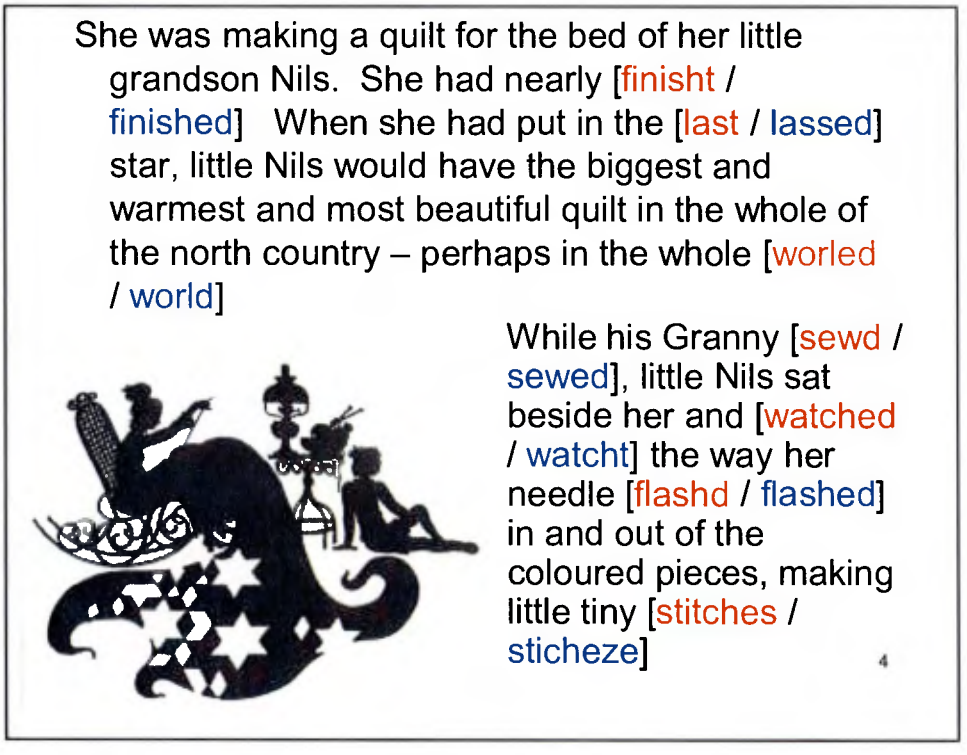
background, rationale and objectives of the research study; an explanation of fundamental concepts in morphology; principles of best practice in teaching morphemes. Emphasis was then placed on ensuring the teachers had a clear understanding of the specific morphological rules that formed the focus of the study. Teachers were then given access to the intervention materials. It was suggested to the teachers that the intervention could form part of the whole-group component of Literacy Hour, but ultimately it was left to the teachers' discretion at what point they delivered each intervention session. However, teachers were asked to adhere strictly to the agreed programme configuration: one session per week for five weeks, with each session lasting around 20 minutes. The intervention was delivered by the teachers for five consecutive weeks following pre-intervention testing in February and March 2009.

The story texts used for the whole-class reading intervention programme were reproduced directly from the book "A Necklace of Raindrops and Other Stories" by Joan Aiken (1968). (Permission was sought from the publisher.) This collection of short magical adventure stories was chosen for its wide-ranging appeal to all Primary-aged children and its wealth of imaginative characters and ideas. It was gauged that three stories would be enough to fill the five 20-minute intervention sessions. These were typed up and composed into three Powerpoint presentations. To ensure that the texts were supported by visual aids, and that participants were optimally engaged and gleaning enjoyment from the stories, the Powerpoint texts were accompanied by the original colourful illustrations (scanned from the book) as well as some additional content-appropriate images found on the internet. Each time the stories featured one of the spelling patterns that were the focus of this study, two alternative spellings were displayed in the text, one in red and one in blue.

2.6.2 Morphological training (Intervention Group)

Teachers read aloud the story – as displayed on the whiteboard – to the whole class, and children's attention was focused on past tense and plural endings at points in the text where the two alternative forms of spelling were provided. Teachers questioned children which spelling they thought was correct in that context, and then outlined to the class the reason why the target spelling was correct in terms of the morphological rule governing that spelling. An example of the information teachers were asked to convey might be, in explaining the spelling of *kissed*: "We know that this spelling should end in *-ed*, even though the final sound is /t/, because the sentence shows us that this is a past-tense verb and they almost always end in *-ed*". It was left to the teachers' discretion and expertise to give and modify their explanations in ability- and age-appropriate ways. The expectation was that children would learn the rule through this whole-class instructional procedure.

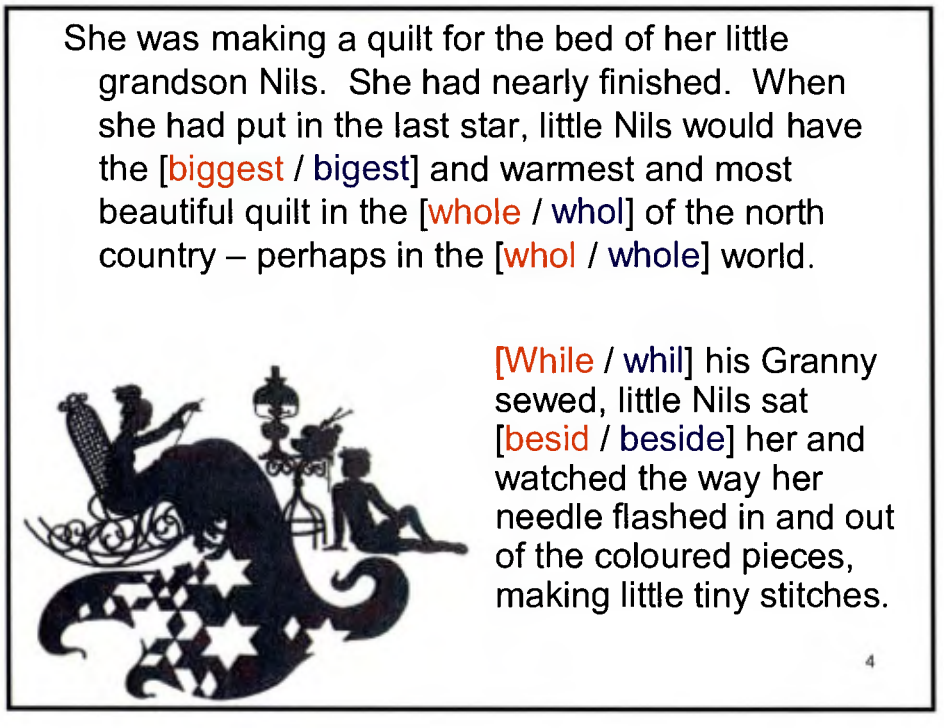
An example slide from the Intervention group's "The Patchwork Quilt" can be seen below.



2.6.3 Control Group

The Control group also received an intervention, following a similar procedure and with identical stories used. The difference lay in the words the children were asked to focus on in the texts, which were *not* words whose spelling was determined by morphological rules. Rather, the focus of the Control group's intervention was to raise awareness of two completely different categories of spelling rule: the rule about "split vowel" digraphs and the rule about doubling of consonants – i.e. phoneme-grapheme correspondence rules. As stated above, the Control group's programme was designed in this way in order to prioritise ethical considerations.

Example slide from the Control group's "The Patchwork Quilt":



Chapter 3:
RESULTS

3.1 Chapter overview and rationale for the tests conducted

This chapter answers the research questions posed in Chapter 1 through quantitative analysis of the data gathered through pre- and post-intervention testing. It was felt that the most logical structure for this chapter was to present the data in the chronological order in which they were obtained.

Following this overview (in Section 3.2), there will be comparison of the group results of baseline morphological awareness skills, measured through the pre-intervention pseudoword task, followed by exploration of individual differences in these results. This will answer Research Question 3. In the next section (3.3), results from immediate and delayed post-intervention testing will be presented, leading to evaluation of the effectiveness of the intervention in increasing morphological awareness. This will answer Research Question 1. The final part of the chapter (3.4) will deal with individual differences in response to the intervention, thus answering Research Question 2.

"Time 1" will henceforth be used to refer to baseline or pre-intervention testing, "Time 2" to immediate post-intervention testing, and "Time 3" to delayed post-intervention testing. The two morphological rules that were tested in the pseudoword task and taught during the intervention are dealt with as distinct results categories (with the exception of Table 8). Mean accuracy scores (number of items correct) and standard deviations are presented in tables, accompanied by textual description of any trends

observable in the data. This is followed by presentation of results from statistical tests undertaken.

The statistical tests used to analyse differences in mean accuracy scores between the Intervention and Control groups were from the family of tests known as ANOVA (Analysis of Variance). ANOVA was chosen because of its potential to compare more than two conditions, by partitioning the total variance in the scores into within- and between-group components (Dancey & Reidy, 2007), and to control for the levels of the family-wise error. However, whilst straightforward ANOVA was sufficient for the Time 1 data, ANCOVA (Analysis of Co-variance) was used in analyses involving post-intervention results. ANCOVA is closely related to ANOVA, exploring whether groups differ on a dependent variable, but it also partials out the effects of a known bias, called the co-variate. The reason for its use was that the Control group had stronger baseline (Time 1) awareness of the plural rule than the Intervention group. The co-variate entered into the model was therefore baseline scores on plural trials, and the ANCOVA served to adjust the means on the co-variate so that the mean co-variate score was the same for both groups. Thus, the effects of the co-variate were partialled out by the ANCOVA procedure.

The validity of conclusions drawn from a statistical analysis depends on the validity of any background assumptions made (Field, 2009). ANOVA and ANCOVA are robust enough to deal with small violations of their background assumptions – e.g. slight departures from a normal distribution – which was another reason for their appropriateness in this case, where the sample size was relatively small. Nonetheless, checks for skewness and kurtosis of the data revealed that all the measures used at Time 1 were normally distributed; variance between the two groups was similar; and there were no outliers. Therefore the assumptions of ANOVA and ANCOVA were considered to be met. Please see Appendix 5 for further details of this exploratory data analysis.

There were five separate analyses conducted in total: two ANOVAs for the Time 1 data (one for each spelling rule); two ANCOVAs for the comparison between Time 1 and Time 2 data (one for each spelling rule); and an ANCOVA for the comparison between Time 1 and Time 3 data (the spelling rules were combined due to a major reduction in data). The variables entered into these models will be described at the relevant points in the text.

Where a significant difference was found in the analyses, the effect size was calculated using omega-squared (ω^2). Effect sizes can be useful in enhancing the meaningfulness and comparability of results, by providing an estimate of how much of the total variance in the dependent variable is due to the independent variable, rather than to within-group variance. (As an estimate of variance explained in the population, omega-squared is relatively unbiased; it does not over- or underestimate as much as, say, eta-squared (Olejnik & Algina, 2003).) According to ω^2 values suggested by Kirk (1996), an effect size of 0.01 is considered small, 0.06 is considered moderate, and 0.14 is considered large.

Only those interaction effects considered relevant in answering the study's original research questions will be reported in this chapter. Full results of significant interactions that are not of theoretical importance (all of which include very small effects) can be found in Appendix 6. Appendix 6 also contains details of non-significant interactions where F>1.

To explore sources of interaction effects, post-hoc t-tests with Bonferroni correction are used. These consist of pairwise comparisons that are designed to compare all different pair combinations whilst controlling for the family-wise error (Field, 2009).

3.2 Baseline Morphological Awareness

3.2.1 Comparison of group performance on the Pseudoword task at Time 1

Overall performance on Time 1 testing of morphological awareness is shown in Table 2.

Table 2: Mean group accuracy scores and SDs on Pseudoword task, Time 1

GROUP	SCHOOL	YEAR		PLURAL RULE TRIALS (max 32)	PAST TENSE RULE TRIALS (max 32)	Total by Year (max 64)	Total by Group (max 64)
Inter-vention	*X*	2	*M*	16.8	18.0	35.4	
			SD	2.42	3.49	6.42	*M* 35.2
	Y	3	*M*	17.58	17.92	35.5	*SD* 8.26
			SD	3.2	4.51	9.56	
Control	*Y*	2	*M*	17.75	18.38	35.67	
			SD	4.07	5.02	10.99	*M* 36.87
	X	3	*M*	20.0	17.39	37.39	*SD* 10.35
			SD	4.53	3.79	9.78	
		Total (max32)	*M*	18.1	17.88		
			SD	3.77	4.14		

Table 2 shows that very similar mean scores were achieved on the pseudoword task by participants across both year groups, and across trials of both morphological spelling rules. Information from Table 2 will now be broken down into separate tables for each morphological spelling rule, to allow for more detailed examination of results. Table 3 presents mean scores for pseudowords that were governed by the plural rule, and Table 4 presents mean scores for pseudowords that were governed by the past tense rule.

Table 3: Means and SDs for correct spelling choices on Plural rule trials by Group (Pseudoword task Time 1)

GROUP		*/ks/-ending words*			*/z/-ending words*		
		1m (max 8)	2m (max 8)	Total (max 16)	1m (max 8)	2m (max 8)	Total (max 16)
Intervention	M	4.15	5.04	**9.2**	3.98	4.07	**8.04**
(*N* = 45)	SD	1.75	1.85	**2.14**	1.72	1.84	**1.7**
Control	M	4.44	5.72	**10.15**	4.64	4.33	**8.92**
(*N* = 40)	SD	1.93	1.73	**2.46**	2.03	1.72	**2.5**
Total	M	**4.28**	**5.35**	**9.64**	**4.28**	**4.19**	**8.45**
(*N* = 85)	SD	**1.83**	**1.82**	**2.32**	**1.89**	**1.78**	**2.14**

Note: For all relevant tables, 'm' represents 'morpheme'. So '1m' = words with one morpheme.

Table 4: Means and SDs for correct spelling choices on Past Tense rule trials by Group (Pseudoword task Time 1)

GROUP		*/d/-ending words*			*/t/-ending words*		
		1m (max 8)	2m (max 8)	Total (max 16)	1m (max 8)	2m (max 8)	Total (max 16)
Intervention	M	4.26	4.57	**8.83**	4.72	4.26	**8.98**
(*N* = 45)	SD	1.89	2.01	**1.95**	1.85	2.10	**2.03**
Control	M	4.51	4.41	**8.92**	4.46	4.44	**8.9**
(*N* = 40)	SD	1.2	1.59	**1.79**	2.02	1.89	**2.15**
Total	M	**4.38**	**4.49**	**8.88**	**4.6**	**4.34**	**8.94**
(*N* = 85)	SD	**1.93**	**1.82**	**2.07**	**1.92**	**1.99**	**2.07**

Two mixed-design Analyses of Variance (ANOVAs), with between-subject variables of Group (Intervention, Control), School (*X*, *Y*) and Year (2, 3), and within-subject variables of Morpheme number (1, 2) and Sound ending (/ks/, /z/ for the plural rule; /d/, /t/ for the past tense rule) were carried out for data in the above tables. Non-significant main effects of School ($F<1$) and Year (plural rule: $F(1,81)=3.57$, $p=0.06$; past tense rule: $F<1$) were observed for both rule categories. For this reason, data are collapsed across School and Year groups in subsequent analyses.

On the plural rule trials, there was a significant main effect of Group ($F(1,81)=4.44$, $p=0.04$, $\omega^2=0.02$), establishing that the groups differed in their plural rule awareness at Time 1. Table 3 shows the cause of this difference to be the Control group having stronger baseline awareness of the plural rule than the Intervention group. As explained in the chapter overview, this mismatch is taken into account in future analyses. The ANOVA yielded a significant main effect for Morpheme number ($F(1,81)=5.06$, $p<0.05$, $\omega^2=0.03$), with a higher level of accuracy on words with two morphemes than one morpheme. Sound ending was significant and had a moderate effect size ($F(1,81)=19.55$, $p<0.01$, $\omega^2=0.08$), with participants in both groups spelling /ks/-ending words correctly more often than /z/-ending words.

On the past tense rule trials, the main effect for Group was not significant, suggesting that the two groups were well matched on their awareness of the past tense spelling rule at Time 1. Morpheme number and Sound ending were also non-significant main effects (all $F<1$).

No significant interactions were observed for either the plural or the past tense rule trials at Time 1.

