THE ROLE OF ANALOGY IN SPELLING IN ENGLISH PRIMARY SCHOOL CHILDREN - A PARTIAL INTERVENTION STUDY

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The English writing system is notoriously irregular in its orthography at the phonemic level. It was therefore proposed that focusing beginner-spellers' attention on sound-letter relations at the sub-syllabic level might improve spelling performance. This hypothesis was tested in Experiments 1 and 2 using a 'clue word' paradigm to investigate the effect of analogy teaching intervention / non-intervention on the spelling performance of an experimental group and controls. The results overall showed the intervention to be effective in improving spelling, and this effect to be enduring. Experiment 3 demonstrated a greater application of analogy in spelling, when clue words, which participants used in analogy to spell test words, remained in view during testing. A series of regression analyses, with spelling entered as the criterion variable and age, analogy and phonological plausibility (PP) as predictors, showed both analogy and PP to be highly predictive of spelling. Experiment 4 showed that children could use analogy to improve their spelling, even without intervention, by comparing their performance in spelling words presented in analogous categories or in random lists. Consideration of children's patterns of analogy use at different points of development showed three age groups to use similar patterns of analogy, but contrasting analogy patterns for spelling different words. This challenges stage-theories of analogy use in literacy. Overall the most salient units used in analogy were the rime and, to a slightly lesser degree, the onset-vowel and vowel. Finally, Experiment 5 showed analogy and phonology to be fairly equally influential in spelling, but analogy to be more influential than phonology in reading. Five separate experiments therefore found analogy to be highly influential in spelling. Experiment 5 also considered the role of memory and attention in literacy attainment. The important implications of this research are that analogy, rather than a purely phonics-based strategy, is instrumental in correct spelling in English.

Key words: analogy, phonology, spelling, literacy development, teaching intervention.

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1. CHAPTER 1: ISSUES IN SPELLING RESEARCH

1.1. INTRODUCTION

To date there has been a larger share of research dedicated to reading than to spelling, although the preponderance of spelling research has increased considerably in the last decade or so (Brown & Ellis, 1994). Possibly, one reason for spelling having received comparatively less attention in relation to reading in the past might be that, in a society where literacy is so highly valued, reading ability is essential, but spelling can more easily be aided with the help of technology (e.g. 'Spellmaster' and spell checkers). Additionally, spelling has only relatively recently been standardised. Prior to the publication of the first English dictionary in 1755, varying written representations were not just permissible, but commonplace. The difficulty with written language, however, is that spellings may be standardized, but pronunciations are still liable to change, whether due to dialectic variation or linguistic evolution. As Ellis (1984) has pointed out, words containing 'gh' such as '*light*', '*right*' or '*eight*' were once pronounced with a /ch/ sound, as in the Scottish word '*loch*', since they are linguistic cousins of the German words '*Licht*', '*Recht*' and '*acht*'. While their pronunciation has remained the same in German, however, it has changed in English: but their spellings have not. It is therefore not surprising, in an irregular orthography like English, that spelling can produce occasional problems for the majority of people, such as being in a "QUANDERY about the spelling of QUANDARY" (Bosman & Van Orden, 1997) and can cause rather greater difficulty for some. However, it is generally agreed that spelling is a more difficult skill to master than reading (Bosman & Van Orden, 1997), so spelling acquisition deserves at least equal consideration to reading, not only so that appropriate remediation can be found where spelling difficulties prevail, but also so as to inform spelling instruction in general.

Furthermore, Berninger *et al.* (1998) have pointed out that "precise representations of a word's spelling in memory can free up capacity-limited resources, during reading and writing, to process and construct meaning" (*ibid*, p.587), so spelling knowledge can indirectly aid both reading and composition fluency. Additionally, many now see spelling and reading as being closely inter-related (Cataldo & Eillis, 1988; Ehri, 1997, Frith, 1985), so an investigation of spelling should add to the general corpus of learning on literacy and its acquisition in children.