3.2.2 Individual differences in Time 1 morphological awareness

In a two-choice task with 32 trials (taking the plural rule and past tense rule trials separately), chance level is 16. An individual participant would be performing at significantly above chance level on the binomial if s/he scored 22 or more out of 32. Therefore, in each rule category on the pseudoword task, this score indicated that a participant was likely to be

using rules to guide his/her spelling choices. Figures 1 and 2 show the number of participants appearing to use morphological rules at Time 1

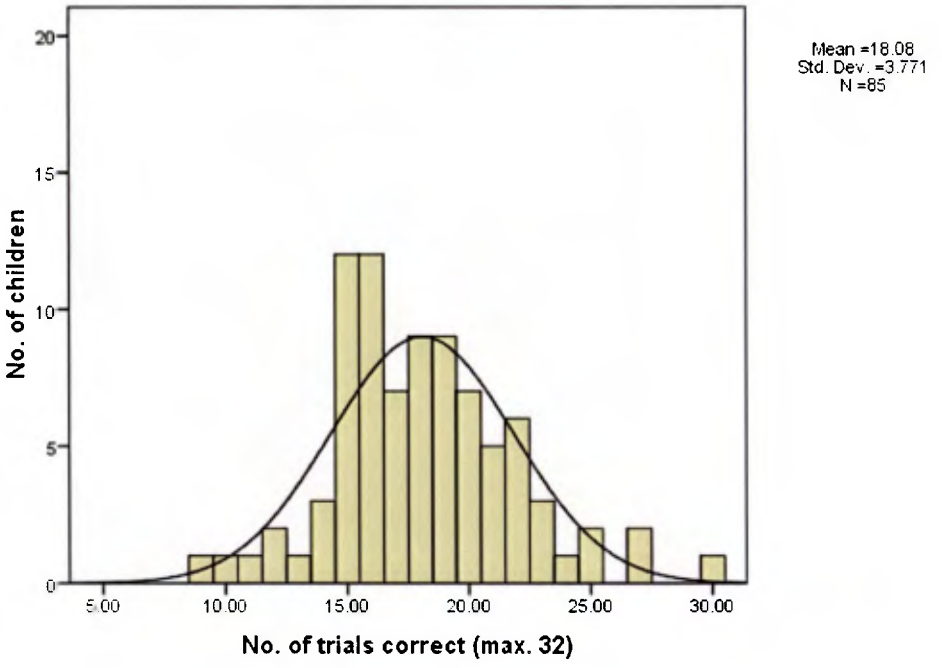


Figure 1: Distribution of participants making correct spelling choices on Plural Rule trials, Time 1

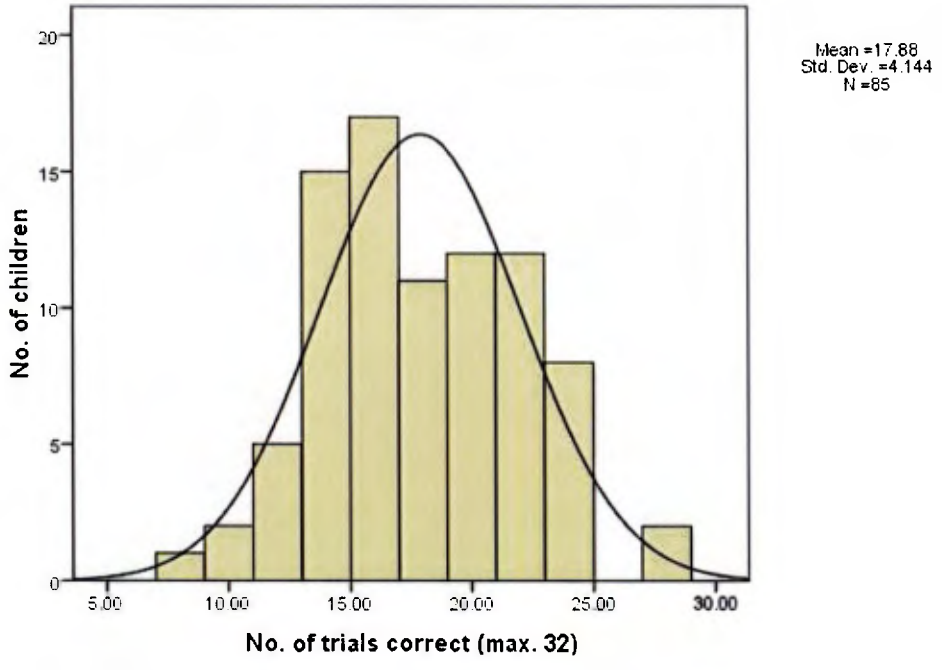


Figure 2: Distribution of participants making correct spelling choices on Past Tense rule trials, Time 1

Both Figures 1 and 2 approximately follow a normal distribution around chance level, suggesting that at Time 1 most children had *no* knowledge of the morphological spelling rules governing plural and past tense words. They would have been making their spelling choices randomly. At the tail-end of both distributions (around the 22 out of 32 mark), there are slight bumps. These participants scored significantly above chance level, thereby showing evidence of rule use. 18% of the whole sample (i.e. 15 out of 85) scored significantly above chance on the plural rule trials, and 22% (i.e. 23 out of 85) on the past tense rule trials.

A year-by-year breakdown of the above-chance group reveals that it represented 14% of pupils in Year 2 and 27% of pupils in Year 3, with each sub-group consisting almost equally of participants knowing the plural rule and participants knowing the past tense rule. In other words, pupils in Year 3 appear more likely to use morphological rules to aid their spelling than pupils in Year 2.

3.2.3 Cognitive and environmental correlates of Time 1 morphological awareness

What was the profile of the children who demonstrated baseline morphological awareness, in terms of wider literacy and language skills, and literary experiences?

In order to assess the existence of any relationships between morphological awareness and abilities in spelling, reading, vocabulary and text exposure/reading experience, a set of correlations was run using scores from the Time 1 pseudoword task and the four background measures. The correlation matrix is shown in Table 5.

Table 5: Pearson Correlations among Time 1 Pseudoword Task scores and Background Measures (*N* = 85)

VARIABLE		*Age*	*Pseudo-word (%)*	*Spelling (SS)*	*Reading (SS)*	*Vocab-ulary (no. correct)*	*TRT (no. correct)*
Age		1.00					
Pseudoword (%)	x^2	0.06	1.00	0.37***	0.38***	0.30**	0.21
Spelling (SS)	x^2	0.09	0.37***	1.00	0.78***	0.51***	0.16
Reading (SS)	x^2	0.16	0.38***	0.78***	1.00	0.43***	0.06
Vocabulary	x^2	0.47***	0.29**	0.49***	0.45***	1.00	0.33***
TRT	x^2	0.41***	0.22*	0.18	0.12	0.46***	1.00

Notes:
Coefficients above the diagonal are partial correlations controlling for age
***Correlation is significant at the $p<0.001$ level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

The correlation coefficients and significance levels in Table 5 could suggest that raw scores on the vocabulary test and book titles/authors recognition test (TRT) improved with age, as one would expect, but scores on the pseudoword task were not correlated with age. Weak relationships were found between performance on the pseudoword task and scores on the standardised spelling and reading tests. The partial correlation controlling for age between the pseudoword task and the TRT did not show a relationship. Vocabulary was moderately related to spelling and reading. There was some indication of a relationship between the TRT and vocabulary test, but this became weak when age was controlled for. No relationship was found between the TRT and the standardised spelling and reading tests, and these findings remained the same when Age was entered as a controlling variable.

3.2.4 Summary of baseline morphological awareness and correlates

1. Overall scores on the Time 1 pseudoword task did not differ significantly across age groups, school, or across the two morphological spelling rules.
2. In plural rule trials, participants found /ks/-ending words easier to spell than /z/-ending words and two-morpheme words easier than one-morpheme words. In past tense rule trials, no such effects were found.
3. Approximately three-quarters of participants were making spelling choices randomly on the pseudoword task; they did not demonstrate morphological awareness. Of participants whose spelling choices were informed by awareness of morphological rules, more were from Year 3 than Year 2.
4. Spelling and reading scores correlated with performance on the pseudoword task but the relationships were not strong.

3.3 Intervention Results

3.3.1 Comparison between Time 1 and Time 2 scores

Results from Time 1 testing will now be compared with results from Time 2 testing, in order to ascertain whether the intervention made a difference to children's morphological awareness. Effects of the intervention are examined using the within-groups variable, Time. To assess whether any

differences between Time 1 and Time 2 were reliable, for each rule, a mixed design ANCOVA was run, controlling for the mismatch between the two groups in plural rule awareness at Time 1. The main terms were Group (Intervention, Control), Time (Time 1, Time 2), Morpheme number (1, 2), and Sound (/ks/, /z/), and the co-variate was Time 1 scores on plural trials. The last three factors were 'repeated measures'.

3.3.1.1 Plural rule trials: Time 1 – Time 2

A summary of the mean accuracy scores on the plural rule component of the pseudoword task at Time 1 and Time 2 testing is shown in Table 6.

Table 6: Mean accuracy scores and SDs for correct spelling choices in Plural rule trials, Times 1- 2

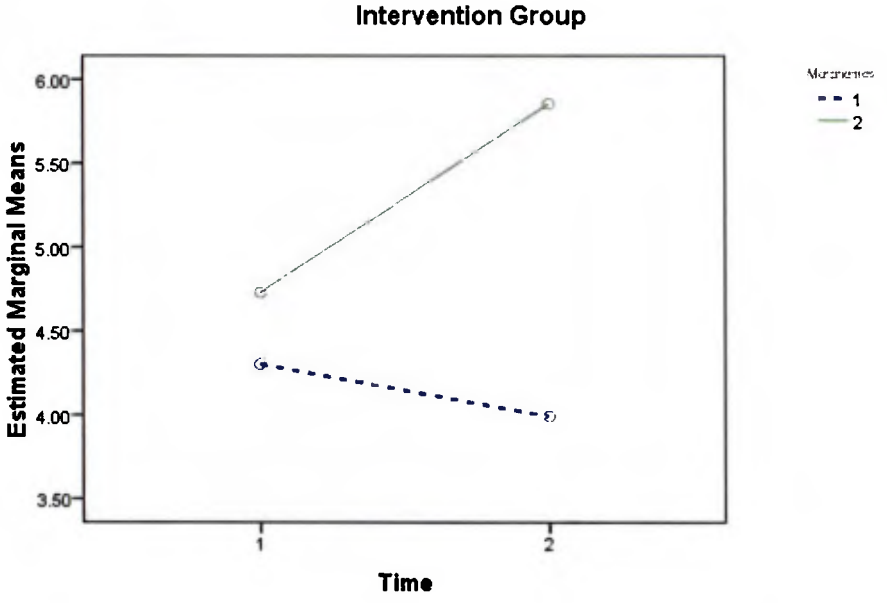
		/ks/-ending words (max 16)				*/z/-ending words* (max 16)			
GROUP		**Time 1**		**Time 2**		**Time 1**		**Time 2**	
		1m (max 8)	**2m** (max 8)	**1m** (max 8)	**2m** (max 8)	**1m** (max 8)	**2m** (max 8)	**1m** (max 8)	**2m** (max 8)
Intervention	M	4.15	5.04	4.29	6.07	3.98	4.07	3.33	5.55
(*N* = 45)	SD	1.75	1.85	2.32	2.06	1.72	1.84	2.71	2.57
TOTAL	**M**	**9.2**		**10.36**		**8.04**		**8.9**	
Intervention	**SD**	**2.14**		**2.74**		**1.7**		**2.63**	
Control	M	4.44	5.72	4.39	5.41	4.64	4.33	4.95	3.77
(*N* = 40)	SD	1.93	1.73	1.9	2.1	2.03	1.72	1.99	2.3
TOTAL	**M**	**10.15**		**9.8**		**8.92**		**8.72**	
Control	**SD**	**2.46**		**2.69**		**2.5**		**2.5**	

Inspection of the mean scores in Table 6 suggests that the Intervention group's spelling of both sound endings for the plural rule improved immediately following the intervention, with the greatest improvement visible in the /ks/-ending words. Spelling of two-morpheme words improved more than spelling of one-morpheme words, for both sound endings. There is a numerical trend for the Control group's use of the plural rule to get slightly worse overall.

The ANCOVA yielded the following results. The main effect for Group (F (1,80)=3.55, p=0.06) indicates that the difference in performance by the Intervention and Control groups did not reach statistical levels of significance. The main effect for Time (F (1,80)=11.18, p<0.01, ω^2=0.02) indicates that mean scores across both groups were significantly higher at Time 2 than at Time 1. There was a significant main effect for Morpheme number (F (1,80)=7.28, p<0.05, ω^2=0.01), with a better level of accuracy on two-morpheme than one-morpheme words. Both these effect sizes were small. The main effect for Sound ending (F (1,80)=3.28, p=0.07) was not significant.

The interaction Time x Sound ending was significant. However, since it is not of theoretical importance and has a very small effect size, full details are not included here, but can be found in Appendix 6. No other two-way interaction was significant.

The three-way interaction Group x Time x Morpheme number was significant but with a small effect size (F (1,80)=7.17, p<0.01, ω^2=0.01). It is shown in the two plots in Figure 3.



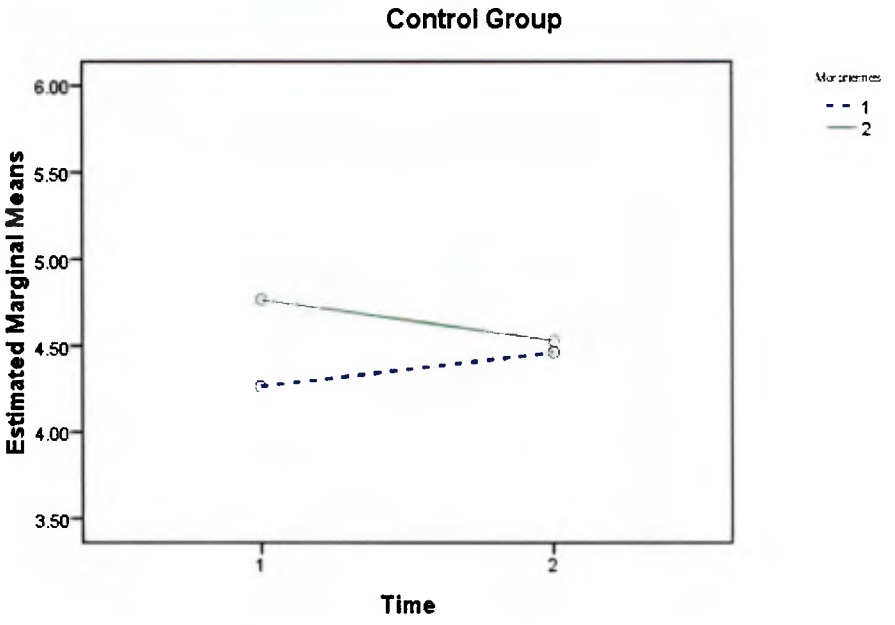


Figure 3: Interaction between Group, Time & Morpheme number on Plural trials (plotted by Group), Times 1-2

To explore the interaction effect, four post-hoc t-tests with Bonferroni correction were carried out. To control for the family-wise error, a probability level of less than 0.013 was required to achieve the $p<0.05$ level of statistical significance. The t-tests showed that the source of the interaction was as follows: between Times 1 and 2, the Intervention group improved more in their spelling of two-morpheme plurals (t (1,44)=4.02, $p<0.001$) than one-morpheme plurals (t (1,44)=1.04, $p=0.324$), whilst the Control group showed the opposite pattern (t-test results were not significant).

The interaction Group x Sound ending x Morpheme number was significant; see Appendix 6 for details. All other three-way interactions were not significant (F<1).

3.3.1.2 Past tense rule trials: Time 1 – Time 2

A summary of mean accuracy scores on the past tense rule component of the pseudoword task for each group across Time 1 and Time 2 is shown in Table 7.

Table 7: Mean accuracy scores and SDs for correct spelling choices in Past tense rule trials, Times 1-2

		/d/-ending words (max 16)				*/t/-ending words* (max 16)			
		Time 1		**Time 2**		**Time 1**		**Time 2**	
GROUP		**1m** (max 8)	**2m** (max 8)	**1m** (max 8)	**2m** (max 8)	**1m** (max 8)	**2m** (max 8)	**1m** (max 8)	**2m** (max 8)
Intervention	M	4.26	4.57	4.69	5.4	4.72	4.26	3.78	6.04
(*N* = 45)	SD	1.89	2.0	2.01	2.23	1.85	2.1	2.5	2.11
TOTAL Intervention	**M**	**8.83**		**10.1**		**8.98**		**9.82**	
	SD	**2.03**		**2.71**		**2.03**		**2.71**	
Control	M	4.51	4.41	4.49	4.28	4.46	4.44	4.0	4.41
(*N* = 40)	SD	1.99	1.59	2.25	2.14	2.02	1.89	2.16	2.12
TOTAL Control	**M**	**8.92**		**8.77**		**8.89**		**8.41**	
	SD	**2.15**		**2.44**		**2.15**		**2.44**	

Inspection of Table 7 indicates higher mean scores for the Intervention group's spelling of /d/-ending words in the past tense rule trials at Time 2 than at Time 1. A similar trend was observed for the spelling of /t/-ending words, but only if they contained two morphemes. Overall, the spelling of two-morpheme past tense words appeared to improve more than spelling of one-morpheme past tense words. The Control group did not show the same trend in their use of the past tense rule at Time 2: their scores remained similar over time across both sound endings and across one- and two- morpheme words.

The ANCOVA for these data did not reveal a significant main effect of Group ($F(1,81)=3.93$, $p=0.05$). The main effects for Time ($F(1,81)=2.31$,

p=0.13) and Morpheme number (F (1,81)=1.82, p=0.18) were also non-significant. The main effect for Sound ending was not significant (F<1).

The interaction between Group and Time was significant but with a very small effect size (F (1,81)=6.35, p<0.05, ω^2=0.008). This is plotted in Figure 4, which also highlights the much better matching between the two groups' awareness of the past tense rule at Time 1 than of the plural rule.

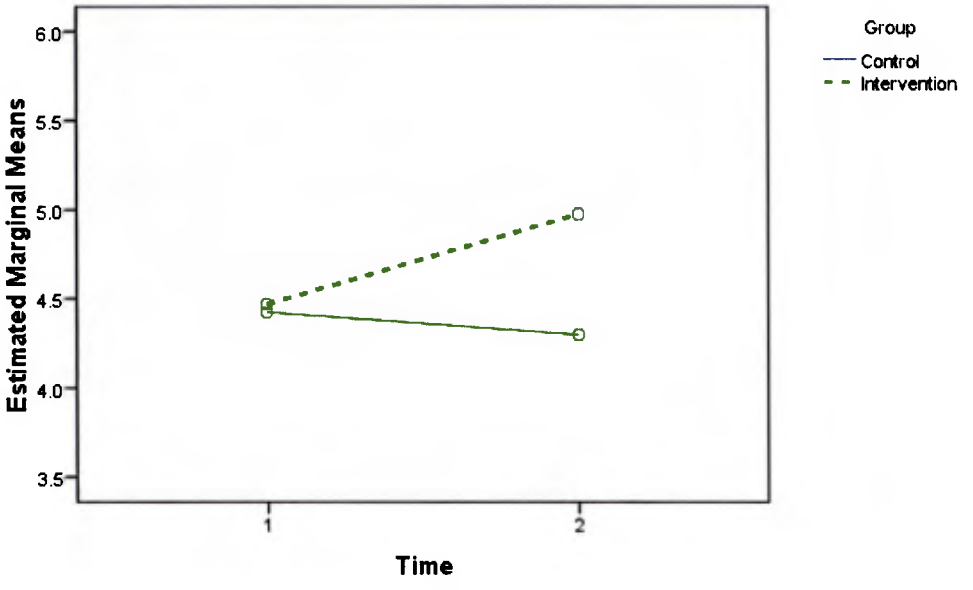


Figure 4: Interaction between Group and Time on Past tense trials, Times 1-2

Post-hoc t-tests with Bonferroni correction (significance level required: <0.017) confirmed that the interaction was due to the significant contrast between the groups' performance at Time 2 (t (1,82)=2.52, p=0.013): the Intervention group improved in their scores on the past tense rule items but the Control group did not. However, exploration for each group separately did not reveal a significant change between Times 1 and 2 for the Intervention group (t (1,45)=1.77) p=0.084) so their improvement is not reliable. (Control group: t (1,37)=0.81, p=0.421.)

The three-way interaction Group x Time x Morpheme number was significant but again with a very small effect size ($F(1,81)=4.08$, $p<0.05$, $\omega^2=0.003$). This is plotted in the two graphs in Figure 5.

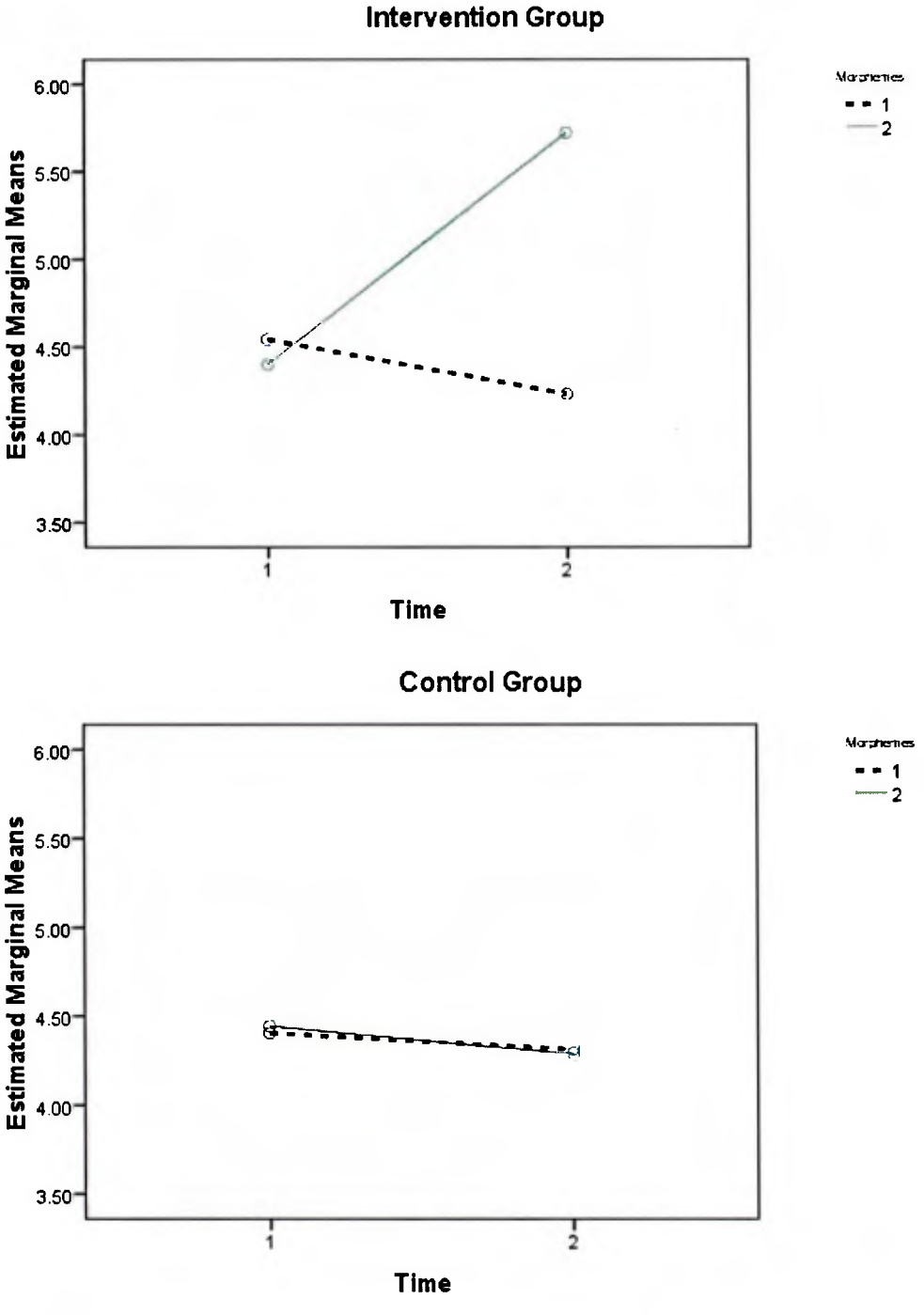


Figure 5: Interaction between Group, Time & Morpheme number on Past tense trials (plotted by Group), Times 1-2

Post-hoc t-tests with Bonferroni correction (significance level required: <0.013) showed that the interaction was due to the Intervention group producing significantly higher scores on two-morpheme past tense trials for Time 2 relative to Time 1 (t (1,45)=3.74, p=0.011), but not on one-morpheme trials, whereas the Control group showed no such contrasts. This was the same pattern that was found in the plural rule category.

The three-way interaction Time x Sound ending x Morpheme number was also significant, and details can be found in Appendix 6.

All other interactions were not significant.

3.3.2 Comparison between Time 1 and Time 3 scores

When carrying out the analyses on the delayed post-intervention (Time 3) data, some surprising results became apparent, leading to the unfortunate discovery that the children in the two different schools had received different types of teaching about spelling during the period between Time 2 and Time 3: School *Y*'s Control group were taught about past-tense verb endings. Since it had been agreed with the teachers that no group would receive additional teaching on the two morphological rules during this interval, the decision was taken to exclude the contaminated data. Due to the methodological design of the study, this meant excluding data from the whole Year 2 age group – i.e. half of the sample: the Control group from School *Y* and the Intervention group from School *X* – as this was the only way to ensure that the data retained for analysis was taken from groups that were matched for age. Year 3 participants were well matched across

the research conditions on age and background characteristics (see Table 2 and Appendix 3 for further details).

The question of whether or not the effects of the intervention were sustained in the Year 3 participants will now be explored, by comparing results from Time 1 and Time 2 testing with those from Time 3. It is important to remember that the number of trials on the pseudoword test was halved at Time 3 to prevent disengagement. Scores on the pseudoword task across the three testing points are summarised in Table 8. In order to compare like-with-like, Time 1 and 2 scores pertain only to those trials that were administered at Time 3.

Table 8: Mean group accuracy scores and SDs on Pseudoword tasks, Times 1-2-3

GROUP		*TIME 1* (max 32)	*TIME 2* (max 32)	*TIME 3* (max 32)
Intervention	**M**	17.68	18.95	19.23
(*N* = 24)	**SD**	5.28	8.55	4.62
Control	**M**	18.51	17.73	19.85
(*N* = 24)	**SD**	6.63	7.2	5.31

Table 8 suggests that, at Time 3, the Intervention group continued to show an improvement over their initial Time 1 scores. The Control group's scores, having reduced slightly between Time 1 and Time 2, indicate a notable and unexplained increase in morphological awareness between Time 2 and Time 3 – despite the removal of the known-to-be-contaminated data.

This data will now be broken down into the two component spelling rules, and results from the statistical tests that were run to assess the reliability of any patterns in the Time 1 to Time 3 data will be presented. With the reduced set of pseudoword trials at Time 3, there were sixteen trials each for the plural and past tense rule categories. In the following analyses, the

trials were matched across Time 1 to Time 3, so that the same sixteen items were selected to produce the mean at each testing point.

3.3.2.1 Plural rule trials: Time 1 – Time 3

Changes in scores on the plural rule component of the pseudoword task between Time 1 and Time 3 testing are shown in Table 9.

Table 9: Mean accuracy scores and SDs for correct spelling choices in Plural rule trials, Times 1-3

		/ks/-ending words						*/z/-ending words*					
		Time 1		**Time 2**		**Time 3**		**Time 1**		**Time 2**		**Time 3**	
GROUP		**1m** (max 4)	**2m** (max 4)	**1m** (max 4)	**2m** (max 4)	**1m** (max 4)	**2m** (max 4)	**1m** (max 4)	**2m** (max 4)	**1m** (max 4)	**2m** (max 4)	**1m** (max 4)	**2m** (max 4)
Intervention	M	2.08	2.58	2.33	3.11	1.42	2.89	2.12	1.89	1.64	2.93	1.39	2.89
(*N*=24)	SD	1.06	1.1	1.29	1.05	1.27	1.34	1.28	1.24	1.48	1.27	1.33	1.14
TOTAL	**M**	**4.67**		**5.44**		**4.91**		**3.91**		**4.57**		**4.73**	
Intervention	**SD**	**1.42**		**1.18**		**1.58**		**1.31**		**1.39**		**1.37**	
Control	M	2.13	3.29	2.22	2.78	3.04	3.00	2.57	2.33	2.25	1.78	2.28	2.36
(*N*= 24)	SD	0.97	0.91	1.07	1.12	1.1	1.22	1.31	1.27	1.24	1.35	1.46	1.32
TOTAL	**M**	**5.21**		**5.0**		**5.46**		**4.59**		**4.03**		**4.27**	
Control	**SD**	**1.26**		**1.09**		**2.05**		**1.67**		**1.42**		**1.98**	

Inspection of mean scores in Table 9 suggests the effects of the intervention on the Intervention group were to some extent sustained for both sound-ending categories of the plural spelling rule. However, breaking this down to take account of morpheme number, the effects were only sustained for two-morpheme words. The Control group gained some awareness of the spelling of one-morpheme /ks/-ending words between Times 1 and 3, but otherwise their scores remained fairly stable. These results should be interpreted cautiously, due to the small number of items in each cell (maximum: 4).

3.3.2.2 Past tense rule trials: Time 1 – Time 3

Changes in scores on the Past tense rule component of the pseudoword task between Time 1 and Time 3 testing are shown in Table 10.

Table 10: Mean accuracy scores and SDs for correct spelling choices in Past tense rule trials, Times 1- 3

		/d/-ending words						*/t/-ending words*					
		Time 1		**Time 2**		**Time 3**		**Time 1**		**Time 2**		**Time 3**	
GROUP		**1m (max 4)**	**2m (max 4)**	**1m (max 4)**	**2m (max 4)**	**1m (max 4)**	**2m (max 4)**	**1m (max 4)**	**2m (max 4)**	**1m (max 4)**	**2m (max 4)**	**1m (max 4)**	**2m (max 4)**
Intervention	**M**	2.19	2.23	2.31	2.98	1.38	3.3	2.38	2.19	1.91	3.16	1.42	3.19
(*N* = 24)	**SD**	1.2	1.18	1.15	1.14	1.24	1.16	1.39	1.29	1.43	1.07	1.47	1.17
TOTAL	**M**	**4.52**		**5.29**		**5.2**		**4.57**		**5.07**		**5.02**	
Intervention	**SD**	**1.46**		**1.22**		**1.69**		**1.38**		**1.29**		**1.5**	
Control	**M**	2.13	2.52	2.25	2.33	2.68	3.08	2.17	2.09	1.9	2.25	2.48	2.52
(*N* = 24)	**SD**	1.1	0.99	1.32	1.35	1.18	1.15	1.15	0.95	1.13	1.28	1.33	1.39
TOTAL	**M**	**4.33**		**4.58**		**5.23**		**4.48**		**4.15**		**4.93**	
Control	**SD**	**1.54**		**1.28**		**1.62**		**1.34**		**1.25**		**1.49**	

Inspection of mean scores in Table 10 suggests the Intervention group's scores in the past tense rule trials remained higher at Time 3 than at Time 1. However, again, the effects were only sustained for two-morpheme words. The Control group also showed improvement in all components of the past tense rule category at Time 3 compared with Time 1, with the greatest score increase evident in /d/-ending words. Once again, the small number of items in each cell limits any reliable interpretation of these data.

A three-way mixed design ANCOVA was computed to address the question of whether any improvement in knowledge of both morphological rules was sustained to Time 3. As explained above, the reason for the use of ANCOVA was the need to control for the mismatch in plural rule awareness at Time 1 between the Intervention and Control groups. Due to the deliberately reduced number of pseudoword test items at Time 3 (32 instead of 64, as detailed in the Methodology section), as well as the

reduction in sample size, trials for the two different spelling rules were dealt with together for this analysis – not subdivided into Sound ending and Morpheme number. The main terms were therefore Group (Intervention, Control), Time (Time 1, Time 3) and Spelling rule (Plural, Past tense) with repeated measures on the last two factors. The co-variate was Time 1 scores on plural trials.

The ANCOVA yielded a main effect for Group (F (1,46)=7.6, p<0.01, ω^2=0.006), indicating that the Control group's scores were higher overall than the Intervention group's scores. The main effect of Time was significant (F (1,46)=13.01, p<0.01, ω^2=0.02), indicating that scores were higher at Time 3 than at Time 1. Both effect sizes were small. The main effect of Spelling rule was not significant (F<1).

The interaction effect Group x Time was significant but with a small effect size (F (1,46)=6.28, p=0.02, ω^2=0.01). This effect is plotted in Figure 6.

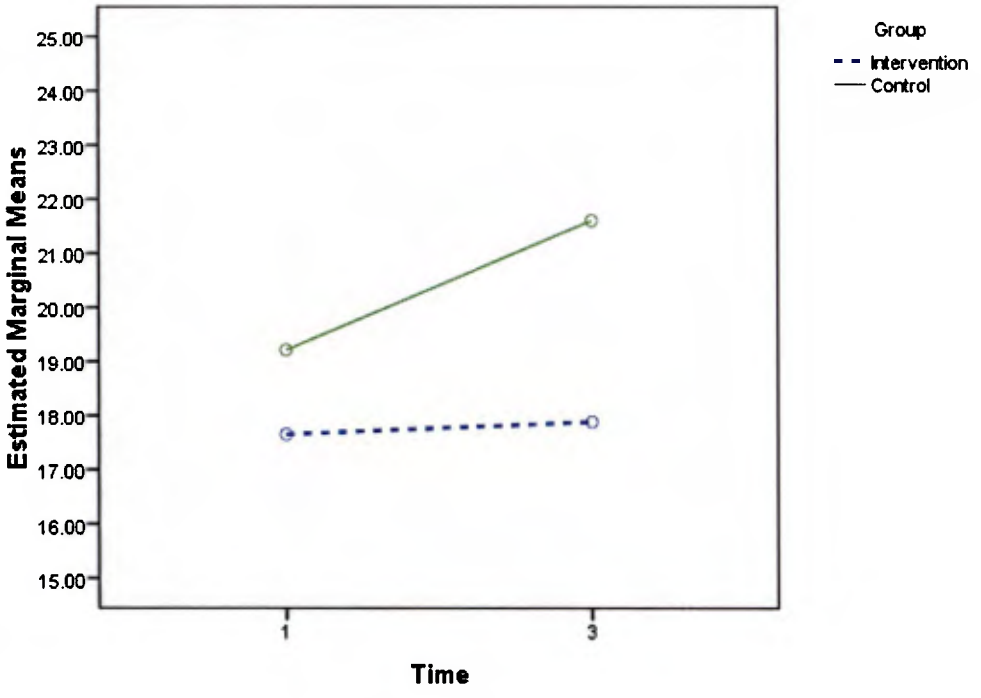


Figure 6: Interaction between Group and Time, Times 1-3

Post-hoc t-tests with Bonferroni correction (significance level required: <0.017) revealed that the interaction was due to the Control group's scores improving markedly between Times 1 and 3 ($t(1,24)=3.49$, $p=0.014$), but the Intervention group's scores not.

The interaction effect Group x Spelling rule was significant; see Appendix 6 for details. No other interactions were significant.

3.3.3 Summary of intervention results

1. The morphology intervention did not lead to reliably higher overall performance by the Intervention group in a task assessing use of the plural and past tense morphological rules in spelling pseudowords.
2. The specific effect of the intervention, for both rule categories, was to improve spelling on words containing two morphemes but not words containing only one morpheme.
3. In the plural rule category, there was a significant main effect of Time, due to improvements made by both the Intervention and the Control group between Times 1 and 2.
4. Time 3 data had to be taken from a smaller sample and consisted of a reduced item set. Overall comparison between Time 1 and 3 scores revealed that any effects of the intervention were not sustained at three-month follow up.
5. The Control group showed a significant and unexplained improvement between Times 1 and 3 in their scores on both the plural and the past-tense spelling rules.

3.4 Individual differences in response to Intervention

Whilst we have seen that there were no overall effects of the intervention, inspection of the data reveals that the intervention did have a positive effect on some participants' scores. This section will cover individual differences in gains, and relate this to how participants performed in the Pseudoword task at Time 1 and the wider background measures of literacy and language. Since the focus here is on the effects of the morphology intervention, analyses in this final section pertain to the Intervention group only.

3.4.1 Standard Deviation method

A valid way of judging "significant gains" between Time 1 and Time 2 is to use the Standard Deviation (SD) score from Time 1, and say that if participants' scores increased by one SD or more between Times 1 and 2, they had made a genuine improvement. The mean number of correct spelling choices on the pseudowords at Time 1 (across all participants) was 35.98 out of 64, and the SD around that mean was 5.9. An increase of one SD is therefore rounded up to represent an increase of 6 points.

Using this method, individual case summaries show that 16 out of 45 children in the Intervention group improved by one SD or more on the pseudoword task at Time 2 compared to Time 1. In other words, the intervention had a significant positive impact on a third of those participants who received it.

Interestingly, this method reveals that 5 out of 40 (or one eighth) of the Control group also improved by one SD or more between the two testing points, despite not receiving the morphology intervention.

3.4.2 Binomial method

The Standard Deviation method on its own does not tell the whole story about the gains made from the morphology intervention. As seen above, there was a range of scores on the pseudoword task at Time 1. An important issue is whether those who made significant gains began, and remained, with a high level of accuracy (thus, remained aware of morphological rules), or began with low accuracy and grew more accurate (gained awareness of morphological rules). We also know that some Intervention group participants did not benefit from the intervention, so there are a further two possibilities to consider: those who began, and remained, with low accuracy (remained unaware of morphological rules), and those who began with high accuracy and grew less accurate (appeared to lose awareness of morphological rules).

In order to capture these data, it was decided that the binomial should be used as an additional way of judging improvement between Times 1 and 2, to complement the information provided by the SD calculations. It has already been established that, at baseline pseudoword testing, the majority of children were showing *no* evidence of morphological rule use. At Time 1, just 9% of the Intervention group scored significantly above chance (i.e. 22 or more out of 32) on plural rule trials, and 21% on past tense trials. Table 11 shows that, by Time 2, their scores had changed as follows:

Table 11: Changes in Intervention Group's awareness of morphological rules, Times 1-2

		PLURAL RULE	*PAST TENSE RULE*
REMAINED AWARE	*(Scoring above chance at both Times 1 and 2)*	5%	7%
BECAME AWARE	*(Scoring around chance-level at Time 1, but above chance at Time 2)*	24%	29%
REMAINED UNAWARE	*(Scoring around chance-level at both Times 1 and 2)*	73%	52%
LOST AWARENESS	*(Scoring above chance at Time 1, but around chance-level at Time 2)*	2%	15%

Note: The percentage scores refer to the percentage of the Intervention group showing this pattern of results across Times 1 and 2.