This introductory chapter considers some of the major issues in spelling research to date. The focus is on normative spelling and its development in children, although some consideration is also given to problems in spelling. Different models of spelling development are discussed, as well as the relationship between spelling and reading. The specific characteristics of English spelling are also considered and the ways in which learning to spell in English might differ from learning to spell in more regular orthographies. Finally, consideration is given to the implications of this research for the teaching of spelling in English.

1.2. THE SPELLING PROCESS

1.2.1. Levels of Representation in Spelling

Spellings are written representations of words, but they relate to spoken language at a number of levels. At the most basic level, spellings represent the individual sounds (or phonemes) in pronunciations through sequences of letters or letter combinations used to convey those sounds in writing (graphemes), such as the letters 'c', 'a' and 't' for '*cat*'. Spelling can therefore be defined, at the simplest level, as being "visible phonology" (Frith, 1980, p.2). At another level, morphemes (such as the '-ed' ending of verbs to indicate past tense, or the '-s'

ending to denote nominal plural) relate to the grammatical elements contained in words and add consistency to spelling, where the pronunciation is not always consistent (as in '*dropped*' pronounced '*droppt*', '*guided*' pronounced '*guidid*', and '*showed*' pronounced '*showd*'; or '*cats*' pronounced as '*cats*', '*dogs*' pronounced '*dogz*' and '*houses*' pronounced '*houziz*'). Knowing the derivation of a word like '*debt*' (from the Latin '*debitum*') or semantic links between words sharing the same derivation (e.g. '*sign*' - '*signal*' and '*heal*' - '*health*') also helps to select the correct spelling. Finally, another level of representation relates to meaning where the same pronunciation may have two or more spellings to denote different word meanings, as in the homophones '*to*', '*two*' and '*too*'; '*rite*', '*write*' and '*right*'; or '*rein*', '*reign*' and '*rain*'.

1.2.2. Different Strategies in Spelling

Traditionally spelling was considered to be largely a question of visually memorizing letter sequences by rote, supported by mnemonic strategies to aid this process, such as ""i' before 'e', except after 'c'". However, brief consideration of the different levels of representation outlined above makes it clear that an awareness of phonology must also be important in spelling, as must sensitivity to morphology and an understanding of word meanings and derivations. The definition of spelling offered above by Frith (1980) as 'visible phonology' also acknowledges the dual role of phonological and visual strategies in spelling. The bulk of research on children's early literacy has focused on phonological awareness and its importance in relation to reading and spelling development. Phonological awareness alone is of little use, however, unless combined with letter knowledge, so as to map individual phonemes (sounds) onto their corresponding graphemes (letters). Even then, over-reliance on phonology, without due consideration of morphology or semantic connections and distinctions, does not result in correct spelling in an irregular orthography like English. A

number of skills are required, skills which are integrated and reciprocal, but for the sake of simplicity will be discussed individually here.

1.2.2.1. Letter Names and Letter Knowledge

Reciting the names of the letters of the alphabet was traditionally a child's most common introduction to literacy instruction. Since children use whatever letter knowledge they have when they start to write, they sometimes apply a letter-name strategy to produce semi-phonetic, if unconventional spellings, such as 'GNYS' ('*genius*'), 'R' ('*are*'), 'KR' ('*car*'), 'U' ('*you*') and '*LEFT*' ('elephant') (Gentry, 1982). Interestingly, however, some types of letter-name spellings have been shown to occur more frequently than others. For example, Treiman (1993, 1994, cited in Treiman, 1998) has shown children to be sensitive to the phonological structure of words, whereby words are made up of an onset (initial consonant or vowel) and rime (remaining part of the syllable), and to honour this structure in the way they represent words in their spelling. Thus, for example, they are more likely to use a letter-name strategy to represent the 'R' in '*car*' (i.e. 'KR') or the 'L' in '*bell*' (i.e. 'BL') than they are to represent the 'B' in '*beat*' ('BT'), in which the letter name does not correspond to a cohesive (rime) unit, but rather to the onset and only part of the rime ('*bea-*').