The presentation of these additional data based on the binomial makes it clear that the majority of participants who benefitted significantly from the intervention had scored in the region of chance level at Time 1 and then scored above chance level at Time 2 (and therefore must have acquired an understanding of rules). Relatively few of those who made significant gains had demonstrated morphological knowledge or awareness initially. The data above also show that the intervention more frequently led to an improvement in use of the past tense spelling rule than the plural spelling rule.

Given that more participants receiving the intervention learned the past tense rule than the plural rule, it is paradoxical to note that there was also a higher rate of participants appearing to *lose* their understanding of the past tense rule between Times 1 and 2.

3.4.3 Factors influencing response to intervention

The existence of two distinct groups was established from the analyses reported in Section 3.4.1: participants who made significant gains from the intervention (improving by one SD on the pseudoword tasks between Times 1 and 2), who will henceforth be referred to as "Improvers"; and participants who did not make significant gains – henceforth, "Non-improvers". The next step was to assess how this dichotomy related to participants' scores on the background measures of spelling, reading, vocabulary and book titles and authors recognition, to see if these factors might have influenced response to intervention.

Mean performance on the background measures is depicted below, clustered for comparison according to whether participants fell into the "Improvers" or "Non-improvers" category in response to the intervention.

Table 12: Mean scores and SDs for background measures by intervention response type

RESPONSE TYPE		*Spelling (SS)*	*Reading (SS)*	*Vocabulary (% correct)*	*TRT (% correct)*
Improvers (*N* = 16)	**M**	105.47	104.77	87.45	65.3
	SD	13.75	16.31	9.73	3.84
Non-improvers (*N* = 29)	**M**	101.1	102.69	85.35	59.3
	SD	11.97	16.72	11.32	2.98

Table 12 suggests a numerical trend for scores on the standardised spelling and reading tests, the vocabulary test and the TRT, to be higher amongst the "Improvers" than the "Non-improvers" who had received the morphology intervention – i.e. those who were better spellers and readers, and had higher vocabulary and print exposure levels benefitted most. However, the differences did not reach statistical significance for any of

the measures (spelling (t (1,44)=1.14, p=0.26); reading t (1,44)=0.38, p=0.97); vocabulary (t (1,44)=0.4, p=0.69); TRT (t (1,44)=2.2, p=0.06)).

A regression analysis was undertaken to examine whether any of these literacy and language measures were predictors of the Intervention group's performance on the Time 2 pseudoword task. The results can be seen in Table 13.

Table 13: Simultaneous Regression for predictors of Time 2 Pseudoword scores

	Beta	*t*	*p*
Age (months)	0.00	-1.51	0.14
Pseudoword Time 1	0.43	4.11	0.00
Spelling (SS)	0.39	2.51	0.01
Reading (SS)	-0.17	-1.07	0.29
Vocabulary	-0.16	-1.26	0.21
TRT	0.14	1.31	0.19

Note: This data pertains to the Intervention group only as the focus here is on the effects of the intervention.

Table 13 shows that the Intervention group's performance on the Time 1 pseudoword task was the strongest independent predictor of their performance on the Time 2 pseudoword task. However, even when variation in Time 1 pseudoword scores and age are accounted for, spelling ability is an independent predictor as well. Reading ability, reading experience (as measured by the TRT) and vocabulary did not account for any additional variability in post-intervention morphological awareness.

3.4.4 Summary of individual differences in response to intervention

1. Morphological intervention did not impact on the whole Intervention group: it improved use of morphological rules in a third of participants.
2. The majority of these participants had not demonstrated morphological awareness initially.
3. The literacy/language levels of children who benefitted from the intervention were not significantly different to those of the children who did not.
4. Spelling ability was an independent predictor of immediate post-intervention morphological awareness scores.

Chapter 4:
DISCUSSION

This research study utilised a quantitative methods approach to address the primary research question of whether we can improve children's use of morphological awareness in spelling by explicitly teaching them about morphemes in the context of text reading, and whether improvements can be sustained. The secondary aims were to construct clearer profiles of the children who respond best to such a morpheme intervention, and of the children who had shown morphological awareness prior to intervention, in terms of their wider literacy and language abilities.

In the first section of this final chapter (4.1), there will be detailed interpretation of the findings presented and analysed in the Results chapter, organised according to the original research questions that provided the rationale for the study. This discussion will endeavour to promote a deeper understanding of the quantitative outcome results obtained, and consider how they fit into the existing body of knowledge drawn upon in the literature review. In the second section (4.2), issues raised by the results, particularly around methodology, will be explored, as well as areas for development and suggestions for future research. Finally (4.3), the implications of the current research will be considered with regard to teaching and the potential delivery of morphological awareness interventions in schools, and also in relation to the practice of Educational Psychology.

4.1 Interpretation of results by research question

4.1.1 Research Question 1: Can we significantly improve children's morphological awareness and spelling skills by explicitly teaching them about morphemes in the context of text reading, and can improvements in morphological awareness be sustained?

4.1.1.1 Overall effects of intervention: short-term

The comparison of scores from pre- and immediate post-intervention pseudoword spelling tasks showed that training in morphological awareness had limited effects for children aged 6-8 years. Overall results suggested that, in the context of a five-week course of whole-class reading sessions, it was not possible reliably to teach morphological rules so that children could apply them to pseudowords whose spelling was determined by the meaning and grammar of the sentence in which they appeared. Whilst the data for both rules – those governing the use of the plural *-s* and the past tense *-ed* inflectional morphemes in spelling – suggested that the Intervention group showed some improvements in morphological awareness between pre- and post-intervention testing, the Group by Time interactions failed to reach reliable levels of statistical significance when simple main effects of Group and Time were taken into account.

Intervention duration, and the frequency of delivery of sessions, may be the major factor in these null results. It now appears that delivering the intervention for just twenty minutes per week for five weeks (i.e. 100 minutes in total) was too little time to dedicate to teaching what are fundamentally quite complex and abstract concepts. It was considerably less time than that taken in interventions reported in comparable studies: Lyster's (2002) lasted seventeen weeks; Nunes *et al*'s (2003), twelve weeks; and Nunes and Bryant's (2006), seven weeks. All consisted of a half- to one-hour session per week. The current findings may lend further

support to the idea that, for spelling as well as for other curricular tasks, distributed learning is more beneficial than massed (Seabrook *et al*, 2005; Shapiro & Solity, 2008; Hattie, 2009; Solity & Vousden, 2009). In negotiations with schools for future classroom-based interventions, therefore, it will be important to insist upon a design that allows a greater time period for teaching and provides opportunities to revisit the learning several times weekly (or, preferably, daily) since children are more likely to retain what they recall frequently. Indeed, distributing teaching into many short sessions may be a particularly critical factor in increasing the impact of morphology lessons delivered on a whole-class basis (Shapiro & Solity, 2008).

Inevitably, the disadvantage of whole-class teaching as practised during this intervention is that it did not take account of individual differences among students in terms of their spelling ability and needs. Indeed, Shapiro and Solity (2008) believe that a key reason for the success of their whole-class ERR intervention was the fact that teachers differentiated between achievement groups during sessions, together with the distributed and frequent delivery of teaching. Differentiation techniques in which pupils receive instruction according to their developmental level and study words that are developmentally appropriate would ideally have been used, (Invernizzi & Hayes, 2004), but could not be incorporated within the practical constraints of this study.

Other instructional psychology principles, too, can offer perspectives on the intervention's lack of overall success. With reference to the learning hierarchy, it is possible that not enough emphasis was put on ensuring that all children had the basic skills required to be able to access teaching on the target skills. Haring *et al* (1978) found that an improvement in basic skills often brings a correlated improvement in more complex skills during the acquisition stage. Whilst it was assumed that children understood grammatical concepts such as past tense and plural (because these are covered at the start of Year 2), perhaps teachers should have been asked

to spend even more time revising these topics before the intervention began.

The lack of an overall intervention effect may relate to the shortage of opportunities provided for children to generalise their learning, perhaps meaning that learning was incomplete. It could be said that only the acquisition and fluency stages of learning were targeted during the intervention. Yet, as Haring *et al*'s (1978) hierarchy highlights, in order for children to process, retain and use new skills, they should pass through the generalisation and adaptation stages as well. It is certainly possible that the intervention led more to procedural fluency in the use of morphemes – i.e. skill in carrying out procedures flexibly, accurately, efficiently and appropriately – than to conceptual understanding and adaptive reasoning (capacity for logical thought, reflection, explanation and justification), which are required for proficiency to be sustained (Kilpatrick, Swafford, & Findell, 2001). The fact that children could not spontaneously generalise any new learning to the pseudoword tasks is taken as evidence that generalisation and adaptation did not occur. Carnine and Becker (1982) have suggested that most children require explicit support to generalise their skills – for example, by being shown how those skills are applied in a range of contexts (Shillcock et al, 1998) – which was not factored in to the intervention design.

Alternative explanations relate to general factors influencing learning in an academic context which, again, may impact on the extent to which children retain new knowledge or merely demonstrate learning on a temporary level. Firstly, it may be that the delivery of the teaching through the medium of story texts, which had only surface relevance and lacked direct conceptual relevance, encouraged learning on a superficial basis only (Mayer, Hesier, & Lonn, 2001). Furthermore, children were not asked to write anything down during the intervention because the findings of Nunes *et al* (2003) showed that the presence or absence of written activity made no discernible difference to results. Nonetheless, research on

teaching methods and learning outcomes shows that practices such as students working through textbook-type exercises are important vehicles for the development of consolidated and flexible knowledge that can be applied in a range of situations (Boaler, 2002). If children had been asked to complete a five-minute exercise after each session based on their understanding of the material, might they have retained their learning better? It might have been even more effective to undertake these exercises in the context of cooperative small-group work, where the advantage is thought to lie in the scaffolding process (Vygotsky, 1986). Problem-solving in groups can widen thinking skills, help structure thoughts, encourage higher-order thinking (Becker & Selter, 1996) and improve conceptual understanding (Leiken & Zaslavski, 1997), all of which are likely to be beneficial in the context of learning about morphemes.

4.1.1.2 Overall effects of intervention: longer-term

Given the failure of the intervention to have an overall positive impact in the short-term, it is unsurprising that the conclusion drawn from delayed post-intervention testing is that there was no sustained or longer-term effect. The morphology interventions reviewed in Chapter 1 did not examine whether learning was retained at a delayed follow-up testing point, which would have prevented comparison of washout effects as related to intervention duration. However, again, this study may be taken as clear evidence that intervention needs to be longer and/or more frequent and/or more intensive if any newly acquired morphological knowledge is to be consolidated and internalised.

It must be remembered that at delayed post-testing, the data set was half its original size, comprising scores from Year 3 participants only. Thus, the disappointing results may relate to the small sample size. (This, and other issues relating to shortcomings of the research methodology, will be

discussed in Section 4.2.) Indeed, inspection of the data reveals that there was a trend for Intervention group participants to retain their learning about two-morpheme words (which, as we have seen, was where the most learning took place), so the effect might have reached significance if data from Year 2's Intervention group could have been used.

Another factor in the lack of a visible longer-term intervention effect could be the marked improvements shown by the Control group at delayed post-intervention. Specifically, the Control group showed a significant improvement on the spelling of the past tense *-ed* morpheme between Times 1 and 3, and this improvement was greater than that of the Intervention group. The effect was visible on words of both sound-ending and on both one- and two-morpheme words. Given that the teacher of this retained Control group gave assurance that pupils had not received additional teaching on the past tense in the intervening period (which would have provided them with an experience similar to that which had been provided in the morphology intervention), and assuming that it is not due to chance, the effect is quite interesting. Closer examination of the data reveals that this increase in mean was caused by the extremely high scores of a handful of Control group participants – three of them scoring over 85% accuracy on the pseudoword task at Time 3, and therefore almost certainly using morphological principles to guide their spelling choices. Thus, perhaps the most likely explanation lies in individual differences, with IQ (which was not measured at the outset) and/or literacy abilities at the source. Indeed, the three very high-scoring Control participants were among the most able in the whole sample in terms of standardised literacy scores.

Taken in conjunction with the likely impact of such individual differences, three possible reasons have been hypothesised for the increase in scores without intervention. The first is simple practice effects of the pseudoword task. The very high-scoring Control group participants may have gained understanding of the objective of the pseudoword task, with the three

administrations of the same task being opportunities for them to clarify in their minds what the correct answers were. This would make sense, since their accuracy grew each time. Indeed, the same effect could apply to members of the Intervention group, too. Practice effects could only be truly ruled out if a different outcome measure of the same skill, such as equivalent versions of the pseudoword task, had been prepared – thus highlighting a flaw in the design of the study.

A second hypothesis is that the pre-intervention pseudoword task actually stimulated an initial awareness in the relevant Control group children, which then promoted self-learning. This would mean that the pseudoword task acted as a sort of intervention in itself. Again, it cannot be dismissed that the same effect might apply to the Intervention group.

A third potential reason, which may stand alone or in addition to the first two, is that the change in scores from Time 1 to Time 3 – a four-month period – provides longitudinal data indicating how these few Control children (who scored very highly on the Time 3 pseudoword test) were in the process of honing their morphological awareness and understanding over time. Given that these same children demonstrated superior literacy skills, this would be consistent with the notion of literacy skills relating to the development of morphological awareness, and metalinguistic awareness perhaps supporting access to more abstract linguistic concepts. It may even be that these children then retained their new learning better than the Intervention group because they worked it out for it themselves.

4.1.1.3 Specific effects of intervention (short-term)

Despite the failure of the morphology intervention to have an overall effect, some successful training was observed at immediate post-testing – limited

to certain participants only, and greater for words with a particular number of morphemes. Firstly, a third of the intervention group benefitted significantly, suggesting that the activities used within the intervention helped these pupils understand morphological spelling principles, gain confidence in analysing words and acquire additional strategies for spelling.

The characteristics of those who did and did not benefit from the intervention will be the focus of later discussion. Meanwhile, features of the intervention must have played some role in the positive result for a third of the Intervention group. Firstly, the presentation of useful items frequently and explicitly, with a focus on just two of the most commonly-occurring morphological spelling patterns, may have allowed these children to learn at a statistically optimal level (Brown, 1998; Solity & Vousden, 2009) and to high fluency levels (Haring *et al*, 1978). The use of real books, with their accurate representations of the grapheme-morpheme mapping system, may also have promoted optimal learning. It can be assumed that one of the reasons that learning occurred is that the pupils were cognitively active in processing and using relevant information, and were receiving immediate feedback (Solity & Bull, 1987; Dickinson, 2003; Hardman, Smith, Mroz, & Wall, 2003). Furthermore, the teachers had the chance to actively monitor pupils' understanding of the concept being taught (Samuelsson, 2008). The partial success of the intervention also supports the idea that a key aspect of successful literacy teaching is interactive whole-class instruction (DfEE, 1998; Shapiro & Solity, 2008) which, if achieved well, can generate a very high level of attention, engagement and active participation by pupils.

The other specific positive effect of the morphology intervention was an improvement in the spelling of two-morpheme but not one-morpheme words in both rule categories (see Figures 3 and 5). This effect was not observed for the Control group. This may indicate a difference in sensitivity to one- or two-morpheme words. Alternatively, it may suggest

that children found it more difficult to grasp the rules when applied to one-morpheme words than when applied to two-morpheme words. Why might this be? It seems they learned successfully that regular plurals (two-morpheme) end in *-s* and past tense words (two-morpheme) end in *-ed*, however they sound. This suggests that they acquired *some* understanding of grapheme-morpheme correspondence rules versus grapheme-phoneme correspondence rules. But perhaps this was the extent of their understanding, and they did not grasp the notion that plural and past tense words consist of two parts: the root and the inflection. In this way, participants learned to apply derivational morphemes according to the meaning and grammar of sentences but, when required *not* to apply the morphemes (i.e. to leave words with one morpheme only), they struggled.

It may therefore be that number of morphemes was too advanced a concept for the cognitive developmental level of 6-8-year-olds, despite explicit instruction. In addition, children may have become confused because of ongoing exposure to the various irregular past-tense verbs in English that are spelled with *-d* and *-t* (e.g. *burnt*, *crept*, *left*) and yet contain two morphemes. This explanation could be borne out by the results, which show that the intervention group's spelling of /t/-ending one-morpheme words actually worsened between pre- and immediate post-testing.

A final point to discuss with reference to the first research question is the fact that an eighth of the Control group appeared to gain awareness of both target morphological spelling rules between Times 1 and 2, despite receiving an intervention aimed at improving their awareness of phonological (not morphological) spelling rules. Indeed, this is particularly important in the plural rule category, where the main effect of Time indicates a significant and specific improvement for the Control as well as Intervention group. It is always possible that this might relate to the pseudoword task used to measure morphological awareness, rather than

to the intervention itself – an issue which will be addressed in the next subsection (4.1.1.2). However, it is quite common when control groups are not left 'untreated' but instead are given an alternative intervention, that there is some form of "Hawthorne effect" (Adair, 1984). This refers to the tendency for research participation *per se* to affect the behaviour and progress of a Control group – perhaps due to an awareness of being observed or active compliance with the supposed wishes of researchers – rather than characteristics of their intervention. It is questionable whether the concept of the "Hawthorne effect" has any value in intervention research because it is used to cover many different phenomena (Wickström & Bendix, 2000) and is difficult to test for (see Baines, Blatchford & Chowne, 2007). It is nonetheless worth considering that the Control group simply derived benefit from the positive educational experiences and teacher attention and reinforcement received during their intervention, and that these benefits had wide-reaching effects.

Other possibilities, which seem more likely given the specificity of the skills assessed through the pseudoword task, are that the improvement seen in an eighth of the Control group relates to the content of their intervention in some way. (Unfortunately, the use of a treatment control in the study does not allow for clarification over such confounding variables.) The phonology intervention may have led to increased metalinguistic awareness in some children, encouraging a focus on the underlying structures and components of words, and leading them to notice and think about morphemes. Perhaps this result is further evidence for the complementary effects of phonological and morphological awareness in spelling, given that Lyster (2002) found that teaching children about morphemes improves their performance in phoneme tasks. It may also be that the exposure to text in an enjoyable and interactive framework may have enabled a few – perhaps the most able – children to draw their own implicit inferences about the morphological bases of spelling (Chliounaki & Bryant, 2007).

4.1.2 Research Question 2: What are the characteristics of children who benefit most from a morphology intervention, in terms of their literacy and language skills, and reading experience?