However, letter-name use is not a reliable strategy since, although many letter names do at least contain the sounds which they convey (e.g. B, D, J, K, O, P, T, V and Z), many either start with another sound (e.g. F, L, M, N, S, U, X and Y), or do not represent their most common pronunciation in their name (the letter-names C and G being pronounced as in '*city*' not '*cake*' and as in '*giant*' not '*good*') and some do not even contain the sound they represent in their names at all (H, W). Most nursery and primary schools in the United Kingdom

therefore no longer use letter-names, but rather use the sounds that they make (phonemes) as the basis of literacy instruction.

Even then, letters are still problematic for young children. Firstly, children do not learn all letter sounds with equal ease. Strong consonant sounds, such as plosives (/p/, /t/, /b/) are learnt more easily than nasals (/n/, /m/), with vowels the last to be learned (Stuart & Coltheart, 1988). Second, there are many more sounds in spoken English than there are letters in the alphabet. As Gough, Juel and Griffith (1992) have noted this means that "either a letter must represent more than one phoneme, or some phonemes must be represented by more than one letter" (*ibid*, p.39). Furthermore, the majority of letter-sound relations are context-dependent (as in '*city*' and '*giant*' above), all of which makes the mapping of sound-letter relations a complicated process for young children.

1.2.2.2. Phonological Awareness

'Phonological awareness' is a blanket term used to refer to an awareness of the sounds in words, rather than the letters that represent them. Thus, while the spoken word '*cat*' may contain three sounds (/c/-/a/-/t/) which correspond neatly with the three letters in its written form, the written forms of many other words in English do not map so neatly onto their spoken forms (e.g. '*church*', '*folk*', '*write*', '*phone*', '*touch*' etc.). Tasks designed to measure phonological or phonemic awareness vary considerably (Yopp, 1988). Typically, however, phonemic awareness tasks require either identification of the component sounds in a word (as in '/c/-/a/-/t/'), or deletion of a phoneme (as in deleting the first sound in '*cat*' to get '*at*') or addition of a phoneme (as in adding /s/ to the beginning of '*cat*' to get '*scat*'). However, these kinds of phonemic manipulation are generally quite problematic not just for pre-literate

children (Bruce, 1964 cited in Goswami & Bryant, 1990; Liberman, Shankweiler, Fischer & Carter, 1974) but for illiterate adults as well (Morais, Cary, Alegria & Bertelson, 1979).

As Goswami and Bryant (1990) have pointed out, however, there is more than one way of analysing a word into its component sounds. Dividing a word into individual phonemes, as in '/c/-/a/-/t/', is one way, but there are at least two others. Possibly the simplest is to divide words into syllables, generally something which young children have little difficulty with (Liberman *et al.*, 1974). Another 'intermediate' way is to divide words into the intra-syllabic units of the onset (initial consonant, consonant cluster or vowel) and rime (the remaining part of the syllable), as in '*c* – *at*' or '*str* – *ing*'. Goswami and Bryant (1990) have suggested that this form of phonological analysis poses less of a problem for pre-literate children than parsing into individual phonemes, since children have less difficulty deleting the entire onset ('*str* – *ing*') than deleting individual phonemes ('*st*(*r*) – *ing*' or '*s*(*tr*) – *ing*'). Treiman (1985) has also shown that children perform better in phoneme deletion tasks that preserve the onset or rime, than in those that do not (see also 1.2.2.1). Furthermore, Bradley and Bryant (1983) have shown that children's early rhyme (or rime) awareness "has a powerful influence on their eventual success in learning to read and to spell" (*ibid*, p.421; see also Bryant, MacLean, Bradley & Crossland, 1990).