One of the secondary aims of the study was to construct a clearer profile of the children who responded well to the intervention and of those who did not show improvements in their morphological spelling knowledge. As we have seen, the children who learned how to make accurate morphological distinctions in past tense and plural words represented only one third of the Intervention group. It is important to remember that whilst a small number of those who showed significant gains were building on an already strong grounding in morphological awareness (i.e. they scored above-chance on the pseudoword task at baseline testing), the majority who benefitted had not shown morphological awareness at Time 1, so they genuinely learned something new (although did not retain it).

What factors characterise those children that enabled them to learn successfully about morphemes? No significant differences were found between the wider literacy and language skills of children who benefitted and children who did not. The regression analysis nonetheless showed spelling ability to be an independent predictor of Time 2 morphological awareness scores, even after accounting for variation in pre-intervention scores and age. There are also further signs in the data – albeit based on weak trends – that higher ability in reading and spelling, and volume of reading, predicted a positive response to intervention (Table 13). It therefore seems reasonable to uphold the hypothesis that better spellers and readers may be predisposed to understand about morphemes because they already have a better grasp of literacy and language concepts, and perhaps also because using morphological knowledge is an advanced and cognitively demanding strategy for reading and spelling

(Westwood, 2008). This would support the idea of a bidirectional relationship between literacy development and morphological awareness (Nunes & Bryant, 2006).

However, the key conclusion that should be drawn is that the children who benefitted most from the morphology intervention cannot be defined by the data collected here, because the measures used cannot account for the individual variation in intervention response. It may be that instructional variables, such as quality of teaching, are at the root of the variation in response (such issues will be addressed in Section 4.2). Alternatively, the variability in the literacy profiles of those children who made significant gains from the intervention could substantiate the claims made by other authors, such as Nunes and Bryant (2006), that interventions – in which the relationship between the morphological structure of words and spelling is made explicit – can be effective across the ability range, with both high and low achievers, but are not effective with all children. Early indications do suggest that morphology teaching should be targeted both at normally-developing children and poor readers/spellers (e.g. those receiving Wave 2 and 3 interventions) (Darch, Kim, Johnson, & James, 2000; Westwood, 2008; Bowers, Kirby & Deacon, 2010), who need even more support to develop the robust skills and meta-awareness of language and literacy that will support them in achieving educational standards commensurate with their cognitive abilities (Dawson, 2005; Mitchell, 2004).

4.1.3 Research Question 3: What proportion of children in this age group show baseline morphological awareness, and how does this relate to their wider literacy and language skills, and reading experience?

The other secondary objective of the study was to add further information to the existing body of research on the extent to which 6- to 8-year-old children, prior to any intervention, use morphological rules to guide their spelling of regular plural nouns and past-tense verbs. The results obtained from baseline testing of morphological awareness through a pseudoword task substantiate theoretical expectations. On the plural trials of the task, 82% of the sample scored around chance level. This suggests that they were guessing their answers and not using the relevant rule. This replicates the findings of Kemp and Bryant (2003), Mitchell (2004), and Bryant and Mitchell (2007). The past tense trials of the pseudoword task follow the same pattern, with 78% of the sample appearing to have no awareness of the morphological rule underpinning /d/- and /t/-ending words. This is consistent with the findings of Nunes *et al* (1997a), Varnhagen *et al* (1997) and Walker and Hauerwas (2006). These scores show that most participants did not use morphemic distinctions, even though the contexts of the pseudoword sentences gave very clear clues for making these distinctions. Yet, the majority demonstrated age-appropriate real-word spelling ability. If they do not have morphological rules at their disposal when spelling, it can be postulated that the knowledge they rely on to spell real words is frequency-based, derived from exposure and familiarity (Chliounaki & Bryant, 2007).

Mention was made in Chapter 1 of the recent updates to the Primary Framework for Literacy (DFES, 2006b), which have included the introduction of some teaching about morphemes. Instruction on the plural and past tense inflections was identified as occurring in Year 2. However, the Time 1 pseudoword task results indicate quite plainly that this teaching is ineffective at increasing explicit awareness of morphological rules – at least, at this stage of children's conceptual development. It does not help most children understand the link between spelling and the grammatical and syntactical role of morphemes, which is what helps them spell accurately in any sentence context. From an educational perspective, the fact that very few children showed morphological awareness suggests that

current practice within the Primary Framework will not be enough to affect literacy and language outcomes in the ways that explicit morphological awareness have been hypothesised to do throughout this research project. In fact, since the inception of the current project, the government has produced a Primary "Support for Spelling" (DCSF, 2010b) guidance document, which seems to recommend more systematic instruction on morphological spelling rules, and explicitly acknowledges the grammatical role of morphemes, and concepts such as number of morphemes in words. It will therefore be important to monitor the implementation of this programme and its effects on levels of explicit morphological awareness in primary school children.

Taken together, the results from the two rule categories at initial pseudoword testing lend further weight to the theory that a dichotomy exists in people's explicit knowledge of the connection between spelling and morphemes (Nunes & Bryant, 2009): a small minority score significantly above chance in pseudoword tasks, but most seem to respond randomly, showing no evidence of rule use. Although by the age of 5 most children have mastered the use of the past tense in spoken language (e.g. Antinucci & Miller, 1976; Rice & Wexler, 1996), this is not the case in written language.

The data from this study may be of particular value as it suggests that a developmental process is at play within the sample in the acquisition of explicit morphological awareness: the above-chance group in Year 3 was 27% whereas the above-chance group in Year 2 was only 14% (with these proportions representing equal numbers on each rule category). To reiterate, those who score above chance on pseudoword tasks understand the morphemic basis for spellings; they are the ones who demonstrate morphological awareness. Such a developmental process has been posited by Treiman and Cassar (1997), Bryant *et al* (2000), and Da Mota (1996), and fits with the stage models of Frith (1985) and Ehri (1997), who conceptualise children progressing from use of purely phonetic spelling

strategies to more global orthographic strategies. However, their stages do not distinguish between implicit and explicit knowledge, and the latter stage can include awareness of morphemes that is frequency-based and inferred from word-specific learning, rather than explicit rule-based knowledge. It has thus been unclear around what age children divide into the chance-level and above-chance groups. The present study may highlight that a key point for this split is between the ages of 7- and 8-years-old.

However, the difference between the age groups on baseline morphological awareness also has implications for issues around multiple strategy use in spelling development, which contrasts with stage theories. While it is obvious that spelling ability does develop over time, some experts have expressed dissatisfaction that developmental stage theories fail to take account of the variation that exists among spellers of the same age in the way they tackle the spelling of unfamiliar words. Siegler's (1996) overlapping waves theory, applied originally to arithmetic, is based on the premise that individual children have multiple strategies for attempting to spell words, that co-exist over prolonged periods. Rittle-Johnson and Siegler (1999) found that the frequency of use of different strategies children possess or acquire rises and falls in waves over time, with a gradual increase in efficiency and sophistication. The theory specifies that learning occurs along four dimensions: (i) more frequent use of the more effective ways of thinking; (ii) increasingly adaptive choices among the available strategies; (iii) increasing efficiency in executing the alternative strategies; and (iv) acquisition of new ways of thinking.

The data from the present study provide some support for the findings of Rittle-Johnson and Siegler (1999). Instead of postulating that Year 2 children fitted into one stage (e.g. sounding out), whereas Year 3 children fitted into another (e.g. drawing on rules and analogies) (Gentry, 1982), it seems likely that the same strategies accounted for the vast majority of both year groups' spellings, and that substantial variability in strategy was

present within each child's spelling in both year groups. However, Year 3 participants performed significantly better than their younger counterparts on the pseudoword task, and this probably results from a combination of addition of new strategies (based on developing metalinguistic and morphological awareness), greater use of more effective strategies, and improved ability to adapt their strategy choice to the task demands (Rittle-Johnson & Siegler, 1999).

Another significant effect on the initial pseudoword task was that /ks/-ending plural words elicited more correct spellings than /z/-ending words. The fact that children across both groups struggled with spelling the plural *-s* in words where the ending is pronounced as /z/ – i.e. where there is conflict between the sound of the inflection and its conventional spelling – may be due to reliance on grapheme-phoneme correspondence rules. However, an alternative explanation is that children base their spelling choices on frequency-based knowledge. All /z/-ending words in the pseudoword task had a long vowel preceding the /z/-ending (e.g. *skays*, *heeze*), which is not a common spelling pattern in English. Kemp and Bryant (2003) found that children did much better with plural words in which the sound just before the /z/-ending was a consonant (e.g. *stogs*), rather than a long vowel. They hypothesised that this was due to children detecting that virtually every word in which the /z/ sound follows a consonant in English is spelled as *-s* (e.g. *fibs*, *digs*), whilst the majority of words in which the /z/ sound follows a long vowel are one-morpheme words (e.g. *freeze*, *please*). This gives children many fewer examples to base their spellings on than in the /ks/ category, where two-morpheme verbs ending in *-cks* are relatively common. Furthermore, it is likely also to give them an aesthetically-driven bias towards particular types of spelling. If this explanation is correct, it was methodologically flawed not to ensure that pseudoword trials of the two different sound-endings were comparable in terms of the frequency of co-occurrence in English of the letter patterns within them.

The second element of the final research question was concerned with examining the literacy and language profile of the children who have morphological awareness before the intervention. Findings from many existing research frameworks – including those of Bryant and colleagues, and connectionist models such as that of Plaut, McClelland, Seidenberg, & Patterson (1996) – have suggested the existence of a relationship between progress in literacy and the development of morphological awareness.

The findings of the current project lend further support to and may extend this picture, although the low-to-moderate strength of relationships indicated by the correlation coefficients highlights the need for cautious conclusions. Nevertheless, the existence of a correlation between scores on the pseudoword task and the standardised spelling test, combined with the regression analysis showing that spelling ability was an independent predictor of Time 2 pseudoword scores (even after controlling for age, Time 1 pseudoword scores, reading and vocabulary) could be taken as confirmation that children who know and use morphological rules are better spellers overall. The success of the good spellers on the pseudoword task shows that morphological rules *can* be used, and suggests that those who do not learn them spontaneously could become better spellers if they were taught them.

Secondly, the correlation between the pseudoword task and the standardised reading test may verify the existence of a relationship between progress in reading and morphological awareness (Carlisle, 1995; Fowler & Liberman, 1995; Casalis & Louis-Alexandre, 2000).

Present results do not assist in the debate about direction and causality in this relationship between morphological awareness and literacy development. As discussed in Chapter 1, it may be most likely that this relationship is a reciprocal one, characterised by cross-domain influences. Nonetheless, the correlation results could support the theory of Frith

(1985), who argues that children learn orthographic (which includes morphological) rules through reading and then apply them to their spelling. They could also substantiate Chliounaki and Bryant's (2007) assertion that Frith's orthographic stage should be divided into two substages: first, children learn a great number of specific words through reading, including those which cannot be explained simply on the basis of alphabetic rules; next, they infer the morphological basis for these differences. Conversely, it may be that the inferential process occurs as a product of children's experiences of trying to write such words, and they then use their developing morphological awareness to tackle longer or more complex words in reading (Nunes & Bryant, 2006).

Whatever the mechanisms of acquisition of this specific skill, the correlation data substantiate the general claim that spelling and reading development are inextricably linked, interacting in a way that leads to increased proficiency in each ability (Frith, 1985).

The relationships found between vocabulary levels and the standardised spelling and reading tests validate the theory that children's spoken language skills are linked to their developing written language skills (Berninger *et al*, 1988; Brice, 2004). Furthermore, the correlation (albeit weak) between the pseudoword task and vocabulary test could suggest that some of the most important correspondences between spoken and written language are at the level of the morpheme. This would be compatible with research findings about children with specific language impairments (SLI), who show dyslexic-type reading difficulties with the written word but who typically have a greater difficulty with morphology, meaning and lexical processes than dyslexic children (Bishop & Snowling, 2004; De Bree & Kerkhoff, 2010; Rice & Wexler, 1996).

What did the results show about the links between reading experience (measured by the TRT) and spelling ability, and reading experience and use of morphological rules to guide spelling? When age was controlled

for, there were surprisingly no indications of a relationship between reading experience and general spelling ability or, more specifically, morphological awareness – either in the correlation or the regression analyses. Due to the poor response rate, the questionnaire data could not provide additional information about these relationships with regard to children's literary experiences in the context of the home learning environment.

These findings do not support Colchester's (2006) suggestion that children may not only abstract word-specific learning but also morphological knowledge from print exposure. Whilst the exact mechanisms behind rule-abstraction are unclear, this suggestion was derived from the hypothesis (Nunes & Bryant, 2006; 2009) that through reading (and writing) experience, children build up a bank of information about how specific words are written. The more children read, the more this bank grows in size; this in turn provides increased opportunity for noticing patterns of spelling in words, and increased likelihood of inferring the connection between morphemes and spelling. Such a hypothesis ties in logically with well-accepted theories (borne out in other elements of the results) that humans are sensitive to frequency patterns, even if these are complex and not formally taught (Kemp & Bryant, 2003).

However, such hypotheses cannot be discarded on the basis of these findings, as the TRT was acknowledged from the outset to be a crude measure (see following section for detailed discussion). It still seems theoretically likely that print exposure is one potential environmental determinant of spelling development, and the variable of reading volume/experience should play a more prominent role in research on individual differences in spelling, as well as in general theories of cognitive development.

A final potentially noteworthy result from the TRT data was the correlation found between reading experience and vocabulary levels (after partialling-

out age). The relationship here was weak but it is also a core finding in the work of Stanovich. Stanovich (2000), whilst acknowledging the need for more evidence, reviews several studies that provide support for causal mechanisms in the relationship, leading him to claim that a major determinant of vocabulary growth is amount of free reading. The process is hypothesised to be one of incidental induction of the meanings of unknown words, through encountering them in different contexts during reading. Although it is important to remember that the reliability of the adapted vocabulary and TRT measures used in the current study is unknown, and the value of the coefficient was low, the correlation result may suggest that the TRT is tapping variation in oral language in this sample, not reading ability.

4.2 Research issues and limitations of the study

These results provide a further step toward understanding the extent and nature of morphological awareness in children aged between 6 and 8 years, and the contribution of this skill to children's spelling development. They also add to the previous research evidence base for considering methods and effects of teaching children about morphological structures. The existence of a Control group enables the conclusion that any positive results do not merely show improvement over time, but of response to intervention. The use of a direct measure of the use of morphemes – spelling pseudowords, and improvement therein – gives confidence in children's learning of a principle rather than the acquisition of isolated spellings of words.

The unique contribution of the current study is its examination of the effects, both short- and long-term, of explicit teaching about the inflectional morphemes *-s* and *-ed*. It also opens up a new way of thinking about teaching morphemes and grammar for spelling. Through the interactive story texts designed by the researcher, teachers have the support that they need for engaging children in an intellectually challenging and motivating group-reading activity. Until now, there had been no such interventions designed to make children more aware of morphemes through actual text reading, where the effect of morphological rules on spelling is repeatedly and strongly visible. The fact that the intervention was classroom-based, delivered by Class teachers, and used real books as its starting point, showed that some of the key principles behind the reading research of Solity and colleagues can be applied to spelling research as well. Finally, with the use of a measure of children's reading experience, this study also attempted to investigate more about the relationship between children's literary exposure and their spelling ability.

However, there are a number of issues inherent in the methodological design and implementation of the present study, as well as issues raised by the results, which underscore the importance of interpreting the findings with caution. These will be discussed now.

The first issue became clear on discovery of the need to discard data from half of the Control group (and therefore half of the Intervention group) at delayed post-testing. This brought to the fore the disadvantage of using treatment controls, rather than genuine controls who receive no intervention. The study's design would have been stronger, and indeed ethical considerations would still have been addressed, if the Intervention group had been compared with a no-treatment Control group, who could receive the intervention after a delay rather than not at all (a "waiting-list control group"). Such a design would allow for better control of confounding variables and extraneous events, but was not possible within the time-frame allowed for this study.

The contamination of the Control group's data also served to highlight the challenges of testing hypotheses and applying interventions in "real-life" classrooms rather than in tightly controlled experimental settings, since it is difficult to know what precisely went on in the classrooms, both during and after the intervention, or the extent to which the teachers followed the researcher's advice on how to use the intervention materials.

The way in which the group text reading was implemented could have been of central importance to the success of children's understanding, and to ensuring that their learning would embed. For example, it was up to the teachers how much they concentrated on the importance of sentence context and meaning in making spelling choices with morphemes. It required the teachers themselves to have a strong understanding of the underlying concepts; despite the researcher-led training session prior to the start of intervention, this would almost certainly have varied between the participating teachers. Other important variables, not accounted for in the design of the study, could be the teachers' levels of enthusiasm and competence in engaging and inspiring their pupils, and relationships or styles of interaction between teachers and pupils. Indeed, the "teacher effect", relating to variations in general quality and effectiveness as a teacher, is known to be one of the strongest predictors of student achievement (Hattie, 2009). Hattie points out that expert teachers do not simply teach: they recognise when learning is not happening, then employ and monitor personalised strategies that work best for each learner.

Thus, the complex pattern of results obtained at both post-intervention testing points may well relate to differences between the four teachers in the quality, consistency and frequency of implementation of the instructional support strategies, and it is essential to recognise the potentially very strong impact that these can have on child performance. The only way to control for the teacher effect would have been to ensure that the same teacher taught all four classes. Seabrook *et al* (2005),

however, argue that this does not necessarily remove teacher differences, since any individual teacher will have different attitudes towards different teaching methods, which will affect the way they teach.

One way to determine whether guided group reading, as designed and used here, really influenced children's spelling in the hypothesised ways would be to take one step back and try it in a more tightly controlled environment, where it is possible to observe how they are actually implemented. Alternatively, "fidelity of implementation" checks, the need for which is highlighted in recent work on reading intervention (e.g. Johnson, Mellard, Fuchs, & McKnight, 2006), might have been undertaken by the researcher during the course of the intervention programme. Previous studies have reported email contact with participating teachers, visits into the schools during the intervention, "twilight" sessions each week to discuss progress, and so on. Another viable (at least partial) solution could have been to request that teachers kept records of their sessions, thereby allowing variations in implementation to be taken into account more systematically. Gresham, MacMillan, Beebe-Frankenberger, & Bocian (2000) highlight that fidelity of implementation can be reduced if teachers believe the approach will not be effective, or if it is inconsistent with their teaching style. This may have been relevant here, where the idea of teaching about morphological spelling principles seemed quite alien to those teachers involved. Regardless of the actual intervention implementation, however, it is highly likely that fidelity checks in the period between immediate and delayed post-intervention testing – serving to remind teachers of the agreed procedure – could have prevented the problem that was encountered, and they should be factored into the methodologies of similar research in future.