Cataldo and Ellis (1988) investigated the different levels of phonological awareness. They suggested that children are initially implicitly aware of the "overall sound properties of words" (*ibid*, p.90), as demonstrated by their sensitivity to rhyme (and rime), whereas explicit ability to manipulate sounds in words (such as phoneme addition and deletion) develops later, partly as a result of experience in learning to read and spell (Ehri & Wilce, 1980; Morais *et al.*, 1979). Yopp (1988) has confirmed that pre-school children find rhyming tasks relatively

easy to perform, but phoneme deletion tasks the most difficult (see also Stanovich, Cunningham & Cramer, 1984). According to Cataldo and Ellis (1988) implicit phonological awareness, reading and spelling initially influence each other reciprocally, but explicit phonological awareness also contributes to spelling from the beginning, while explicit phonemic understanding comes to reading via experience with spelling.

It appears, then, that the relationship between literacy acquisition and phonological awareness is in part reciprocal (Goswami & Bryant, 1990; Hecht & Close, 2002; Schneider, Kuespert, Roth & Vise, 1997; Wagner, Torgesen & Rashotte, 1994), and in part causal (Bradley & Bryant, 1983; Bryant *et al.*, 1990; Hecht & Close, 2002; Lundberg, Frost & Petersen, 1988; Shneider *et al.*, 1997). Perhaps a resolution to the cause-consequence question might be to suggest that, while improved phonological awareness undoubtedly leads to improved literacy skills, spelling or reading experience alone does not necessarily lead to improvement in phonological awareness until literacy skill has reached a certain level, at which point spelling experience, more than reading experience also predicts phonological awareness (Hecht & Close, 2002).

Phonological awareness is not synonymous with using individual phoneme-grapheme or grapheme-phoneme correspondences, which do not always result reliably in accurate spelling and reading in an irregular orthography like English. There is a 'middle ground' between a 'letter-by-letter or phoneme-by-phoneme' approach and a whole word approach (Kessler & Treiman, 2001). This "middle ground is that readers and spellers use correspondences between spellings and phonemes that are conditioned by context" (*ibid*, p.592). The suggestion is therefore that an awareness of sound at a multi-phonemic level and sensitivity to phonemic context (i.e. how one phoneme relates to another in the context of the word as a

whole) add consistency to both reading and spelling (Kessler & Treiman, 2001; Treiman, Mullennix, Bijeljac-Babic & Richmond-Welty, 1995). Kessler and Treiman, for example, make the observation that "vowels are by far the most inconsistent syllable part in both directions, and the part that gains most from considering other parts of the syllable", and that "items tend to be helped more by the syllable part to their right than by the syllable part to their left", with codas (word endings) improving vowel spelling approximately "twice as much as the opposite" (*ibid*, p.611). This therefore suggests a special role for rimes (which correspond to the medial vowel and the coda) in adding consistency to English spelling.

1.2.2.3. Analogy Use in Spelling

Ehri (1997) claims that there are at least three ways to process words: by memory (for known spellings); by invention (segmenting the individual sounds in a word and assembling the corresponding graphemes to produce its spelling); or by analogy with a known word or known spelling pattern. Thus, she suggests, while known spellings are processed by memory, unfamiliar words can either be assembled by applying phoneme-grapheme correspondences or worked out by accessing a familiar word with an analogous pronunciation in lexical memory and generating the remaining parts of the word.

A considerable body of research on literacy acquisition has focused in recent years on children's use of analogy (Bernstein & Treiman, 2001; Bowey, Vaughan & Hansen, 1998; Bruck & Treiman, 1992; Goswami, 1986, 1988, 1991, 1993; Goswami & Mead, 1992; Muter, Snowling & Taylor, 1994; Savage & Stuart, 1998, Exp.2, but see also Nation & Hulme, 1996; Nation, Allen & Hulme, 2001). Some have also suggested that children make special use of rimes in their use of analogy ('*beak-peak*'), both in reading (Goswami, 1986) and in spelling (Goswami, 1988), as opposed to beginning unit combinations ('*beak-bean*') or individual