Another potential limitation of the study concerns the shortage of background information obtained on individual differences within the sample. Of course, it was originally hoped that the questionnaire about home learning environments would provide some clues to patterns within

the current sample. However, the researcher became aware that minimal variation existed within this sample in terms of free school meals or children with English as an additional language – two factors which might be associated with socio-economic status and which, in turn, might impact on literacy and language abilities. Thus, even if the questionnaire data had ultimately been used, it might only have tapped variation in reading volume.

No measure of IQ was taken, something which could have provided valuable insight into the relationship between general intelligence and morphological awareness and intervention response. It is therefore important to acknowledge the likelihood of variation, which was not controlled for, in children's intrinsic abilities to access the activities in which they participated. The pseudoword task was a relatively complex procedure and, whilst Class Teachers and Teaching Assistants were available to provide individual attention and support where possible, administration of the task on an individual basis may have been preferable, in order be convinced of all participants' understanding of task demands.

There is also likely to have been individual variation in children's conceptual understanding of grammar and morphology, which could well have affected their response to training. The morphology-based spelling explanations given by teachers during the group reading sessions may have been too complex and abstract for some and there is a risk that teachers may not have successfully differentiated their input to appropriate level or extent. In particular, children with weaker oral language skills may not understand concepts such as tense as easily as other children, not only because of their reduced vocabulary but also because of a general lack of metalinguistic awareness in such a population, particularly those with SLI (Smith-Lock, 1995). Lum and Bavin (2007) report that children with SLI require a longer time and show a lower level of accuracy in making grammatical judgements, which would probably make it hard for

them to keep up with the pace of a group reading session, in which the focus is on analysing the meaning and grammar of sentences, and relating it to spellings. Whilst there were no known participants with SLI in the sample, the children who scored at the lower end of the distribution on the background vocabulary assessment may have struggled to fully access the teaching content for these reasons, highlighting the need for consideration of differentiation strategies in future morphology interventions.

A significant reason for vigilance in generalising certain conclusions is the use of measures of which the validity and reliability is unknown. First, with respect to the pseudoword task, it is necessary to recognise that there were no measures in the current study which could demonstrate transfer between performance on this task, following intervention, and real-word spelling in typical contexts. Instead, key findings from previous research in relation to transfer of morpheme knowledge, were relied upon (e.g. Nunes & Bryant, 2003; 2006). The administration of a real-word spelling test at post-intervention testing – with words containing the relevant past-tense and plural morphemes – would nonetheless have strengthened the design in this regard.

The use of non-standardised measures of vocabulary and reading experience could also potentially be problematic. All results from the vocabulary test and TRT must be interpreted cautiously as reliability and validity of these measures is unknown. Having adapted the British Picture Vocabulary Scales (BPVS) for group administration, it was not possible to tailor administration to individuals' abilities, thus scores may not have been accurately reflective of all children's basal or ceiling levels of vocabulary. This reduces the BPVS's reliability.

The TRT has many weaknesses as a measure, and was rendered even weaker given that it was not possible to compare its results with data from the questionnaire. The TRT was not expected to measure absolute

amount of reading, but to provide an indication of relative differences in exposure to print. The fact that it is a very indirect proxy indicator could be problematic and reduce its validity. It may lead to underestimations of a child's exposure to print: firstly, the printed word takes many forms, and only including books titles and authors in the test fails to take account of exposure through other means (Saxton, 2010b). Secondly, intelligent, curious children may well spurn popular books for more diverse reading matter (Saxton, 2010b). Inherent in the TRT is also the risk that it will provide overestimations of exposure to print – for instance, a child could have gained familiarity with a book title or author through conversations, television, radio or the internet, without having been exposed to the actual work. However, as Stanovich (1993) points out, this feature could be a strength just as often as a drawback, because most behaviours leading to familiarity with titles and authors are probably reflections of immersion in a literate environment. Furthermore, the possibility of responding on the basis of a shallow familiarity means that the TRT is not too cognitively demanding and that it does not stress memory as much as some other tasks in which children might be asked to recall titles or information about plot and/or characters (Stanovich, 1993).

In terms of future research possibilities signposted by the current study, exploration of the role of socio-economic factors, and within-child factors such as IQ, in children's spelling development (and specifically morphological awareness) would certainly be of interest to Educational Psychology. Maughan *et al* (2009) have initiated an exploration into such issues, and they are worthy of a great deal more focus.

Another area for future research, highly relevant to Educational Psychologists (EPs), would be detailed analyses of the profile of children who benefit most from a morphology intervention and, more specifically, of the effects of intervention on weak spellers and readers. Given that the sample was a relatively able one, with only one or two pupils scoring beneath the low average range in the standardised spelling and reading

tests, it was not possible to assess directly the impact of the intervention on children who had fallen behind in reading and spelling. Indeed, the focus of the current intervention was not to target children with learning difficulties or developmental disorders, but rather to look at typically-developing children – which, in itself, is useful in contributing better understanding of theory and practice in the field of learning difficulties.

As mentioned in Chapter 1, there are suggestions that pupils with learning difficulties can benefit from explicit instruction that helps them understand morphemes (Westwood, 2008). Although most students with learning disabilities have difficulty with all forms of written expression, spelling problems rank as some of the most difficult to remediate and are common (Bruck, 1988). One explanation for this is that they are less adept than normally-developing students in devising and utilising spelling strategies that involve the systematic application of spelling rules (Darch *et al*, 2000). Darch *et al* found that intensive and skill-directed rule-based instruction (phonological and morphological, for different word types) was significantly more effective than methods that rely on the use of motivational spelling activities, visual imagery and writing practice, without systematic introduction of spelling rules, for primary-aged children with learning difficulties. The authors suggest that such intervention corrects their strategy deficits, and that the morphological aspect specifically improved awareness of root forms within derived counterparts, of how to spell suffixes, and how to attach suffixes to base words correctly.

It has been found elsewhere that, when matched by reading level, older very poor readers'/spellers' scores in morphology and syntax awareness tasks did not differ from a group of normal readers (Bryant, Nunes, & Bindman, 1998; Egan & Pring, 2004; Shankweiler, Crain, Katz, Fowler, Liberman, Brady, & Thornton, 1995; Tsesmeli & Seymour, 2006). Yet, Nunes and Bryant (2009) point out that poor readers/spellers will never be able to infer morphological rules for themselves because they do not read enough to develop a bank of word-specific knowledge. They suggest that

morphology intervention with this population could be an opportunity to teach to their strengths, and an alternative way of helping them develop skills of word recognition and spelling. Nunes and Bryant (2009) report their own, as yet unpublished, study in which they compare the effects of a phonology intervention with a morphology intervention for children aged 8 to 11 with average IQ but delays in reading/spelling of at least 18 months. They found that poor readers made significantly more progress in suffix spelling than the Control group. Although the level of progress of the morphology group was marginally less than the progress of those who received the phonological intervention, Nunes and Bryant state this should be interpreted with caution. The level of input was relatively modest (approximately 15 hours over a 7-month period), and it is quite possible that poor readers would require a much longer morphology intervention to attain success. Furthermore, all children had already received extensive phonics instruction, so the phonology group's learning was reinforcing what they had been taught in their regular classrooms. Nonetheless, Nunes and Bryant conclude from their experiment that poor readers can learn to use morphological skills to improve their reading/spelling, but that this does not compensate for difficulties with phonology. Therefore, effective interventions should combine both forms of teaching.

4.3 Implications for practice

4.3.1 Implications for teaching and intervention

A much-debated question in the history of educational theory and practice in spelling is what should children learn and how? In the past, whether

through rote list learning, visual learning or multisensory methods, the emphasis was on teaching children whole words and expecting them to learn through memorisation (e.g. Fernald, 1943; Peters, 1985; Schonell, 1957). Nunes and Bryant (2006) suggest that the implicit theory behind these approaches is that written words are spelling responses to be learned as individual items, with no place for understanding or for the creative role of children in generating spellings. However, Read's (1975) work showed that young children are able, through knowledge that letters represent sounds, to invent spellings for words that nobody has taught them to write. Since that time, there has been a theoretical shift, led by researchers such as Ehri (1997) and Treiman (1993), to acknowledging that children create spellings from their understanding of the rules and constraints or their writing system; they do not just reproduce (correctly or incorrectly) memorised spellings.

Hence, individuals learn to spell words through acquiring an understanding of the principles underpinning orthographic spelling patterns (Holmes & Davis, 2002) according to their native writing system. This has become the basis of most spelling teaching, with the focus being on increasing children's understanding of the relations between the spellings of different words, and instruction around units that can be generalised to other spelling situations, and therefore are easier to store in long-term memory than whole-word forms (Elbro & Arnbak, 1996; Teaching & Learning Research Project, 2006). This has been a very positive move but, as we have seen, the emphasis has been on phonology-based approaches. This has been largely successful in improving reading levels nationally but spelling levels have continued to lag behind. Why? To recap, although they draw on the some of the same underlying knowledge and skills, reading is relatively more adaptable than spelling because additional contextual clues are used to aid word recognition, whilst spelling requires accurate retrieval and reproduction of sequences of letters that cannot be guided at all from context (Westwood, 2008). Moreover, according to Mastropieri and Scruggs (2002), the recognition process required for

reading is usually an easier memory process than the recall and production processes that are required for spelling.

Whilst phonology is important for spelling, the difficulties just described are compounded by the fact that phonological spelling principles frequently cannot give the dictionary-correct spelling. The findings from the present study add to the already well-established idea that improving explicit linguistic awareness in schoolchildren has a positive effect on how well they learn to read and spell, by suggesting that morphological awareness, in addition to phonological awareness, may be fundamental for circumventing or mediating some of the challenges inherent in the spelling process. Furthermore, the potential benefits of including teaching about morphemes in the curriculum could go well beyond spelling.

A further implication for teaching, prompted by the preceding discussion, is that learning to spell involves developing efficient and flexible strategies (Senechal, Basque, & Leclaire, 2006). Strategic spellers are able, when necessary, to call upon several sources of information for encoding and checking unfamiliar words. Teaching students to use effective strategies is one of the main goals of instruction in spelling (Lam & Westwood, 2006). Rittle-Johnson and Siegler (1999) point out that, although most children develop a number of strategies for themselves, often these strategies are insufficient to meet all their needs. The teacher's role is to extend their existing repertoire – and this may include teaching strategies based on the morphemic structure of words, and its relationship with the meaning and grammar of sentences.

Given that the weakest spellers seem to have a limited repertoire of strategies to use when spelling and checking words – tending to rely on rote memorisation and recitation, rather than taking an analytic approach – the implication is that they in particular need to be taught a wider range of effective strategies (Graham, Harris, & Chorzempa, 2002). Explicit instruction should promote a fuller knowledge of the English spelling

system and how it operates (Westwood, 2008), and a central element of this is the morphemic structure of words. Children whose spelling difficulties may be related to underlying problems with language, memory and phonological awareness, together with insufficient learning strategies (Plaza & Cohen, 2007), may all benefit from a morpheme intervention. Future research should specifically address the question of targeting morphology interventions to those who would benefit most – for example, perhaps, children with specific learning impairments.

A final overriding implication of the current research for teaching is that whilst past practice had shown that teaching children about grammar and spelling can be boring (Nunes & Bryant, 2006), and might therefore have little effect on literacy, the current research has suggested that it is possible to teach morphological principles to children in a way that maintains their interest in the classroom. Although future morphology interventions should endeavour to take better account of and be tailored to individual children's cognitive abilities and levels of conceptual understanding and development, the feedback received from teachers was positive: despite its conceptual base, children enjoyed the intervention; it was very visual and interactive; the story texts were highly engaging. Furthermore, the shortness of individual sessions was valued, even if in future they should be more frequently distributed and the overall duration of intervention should be longer.

4.3.2 Implications for Educational Psychology (EP) practice

In this final section, the focus will turn to the implications of the current research findings to the practice of EPs. An EP is concerned with helping to remove barriers to learning for those who are experiencing problems

within an educational setting, and with finding ways to enhance the learning and development of all children and young people. There may have been increased focus in recent years on prioritising the domains of mental health, emotional and social wellbeing within this remit, but the professional contribution of the EP to successful literacy development remains huge (BPS, 2006). There is increasing evidence to show how morphology interventions could be a useful tool for promoting literacy development generally, and specifically in children who continue to experience difficulties developing fluid literacy skills despite phonology-based interventions (Bowers *et al*, 2010). It is clear that literacy draws on many cognitive domains, and EPs can play a key role in informing teachers of the range of strategies and skills that children utilise, in order to improve matching between types of intervention and pupil profiles – thus leading to greater cost-effectiveness for Local Authorities and higher literacy standards nationally.

Inherent in the EP role is the need to keep abreast of current research findings, and share and promote them in a way that is accessible and that translates to evidence-based strategies for change that are relevant and implementable (Cameron, 2006). However, Educational Psychology is a profession that will benefit from working from a stronger evidence base, derived from empirical studies, as far too much policy-making has been carried out using programmes that have not been systematically evaluated (Brooks & NFER, 2007). Part of the reason for this seems to have been the difficulty of integrating the "gold standard" of research methodologies (controlled trials and random assignment) with everyday classroom contexts. As a consequence, the profession has struggled to make the impact it ought to make on mainstream education (Solity, 2000). This is particularly the case in the field of literacy, where the persistence of low attainment suggests much is still required from the school system and its supporting services (Maliphant, 2000). More specifically, the paucity of spelling studies highlighted by Brooks (Brooks & NFER, 2007) has meant that EPs have struggled in this central part of their role – that of informing

our practice and the guidance we give to schools about one of the most key cross-curricular skills with reproducible, empirical research findings.

Fortunately, the publication of a number of recent independent reviews of research evidence to inform current practice and policy for the teaching of reading (Rose, 2006; 2009), and DCSF-commissioned evaluations of current intervention programmes for difficulties with literacy (Brooks & NFER, 2007) and mathematics (Dowker, 2004), indicates a move towards evidence-based policy and practice in education. This is accompanied by an increasing demand by practitioners for reliable evidence from well-controlled studies examining the long-term efficacy of educational programs and interventions for pupils with severe and persisting reading and spelling difficulties (e.g. Rose, 2009).

There is no doubt that in areas relating to crucial educational outcomes such as spelling, research involving randomised controlled trials (RCTs) should have a central and critical role (Seethaler & Fuchs, 2005). Future research needs to employ RCTs in larger-scale studies to rigorously test the effect of morphology-based interventions for spelling. The current study nevertheless highlights the fact that, with the breadth of their training, skills and theoretical grounding, EPs are in a unique position to devise programmes themselves, potentially influencing educational practice through the synthesis of theory, research and practice in a way that emphasises raising children's attainment. Secondly, EPs are in an excellent position to participate in the evaluation of the efficacy of intervention programs. Useful to this end, Carter and Wheldall (2008) discuss factors to consider when weighing up the evidence from intervention research, as a temporary solution to the dearth of RCTs. Such factors include the consistency of findings with existing scientific evidence and theory, and whether or not the claims are testable and stable and potentially falsifiable using experimental research.

The current research project fits well into this context. Whilst the results must be interpreted with caution, it is hoped that the study will help enhance EPs' understanding of the inherently complex process of learning to spell and, more generally, of the development of robust literacy skills. As with any type of research referred to in EP work, perhaps one of the main values of this study will lie in providing a conceptual framework for the examples of successful learning or learning difficulties that EPs observe. Another is in suggesting where to look for solutions to practical problems. Research theories do not give EPs solutions, but they do direct their attention to those variables that may be crucial in finding solutions (Hill, 2002).

4.4 Conclusions

It has not been possible to establish that a short intervention can improve primary school children's awareness of two of the most common morphologically-based spelling rules. There were positive immediate gains in morphological awareness for some pupils, although generalisation to spelling real words was not shown (only pseudowords). The study may be taken as evidence that intervention needs to be longer, more intensive and/or more frequently distributed, in order to ensure that morphological knowledge will be retained. The possible reasons for the pattern of results have been discussed, with reference to the methodological limitations of the study and shortcomings of the intervention design.

The findings of the study give new insights into the development of implicit and explicit morphological awareness, and authenticate previous theories that, whilst children aged 6- to 8-years-old are reasonably good at using

morphemes creatively in spoken language, most are unable to make explicit distinctions in written language. It has been argued that many of the most common difficulties in our spelling system can only really be tackled through the use of morphemes. Although conclusions are tentative, it has been suggested that making children explicitly aware of morphemes and their role in spelling through systematic teaching may be a good strategy to help children of all ability groups, including those with literacy and language difficulties, to develop more robust and accurate spelling skills. Perhaps it may also promote wider literacy and language development.

The results have been set in the context of contemporary educational theory and practice, and the field of educational psychology, a profession which has been lacking an evidence base from empirical studies investigating some of these most key areas of child development.

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APPENDIX 1:

Assessment of Exposure to Print

Stimuli from the Book Titles and Authors Recognition Test (TRT)

BOOKS

GENUINE	*'FOILS'*
James and the Giant Peach	Joanne
The Secret Garden	Ethan Allen
The Hobbit	Sally's Secret
Stuart Little	The Hideaway
Five Children and It	The Missing Letter
Jabberwocky	100 Dalmatians
Alice's Adventures in Wonderland	The Lion, the Wizard and the Wardrobe
Charlotte's Web	Curious Jim
Guess how much I love you	Hot Top
Harry Potter and the Philosopher's Stone	It's my Room

AUTHORS

GENUINE	*'FOILS'*
Allan Ahlberg	Maria Dixon
Dr Seuss	Martin Douglas
Jill Tomlinson	Laura Brooks
Enid Blyton	Rachel Daniels
Beatrix Potter	A.E. Edwards
Mick Inkpen	Lynley Dodd
Jacqueline Wilson	Frank Page
Dick King Smith	Sonia Sage
J.K. Rowling	Alfred Oxenbury
C.S. Lewis	Ed Brice

APPENDIX 2A:

Questionnaire about children's home learning environments and literary experiences

Leading education and social research
Institute of Education
University of London

Learning to Read Survey

Your child's class has been selected to participate in a doctoral research project on literacy development. The research is being conducted in collaboration between the Institute of Education (University of London) and Oxfordshire Educational Psychology Service.

This survey asks about your child's experiences in learning to read. I am interested in what you and your child do. There are no right or wrong answers to these questions.