letters ('*beak-lake*'), whereas others (Nation & Hulme, 1996) have refuted any such rime advantage in spelling and have demonstrated that children of varying spelling abilities are able to use analogy with medial phonemes ('*corn-lord*') to the same degree as with the rime ('*corn-born*') or onset-vowel ('*corn-cord*'). Bernstein and Treiman (2001) found children to be sensitive to positional cues in spelling novel graphemes ('*ii*' for /aɪ/) in nonsense words, both in the context of the rime (/gaɪk-vaɪk/) and in the context of the initial consonant plus vowel (/gaɪk-gaɪt/). Whether the evidence points to a rime advantage or not, Kessler and Treiman (2001) suggest that such an advantage should be seen within a framework which operates at the phonemic level, "but can take into account the context in which each phoneme is found" (*ibid*, p.611), i.e. the intra-syllabic context. The advantage of an analogy strategy is therefore that it is not limited to phoneme-grapheme or grapheme-phoneme correspondence rules, which are often unreliable in an irregular orthography, but takes into account how phonemic units operate within the context of the word as a whole.

1.2.2.4. Visual or Lexical Strategies

Related to the context within which phonemes connect with each other is the context within which letters relate to each other and what makes up a 'permissible' letter combination or letter string in a given orthography. As has already been pointed out in the above section, contextual or positional information of this kind is highly relevant in terms of providing information about how to pronounce or spell individual letters or phonemes, such as the initial hard /g/ and final soft /j/ sound in '*garage*' or the different pronunciation of the letter 'c' in '*ace*' and '*cake*' for example. In these instances, the pronunciation of 'g' and 'c' must be considered in the context of the following vowel, rather than in isolation. An understanding of this kind of information and the permissibility and, indeed, probability of specific letter combinations occurring in a given orthography is highly salient in arriving at the correct

pronunciation or spelling. In some cases this kind of knowledge is informed by complex spelling rules and conventions (as in 'c' + 'e' = /s/), akin to the phonological-constrained measure used by Lennox and Siegel (1996) in their comparison of phonological and visual strategies used by average and poor spellers. On other occasions, however, knowledge of what is permissible or non-permissible (such as double consonants at the beginnings of words) or recognition of very infrequently occurring letter combinations (such as the doubling of 'a' in '*aardvark*' or of 'u' in '*vaccuum*') is more likely to be visually processed.

Aaron, Wilczynski and Keetay (1998) refer to the recognition of these latter kinds of frequently occurring intra-word patterns as 'stochastic' memory. 'Stochastic' memory is conceived of as a kind of rule-based but non-phonological process, whereby a set of conventions is abstracted about predictable and frequently occurring letter patterns. Though visually processed, this is not entirely synonymous with 'visual' memory, however, as was demonstrated by Aaron *et al.* (1998) in a comparison of the spelling processes of deaf and reading-age-matched hearing children. Although the deaf children were considerably more accurate than the hearing children at spelling homophones when phonological processing was not obligatory (e.g. spelling homophones in context: '*the sky is <u>blue</u>*' and '*the wind <u>blew</u>*'), they performed very poorly in comparison to the hearing controls in a second homophone spelling task which required the use of phonological information (i.e. producing word pairs which sound the same but are differently spelled: '*hear-here*'; '*right-write*'). However, in a third spelling task, both groups of participants reproduced many more visually presented pronounceable pseudo-words ('*doof*', '*doal*', '*kram*') than non-pronounceable pseudo-words ('*dfoo*', '*dloa*', '*rmka*'). Since the deaf participants had been shown to be better spellers of homophones than the hearing controls in the first task, but had failed in the phonologically encoded homophone-production task, they might have been deemed to be relying on visual

processes in their spelling. However superior rote visual memory should have resulted in the deaf children recalling equal proportions of pronounceable and non-pronounceable pseudo-words. The fact that they did not do so is offered as evidence by Aaron *et al.* that the deaf group must have been using stochastic memory as a major strategy in recalling the pronounceable non-words. Their interpretation is supported by the qualitative difference in spelling errors between the hearing and non-hearing groups, the former making predominately phonological errors, while the latter's mistakes were largely non-phonological in nature.