The information being collected will be extremely useful for helping understand how young children learn to read and write, and for helping to improve the teaching and learning of literacy for all children. I ask that you respond to all of the questions you feel comfortable answering. I would like to reassure you, however, that your responses to this survey are completely confidential.

This survey should be completed by the child's parent or current primary caregiver, or jointly by both parents or primary caregivers.

Please complete and return the survey to school BEFORE THE SUMMER HOLIDAYS. With many thanks for your time and co-operation.

YOUR CHILD'S NAME:..... CLASS:.....
SCHOOL:.....

1. Before your child began Primary school education, how often did you or someone in your home do the following activities with him or her?

*Check **one** box for each line.*

	Often	Sometimes	Never or almost never
a) Read books.....			
b) Tell stories.....			
c) Sing songs.....			
d) Play with alphabet toys.....			
e) Talk about things you had done..			
f) Talk about what you had read....			
g) Write letters or words			
h) Read aloud signs and labels.....			
i) Visit a library.....			

2. What language did your child speak when he/she began school?

If your child spoke more than one language at the same time, you can check both boxes.

a) English ..... ☐
b) Other (please specify) ..... ☐

3. How often do you or someone else in your home do the following activities with your child?

*Check **one** box for each line.*

	Almost every day	Once or twice a week	Once or twice a month	Never or almost never
a) Listen to my child read aloud.....				
b) Talk with child about things we have done.....				
c) Talk with child about what he/she is reading.....				
d) Discuss my child's classroom reading work with him/her.....				
e) Visit library/bookshop.....				
f) Help child with reading for school				

4. In a typical week, how much time do you usually spend reading <u>for yourself</u>, including books, magazines, newspapers, and materials for work?

*Check **one** box only.*

Less than one hour a week.....	
1-5 hours a week.....	
6-10 hours a week.....	
More than 10 hours a week.....	

5. When you are at home, how often do you read for your own enjoyment?

*Check **one** box only.*

Every day or almost every day.....	☐
Once or twice a week.....	☐
Once a twice a month.....	☐
Never or almost never.....	☐

6. Please indicate how much you agree with the following statements about reading.

*Check **one** box for each line.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I read only if I have to.....				
b) I like talking about books with other people.....				
c) I like to spend my spare time reading.....				
d) I read only if I need information...				
e) Reading is an important activity in my home.....				

7. About how many books are there in your home? (Do not count children's books)

*Check **one** box only.*

0-10	☐
11-25	☐
26-100	☐
101-200	☐
More than 200	☐

8. About how many children's books are there in your home (mainly in English)?

*Check **one** box only.*

0-10	☐
11-25	☐
26-50	☐
51-100	☐
More than 100	☐

9. What is the highest level of education completed by the child's father (or stepfather or male guardian) and mother (or stepmother or female guardian)?

*Check **one** box for each column.*

	Child's father	Child's mother
a) Some primary or lower secondary, or did not go to school.....	☐	☐
b) Lower secondary (GCSEs).....	☐	☐
c) Sixth form (A-levels).....	☐	☐
d) Post-secondary further education (e.g. vocational training).....	☐	☐
e) University first degree.....	☐	☐
f) University beyond first degree (e.g. Masters).....	☐	☐
g) Not applicable.....	☐	☐

10. Which best describes the employment situation of the child's father and mother (or equivalents)?

*Check **one** box for each column.*

	Child's father	Child's mother
a) Working at least full-time for pay.....		
b) Working part-time for pay.....		
c) Not working for pay, but looking for a job		
d) Other.....		

11. Compared with other families, how well-off do you think your family is financially?

*Check **one** box only.*

Very well-off.....	
Somewhat well-off.....	
Average.....	
Not very well-off.....	
Not at all well-off.....	

THANK YOU... YOUR TIME AND EFFORT IS GREATLY APPRECIATED!

APPENDIX 2B:

Questionnaire scoring scheme and data

To summarise questionnaire data concisely, and following the analysis practice of the PIRLS (2006) study that the questionnaire was adapted from, information from individual questions was combined to form constructs that were more valid and reliable than the component questions. The constructs created can be seen in Table 15, where the average score for each construct is quantified.

Table 14: Means and SDs for each questionnaire construct

CONSTRUCT	Questions grouped to create Construct	Mean score	Mean %	Std. Dev.
Early home literacy activities	Question 1 (low numbers representing "Never"; high numbers, "Often")	23.67 out of 27	87.67	3.08
Current home literacy activities	Question 3 (low numbers representing "Never"; high numbers "Often")	19.13 out of 24	79.71	2.91
Parental attitudes to reading	Questions 4, 5 & 6 (low numbers representing unfavourable attitudes; high numbers, favourable attitudes)	23.63 out of 28	84.34	5.27
Quantity of books in home	Questions 7 & 8 (low numbers representing few books; high numbers, many books)	8.7 out of 10	87	1.42
Parental education level	Question 9 (low numbers representing minimum level; high numbers maximum level)	8.55 out of 14	61.07	2.32
Family economic situation	Question 11 (low numbers representing not well off; high numbers, well off)	3.16 out of 5	63.2	0.82

Table 14 shows that parents reported a very high level of engagement with their children in activities that foster literacy development, particularly before their children started school (e.g. telling stories, singing songs, playing with alphabet toys, reading aloud signs, talking about things they have done), but also now that their children are in Years 2 and 3 (e.g. listening to child read aloud, discussing child's reading work with them,

visiting library or bookshop). Parents also reported having very favourable attitudes towards reading themselves – engaging in a several hours per week of reading books, magazines and newspapers, both for enjoyment, for work, and for practical purposes such as when seeking information. Parents reported a high number of books in their homes – with the average number approaching 250; these are comprised of both children's and adults' books. In terms of the highest level of education of either or both parent(s), where the lowest-scoring category is primary education, and the highest-scoring category is Masters or PhD, the level most commonly reported was post-secondary further education or university first degree level. The final construct concerned the economic situation of the family, and parents reported most commonly that, compared to other families, their family was averagely well-off.

In spite of the low return rate of the questionnaires, correlations were run to see if there was a positive relationship between any of the six constructs, shown in Table 15, and performance on the Pseudoword task at Time 1. (The completed questionnaires pertained to an almost even number of Year 2s (15) and Year 3s (16), meaning that age would not be a confounding factor in any analysis.) No significant correlations were found.

APPENDIX 3:

Characteristics and matching of Year Groups on age and background measures

Table 15: Year 2 Mean scores and SDs for Age and Background Measures

GROUP		AGE (years)	SPELLING (standard score)	READING (standard score)	VOCABULARY (% correct)	TRT (% correct)
Intervention	M	7.04	99.85	97.55	81.47	61.13
(*N* = 19)	SD	4.6	10.25	14.88	11.79	3.22
Control	M	7.04	102.56	107.06	80.1	55.2
(*N* = 23)	SD	6.09	14.34	25.14	6.87	6.47

Table 16: Year 3 Mean scores and SDs for Age and Background Measures

GROUP		AGE (years)	SPELLING (standard score)	READING (standard score)	VOCABULARY (% correct)	TRT (% correct)
Intervention	M	8.03	104.92	108.0	89.82	65.83
(*N* = 26)	SD	6.73	14.08	16.36	9.36	3.73
Control	M	7.94	101.4	103.24	94.13	67.2
(*N* = 16)	SD	4.27	12.51	11.17	6.75	3.35

Note: The tests used were the Single Word Spelling Test, Group Reading Test 6-14, British Picture Vocabulary Scales, and a version of the Titles Recognition Test. Details are found in Section 2.2.1.

Tables 15 and 16 show that the research groups within Year 2 and Year 3 were well matched on their scores on the background measures. Within each Year, t-tests indicated no significant differences between the Intervention and Control groups on age, spelling, reading, vocabulary or the TRT (all $p>0.1$).

APPENDIX 4A:

Assessment of Morphological Awareness, Times 1 & 2

Full set of stimuli from Pseudoword Task

Note: Pseudoword pairs (as provided on participants' worksheets) are in bold; target words are underlined. Sentences were read aloud but not provided on worksheets.

Plural rule trials

/z/ sound-ending, one morpheme

1. Yesterday I saw two heezes. Today, I saw only one [**heeze** / **hees**].
2. Three klazes are on the steps. Please pass one [**klays** / **klaze**] to me.
3. These greezes are very sharp, but my [**grees** / **greeze**] is blunt.
4. These are phozes. There is one [**phoze** / **phows**] behind the tree.
5. Are the trozes ready yet? When will my [**trows** / **troze**] be ready?
6. Those fruzes are heavy. Can you lift one [**frues** / **fruze**]?
7. These are the green skazes with just one red [**skaze** / **skays**] in bloom.
8. It's time for the zazes to fly South. There is one [**zaze** / **zays**] over there.

/z/ sound-ending, two morphemes

9. Last week I heard a pree. Today I heard two [**preeze** / **prees**] singing.
10. In my garden I have one foo, but in the park there are many [**foos** / **fooze**].
11. I found a moi. I will put it with my other two [**mois** / **moize**].
12. There was one vae on the stairs, but now there are many [**vaeze** / **vaes**].
13. Originally we had one droe, but now we have three [**droes** / **droeze**].
14. I'd like to change this large grue for two small [**grues** / **grueze**], please.
15. One kae is not much use: we need many [**kaeze** / **kaes**].
16. Please take one thae from the pile of ten [**thaeze** /**thaes**].

/ks/ sound-ending, one morpheme

17. On Tuesday I saw two snoxes. Today, I saw only one [**snox** / **snocks**].
18. Over there are three draxes. Please pass one [**dracks** / **drax**] to me.
19. I can see five thexes. One [**thecks** / **thex**] is coming closer.
20. These toxes are rusty. Do you want a rusty [**tox** / **tocks**]?
21. These bixes are ready now. Do you want a [**bix** / **bicks**]?
22. Those zaxes are heavy. Can you lift a [**zacks** / **zax**]?
23. The frixes are all different colours. Do you want the green [**fricks** / **frix**]?
24. Let's try some bluxes. Can you taste your [**blucks** / **blux**]?

/ks/ sound-ending, two morphemes

25. Last week I heard a yock. Today, I heard two [**yox / yocks**] singing.
26. Here there is one thack, but in the garden there are many [**thax / thacks**].
27. I found a dreck today. I will put it with my other [**drecks / drex**].
28. There was one creck on the shelf, but now there are many [**crex / crecks**].
29. Last year we had only one kruck, but now we have five [**krucks / krux**].
30. I'd like to exchange this large zick for two small [**zicks / zix**] please.
31. You'll need this key for the crick. There are two [**crix / cricks**].
32. Snooker players use a pleck. He has a choice of four [**plex / plecks**].

Past tense rule trials

/t/ sound-ending, one morpheme

33. I love bupting. When would you like to [**bupt / bupped**] with me?
34. Having learned about basting, I can now [**bast / bassed**] my dog.
35. Seeing you bockting makes me want to [**bocked / bockt**].
36. She likes dackting so much that she even wants to [**dackt / dacked**] in the garden!
37. You are always kefting with your family. I like to [**keft / keffed**] with Dad on Sundays.
38. My Mum is sapting the vegetables before serving. I don't know how to [**sapped / sapt**].
39. Why are you pipting here? You shouldn't [**pipped / pipt**] at the car park!
40. I enjoy nofting. I occasionally [**noffed / noft**] after breakfast.

/t/ sound-ending, two morphemes

41. When are you going to riff? He [**riffed / rift**] on Tuesday.
42. I want to wurf but I don't know where! Jim [**wurfed / wurft**] on the roof.
43. I like to veck in the sunshine. Yesterday I [**veckt / vecked**] when the rain stopped.
44. Connor loves to tiss. He [**tissed / tisst**] on the beach today.
45. Sometimes we manage to gop. Ben [**gopt / gopped**] on his way home from school.
46. He tends to brip if he gets angry. He [**bript / bripped**] when his car did not start.
47. When we go on holiday, Mary likes to sop. She [**sopped / sopt**] last year in France.
48. The wind is about to grack. Last time it [**grackt / gracked**], the leaves fell off the trees.

/d/ sound-ending, one morpheme

49. Everyone is slanding at the moment. Would you like to [**sland / slanned**] with me?
50. I heard that the people trarded. I did not know they were going to [**trard / trared**].
51. The plants need to be pellded. Will Kate [**pelled / pelld**] them tomorrow?
52. I have never liked brunding, so I don't want to [**brunned / brund**] today.
53. Patrick always talks about when he wolded. Is he ever going to [**wolled / wold**] again?
54. There are twenty dogs crunding there. Is your dog going to [**crund / crunned**]?
55. I really do not understand dinding. I don't think I will ever know how to [**dinned / dind**].
56. My parents fanned on holiday. They do not want me to [**fand / fanned**].

/d/ sound-ending, two morphemes

57. Freddie knows how to snin. Yesterday he [**snind / sninned**] all day long.
58. Emily likes to mar. Last week she [**marred / mard**] along the street.
59. I often prill my head. This morning I [**prilled / prild**] my head.
60. You larn whenever you have free time. In the summer my brother [**larnd / larned**] a lot.
61. I always gorn things. Yesterday I [**gorned / gornd**] my bicycle and it got a flat tyre.
62. That man tends to plar his car, even when driving. He [**plared / plard**] his car last week.
63. If you come to the park, I will show you how to broon. Yesterday, I [**broond / brooned**].
64. When the winter comes, hedgehogs vull. This morning, a hedgehog [**vulled / vuld**].

APPENDIX 4B:

Comparability of Pseudoword Task trials' syntax, morphology and vocabulary

Plural rule trials

Pseudoword category	Mean number of clauses	Mean number of words	Mean length of utterance	Mean number of syllables per word	Mean number of words in top 2000 most frequent words
1m /z/	1.9	7.9	6.4	1.6	7
2m /z/	1.8	10	7.6	1.4	9.4
1m /ks/	2	10.6	6	1.5	8
2m /ks/	1.9	12.3	8	1.4	9.3

Past tense rule trials

Pseudoword category	Mean number of clauses	Mean number of words	Mean length of utterance	Mean number of syllables per word	Mean number of words in top 2000 most frequent words
1m /t/	1.9	12	8	1.6	9.8
2m /t/	2.2	13	8	1.4	11
1m /d/	2.1	13	7.7	1.4	11
2m /d/	1.9	14	8	1.4	11

Notes: "1m /z/" refers to one-morpheme /z/-ending words; "2m /z/" refers to two-morpheme /z/-ending words; etc. Mean Length of Utterance was calculated with the aid of the website "Speech Therapy Information and Resources" (STIR, 2010). Mean number of syllables was calculated with the "Textalyser" tool (Textalyser.net, 2004). Frequency of words was calculated with the "Word Frequency Text Profiler" (Edict Virtual Language Centre, 2010).

For both sets of rule trials, t-tests indicated that there were no significant differences between sentences within each pseudoword category with regards to any of the afore-analysed aspects of their composition (all $p > 0.08$, except mean number of words in the plural rule trials, where $p \geq 0.05$). This provides assurance that the trials for each category of target pseudoword were comparable in terms of their syntactic, morphological and lexical complexity.

APPENDIX 4C:

Assessment of Morphological Awareness, Time 3

Reduced set of stimuli from Pseudoword Task

Plural rule trials

/z/ sound-ending, one morpheme

1. It's time for the zazes to fly South. There is one [**zaze** / **zays**] over there.
2. Are the trozes ready yet? When will my only [**trows** / **troze**] be ready?
3. These greezes are very sharp, but my [**grees** / **greeze**] is blunt.
4. Yesterday I saw two heezes. Today, I saw only one [**heeze** / **hees**].

/z/ sound-ending, two morphemes

5. Originally, we had one droe, but now we have three [**droes** / **droeze**].
6. I found a moi. I will put it with my other two [**mois** / **moize**].
7. Last week I heard a pree. Today I heard two [**preeze** / **prees**] singing.
8. One kae is not much use: we need loads of [**kaeze** / **kaes**].

/ks/ sound-ending, one morpheme

9. I can see five thexes. One [**thecks** / **thex**] seems to be coming closer.
10. These bickses are ready now. Do you want a [**bix** / **bicks**]?
11. The frixes are all different colours. Do you want the one green [**frix** / **fricks**]?
12. On Tuesday I saw two snoxes. Today, I saw only one [**snox** / **snocks**].

/ks/ sound-ending, two morphemes

13. You'll need this key for the crick. There are two [**crix** / **cricks**].
14. Last week I heard a yock shout. Today, I heard two [**yox** /**yocks**] shouting.
15. I found a dreck today. I will put it with my group of other [**drecks** / **drex**].
16. In my garden I have only one thack, but in the park there are many [**thax** / **thacks**].

Past tense rule trials

/t/ sound-ending, one morpheme

17. I love bupting. When would you like to [**bupt / bupped**] with me?
18. Why are you pipting here? You shouldn't [**pipped / pipt**] at the car park!
19. Seeing you bockting makes me want to [**bocked / bockt**].
20. You are always kefting with your family. I like to [**keft / keffed**] with Dad on Sundays.

/t/ sound-ending, two morphemes

21. When are you going to riff? He [**riffed / rift**] on Tuesday.
22. When we go on holiday, Mary likes to sop. She [**sopped / sopt**] last year in France.
23. Sometimes we manage to gop. Ben [**gopt / gopped**] on his way home from school.
24. I like to veck in the sunshine. Yesterday I [**veckt / vecked**] when the rain stopped.

/d/ sound-ending, one morpheme

25. Everyone is slanding at the moment. Would you like to [**sland / slanned**] with me?
26. Patrick always talks about when he wolded. Is he ever going to [**wolled / wold**] again?
27. The plants need to be pellded. I wonder if Kate will [**pelled / pelld**] them tomorrow.
28. I really do not understand dinding. I don't think I will ever know how to [**dinned / dind**].

/d/ sound-ending, two morphemes

29. If you come to the park, I will show you how to broon. Earlier, I [**broond / brooned**].
30. Freddie knows how to snin. Yesterday he [**snind / sninned**] all day long.
31. I often prill my head. This morning I [**prilled / prild**] my head.
32. I always gorn things. Yesterday I [**gorned / gornd**] my bicycle and it got a flat tyre.

APPENDIX 4D:

Correlations undertaken to form reduced Pseudoword Task, Time 3

The process involved in reducing the pseudoword stimuli by half was as follows:

1. Divide set of eight stimuli for each pseudoword category into four, and endeavour to ensure that mean scores for reduced set are more-or-less half the mean scores for whole set. (Mean scores are taken from Times 1 and 2 together.) Continue substituting different pseudowords into the reduced set, until this is achieved.

E.g. for /z/-ending one-morpheme words

Mean for whole set (*heeze*, *klaze*, *greeze*, *phoze*, *troze*, *fruze*, *skaze*, *zaze*): **4.28** out of 8 (*SD*=1.2)

Mean for half set (*heeze*, *greeze*, *troze*, *zaze*): **2.15** out of 4 (*SD*=1.89)

2. Run correlations to check that mean scores on four retained /z/-ending one-morpheme words correlate highly (in terms of correlation co-efficients, direction of correlation, and significance levels) with scores from the original set of eight. The results for each pseudoword category were as follows (note that in all tables *N*=85 and ** indicates that correlation is significant at the 0.01 level (2-tailed)):

/z/-ending one-morpheme words

		/z/ 1m old	/z/ 1m new
/z/ 1m old	x^2	1.00	0.79**
/z/ 1m new	x^2	0.79**	1.00

/z/-ending, two-morpheme words

		/z/ 2m old	/z/ 2m new
/z/ 2m old	x^2	1.00	0.84**
/z/ 2m new	x^2	0.84**	1.00

/ks/-ending, one-morpheme words

		/ks/ 1m old	/ks/ 1m new
/ks/ 1m old	x^2	1.00	0.82**
/ks/ 1m new	x^2	0.82**	1.00

/ks/-ending, two-morpheme words

		/ks/ 2m old	/ks/ 2m new
/ks/ 2m old	x^2	1.00	0.76**
/ks/ 2m new	x^2	0.76**	1.00

/t/-ending, one-morpheme words

		/t/ 1m 2 old	/t/ 1m new
/t/ 1m old	x^2	1.00	0.87**
/t/ 1m new	x^2	0.87**	1.00

/t/-ending, two-morpheme words

		/t/ 2m old	/t/ 2m new
/t/ 2m old	x^2	1.00	0.81**
/t/ 2m new	x^2	0.81**	1.00

/d/-ending, one-morpheme words

		/d/ 1m old	/d/ 1m new
/d/ 1m old	x^2	1.00	0.85**
/d/ 1m new	x^2	0.85**	1.00

/d/-ending, two-morpheme words

		/d/ 2m old	/d/ 2m new
/d/ 2m old	x^2	1.00	0.80**
/d/ 2m new	x^2	0.80**	1.00

APPENDIX 5:

Background assumption checks for ANOVAs and ANCOVAs

Skewness and kurtosis of measures used at Time 1

Plural rule trials

GROUP	Measure	Skewness	Std. Error of skewness	STANDARDISED SKEW	Kurtosis	Std. Error of kurtosis	STANDARDISED KURTOSIS
Intervention	1m /ks/	-.06	0.35	**-0.17**	0.02	0.69	**0.03**
	1m /z/	0.09	0.35	**0.26**	-1.15	0.69	**-1.67**
	2m /ks/	-.13	0.35	**-0.37**	-0.91	0.69	**-1.32**
	2m /z/	-.35	0.35	**-1**	0.1	0.69	**0.15**
Control	1m /ks/	-0.04	0.38	**-0.11**	-1.14	0.74	**-1.54**
	1m /z/	-0.14	0.38	**-0.37**	-0.27	0.74	**-0.36**
	2m /ks/	-0.05	0.38	**-0.13**	-1.02	0.74	**-1.38**
	2m /z/	0.17	0.38	**0.45**	-0.49	0.74	**-0.66**

Past tense rule trials

GROUP	Measure	Skewness	Std. Error of skewness	STANDARDISED SKEW	Kurtosis	Std. Error of kurtosis	STANDARDISED KURTOSIS
Intervention	1m /d/	-0.25	0.35	**-0.71**	-0.03	0.69	**-0.04**
	1m /t/	-0.29	0.35	**-0.83**	-0.84	0.69	**-1.22**
	2m /d/	0.08	0.35	**0.23**	-0.35	0.69	**-0.51**
	2m /t/	0.1	0.35	**0.29**	-0.59	0.69	**-0.86**
Control	1m /d/	0.19	0.38	**0.5**	-0.67	0.74	**-0.91**
	1m /t/	0.03	0.38	**0.08**	-0.86	0.74	**-1.16**
	2m /d/	0.24	0.38	**0.63**	-0.63	0.74	**-0.85**
	2m /t/	-0.5	0.38	**-1.32**	-0.24	0.74	**-0.32**

Notes: "1m /z/" refers to one-morpheme /z/-ending words; "2m /z/" refers to two-morpheme /z/-ending words; etc. To obtain standardised skew and standardised kurtosis, "skewness" was divided by "std error of skewness", and "kurtosis" was divided by "std error of kurtosis", respectively. If these results had been greater than 1.96, they would have been judged significantly different from a normal distribution.

APPENDIX 6:
Additional details on interactions from ANOVA/ANCOVA analyses

TIME 1 ANOVA: Plural rule trials

The interaction Sound ending x Morpheme number was not significant but F>1 (F (1,81)=2.71, p=0.07).

TIME 1 ANOVA: Past tense rule trials

The following interactions were not significant but F>1:

Sound ending x Morpheme number (F (1,81)=1.02, p=0.32);
Group x Year x Sound ending (F (1,81)=2.44, p=0.12);
Group x Year x Morpheme number (F (1,81)=1.67, p=0.2);
Group x Sound x Morpheme number (F (1,81)=1.39, p=0.24).

TIMES 1-2 ANCOVA: Plural rule trials

The interaction Time x Sound ending was significant (F (1,80)=4.74, p<0.05, ω^2=0.006). This is plotted in Figure 7.

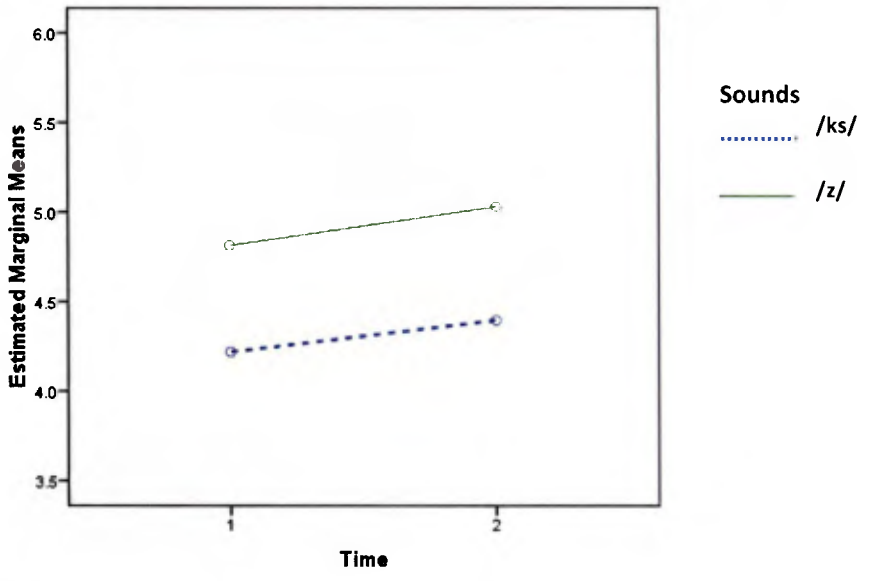


Figure 7: Interaction between Time and Sound Ending on Plural trials, Times 1-2

A paired t-test with Bonferroni correction (significance level required: <0.017) showed that the source of the interaction was spelling of /ks/-ending words improving more than spelling of /z/-ending words between Times 1 and 2 (t (1,85)=1.73, p=0.093 vs t (1,85)=1.09, p=0.231).

The interaction Group x Sound ending x Morpheme number was significant (F (1,80)=4.81, p<0.05, ω^2=0.006), and is shown in the two plots in Figure 8.

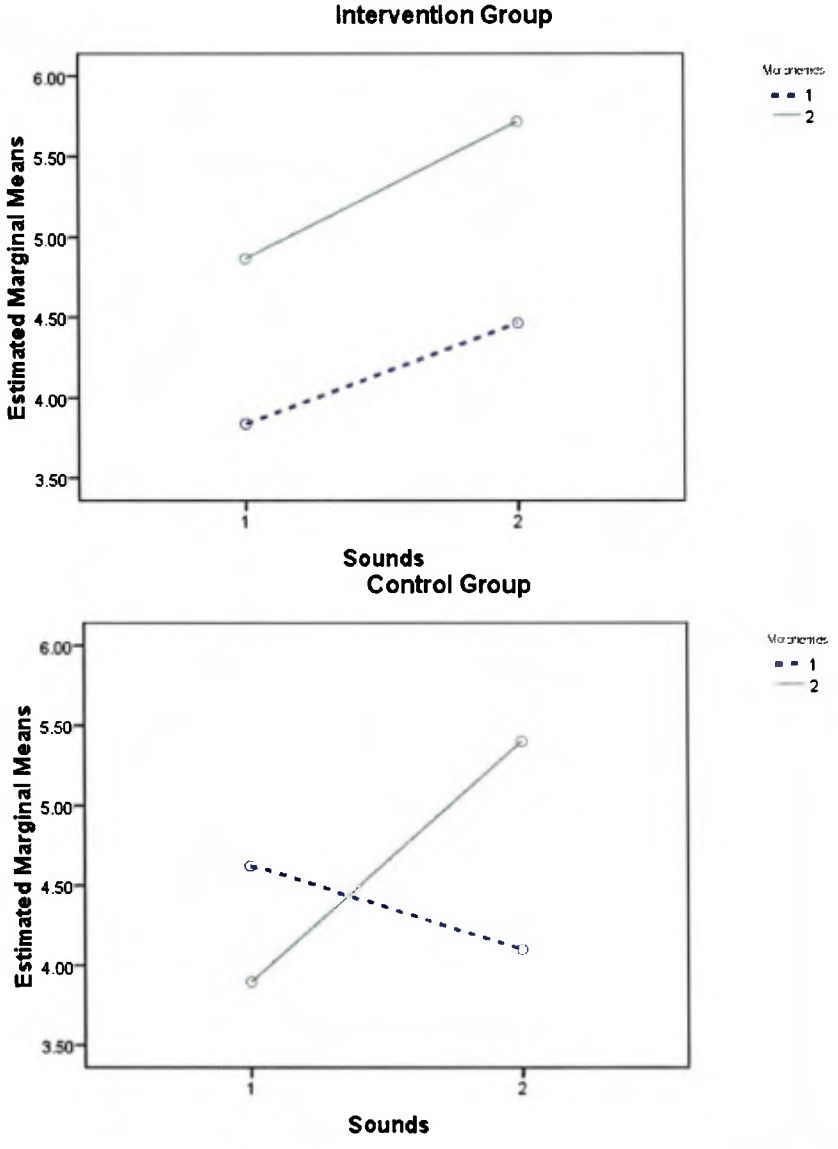


Figure 8: Interaction between Group, Sound ending and Morpheme number (plotted by Group), Times 1-2

Post-hoc t-tests with Bonferroni correction (significance level required: <0.013) showed that the interaction was owing to the Intervention group

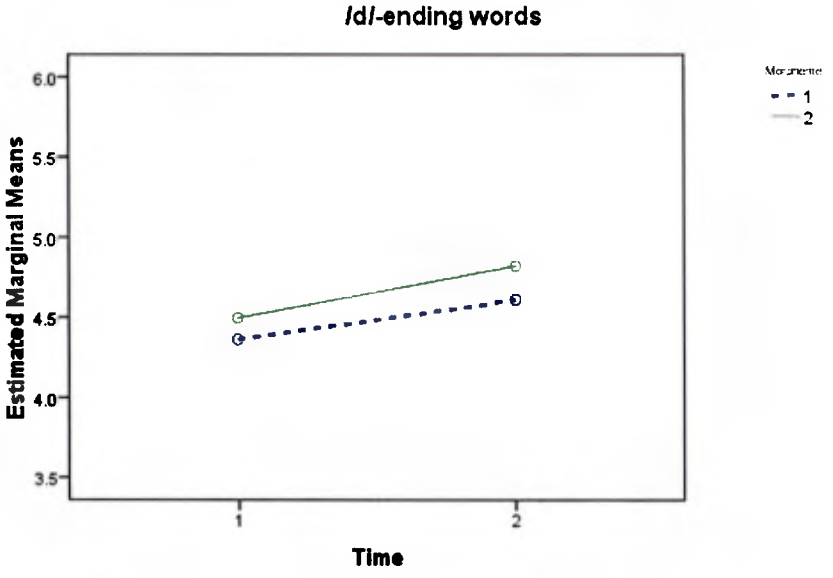
faring better on one-morpheme /ks/ words than one-morpheme /z/ words (t (1,44)=3.76, p=0.012), and the Control group faring better on one-morpheme /z/ words than one-morpheme /ks/ words (non-significant result).

The following interactions were non-significant but F>1:

Group x Time (F (1,80)=3.55, p=0.06);
Group x Sound ending (F (1,80)=1.67, p=0.2);
Group x Morpheme number (F (1,80)=3.82, p=0.06);
Time x Morpheme number (F (1,80)=1.81, p=0.18).
Group x Time x Sound ending x Morpheme number (F (1,80)=3.17, p=0.08)

TIMES 1-2 ANCOVA: Past tense rule trials

The interaction Time x Sound ending x Number of morphemes was significant (F (1,81)=7.94, p<0.05, ω^2=0.004), and is plotted in Figure 9.



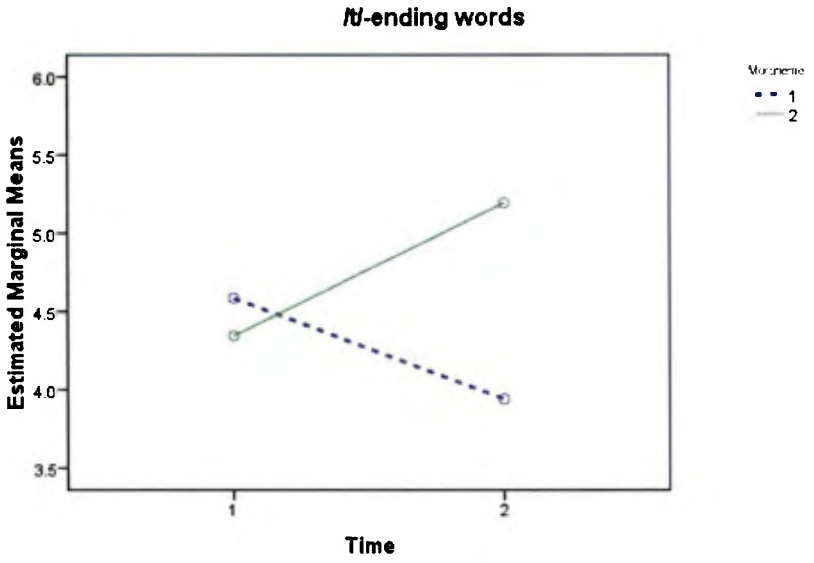


Figure 9: Interaction on Past tense trials between Time, Sound ending and Morpheme number (plotted by Sound ending), Times 1-2

Post-hoc t-tests with Bonferroni correction (significance level required: <0.013) show that, for /d/-ending trials, there was improvement between Times 1 and 2 on both one-morpheme and two-morpheme words (but $p>0.1$). For the /t/-ending trials, there was a significant increase in scores on two-morpheme words (t (1,83)=3.13, p=0.008) but a non-significant drop in scores on one-morpheme words (t (1,83)=2.04, p=0.053).

The following interactions were not significant, but F>1:

Group x Morpheme number (F (1,81)=1.75, p=0.19);
Time x Morpheme number (F (1,81)=3.47, p=0.07);
Sound ending x Morpheme number (F (1,81)=1.67, p=0.2);
Group x Test x Sound ending x Morpheme number (F (1,81)=3.32, p=0.07).

Times 1-3 ANCOVA: Plural & Past tense rule trials combined

The interaction between Group and Spelling rule was significant (F (1,46)=4.74, $p<0.05$, $\eta^2=0.09$), and is plotted in Figure 10.

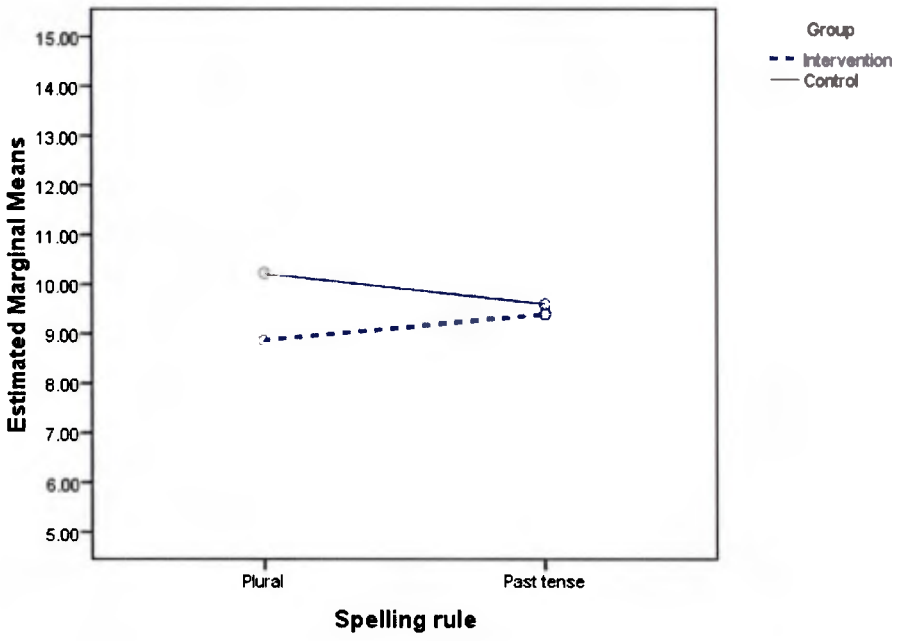


Figure 10: Interaction between Group and Spelling rule, Times 1-3

Post-hoc t-tests with Bonferroni correction (significance level required: <0.017) showed the source of this interaction to be the Control group faring better on the past tense than the plural rule (t (1,23)=2.07, *p*=0.054), but the Intervention group faring better on the plural than the past tense rule (t (1,26)=1.34, *p*>0.1).

The following interactions were not significant, but F>1:

Time x Spelling rule (F (1,46)=1.95, *p*=0.17);
Group x Time x Spelling rule (F (1,46)=1.48, *p*=0.23).