Both naturalistic and experimental studies have shown that children are aware of these kinds of orthographic constraint when they learn to spell. For example, Treiman and her colleagues showed that even kindergarten and first grade children are more likely to choose conforming than non-conforming items as 'permissible', even when both are pronounceable using grapheme-phoneme correspondence (e.g. '*nuck*' and '*ckun*'– Treiman & Cassar, 1997; Treiman, 1993) and that they are more likely to use double consonants (e.g. 'll' or 'ss') or consonant combinations (such as 'ck') in the middle or at the ends of words (e.g. '*pess*'), than at the beginning (e.g. '*ppes*' – Cassar & Treiman, 1997; also Treiman, 1993; Treiman & Cassar, 1997), while first-graders are also more likely to choose allowable doublets (e.g. '*jull*') more frequently than non-conforming doublets (e.g. '*jukk*' – Cassar & Treiman, 1997).

Goulandris (1994) refers to a similar finding in a study undertaken to investigate the effect of high- or low-contingency spelling patterns on the spelling performance of 8- and 10-year-old children, in which low-contingency or irregular patterns (e.g. '*fruit*') were less likely to be adopted in spelling non-words than more predictable ones (e.g. '*shoot*'). Thus, there is evidence that this kind of probability information is essential for normal spelling development, at least in English (but see also Alegria & Mousty, 1996 in relation to French).

Indeed Snowling (1994) refers to a single case study (Goulandris & Snowling, 1991) of a young woman, who possessed normal phonological skills but whose visual memory was seriously impaired. Her spelling was phonologically recognisable, but showed a lack of awareness of high-probability spelling patterns (e.g. '*censitive*' for '*sensitive*'; '*mayjour*' for '*major*'), although her reading was adequate.

It is therefore evident that, although phonological awareness is important in the acquisition of literacy, visual and lexical strategies are also essential, particularly in an irregular orthography. Indeed Hanley and McDonnell (1997) have provided evidence from a single case study of an adult patient with preserved reading comprehension and written spelling, but severely impaired speech production and phonological ability, that accurate reading and spelling can be achieved in the complete absence of phonological mediation. Thus, when their patient (PS) was given a series of definitions to read (e.g. '*to measure how heavy an object is*') and then asked to write down the spelling, not of the word that matched the definition ('*weigh*'), but of a phonologically indistinguishable homophone ('*way*'), he was markedly poorer at this task, which required phonological in-put, than when he was either asked to spell the word associated with the original definition ('*weigh*') or required to spell '*way*' in an ordinary spelling task. However, others (e.g. Ehri, 1992; also Gough, Juel & Griffith, 1992) take the view that accurate sight word reading cannot develop initially without letter-sound knowledge, since accurate sight word reading is, according to Ehri (1992), dependent on visual-phonological connections between the written word and its pronunciation.

1.2.2.5. Morphological Strategies in Spelling

Although research has been relatively deficient in the area of written morphology, compared with, for example, phonological awareness, morphology nevertheless plays an important role

in spelling, not only in English, in which an understanding of morphology can add consistency to an orthography famous for its inconsistency, but also in other languages. Nunes, Bryant and Bindman (1997) demonstrated the limitations of a purely phonological strategy in spelling, as illustrated by children's phonetic spellings of the 'ed' past tense suffix (e.g. '*kist*' for '*kissed*' or '*dresst*' for '*dressed*'), and suggested that these spellings demonstrate a definite stage at which children begin to incorporate morphological relations. However, the transition from one stage to the next is gradual, with children typically progressing via an intermediate stage, during which they demonstrate a rudimentary awareness of the 'ed' suffix but tend to generalize this to irregular as well as regular past tense verbs (e.g. '*sleped*' for '*slept*') and, on occasion, to over-generalize the 'ed' ending to non-verbs as well (e.g. '*sofed*' for '*soft*').

However, Treiman and colleagues (Treiman & Cassar, 1996, 1997) have challenged the view that morphological strategies appear comparatively late in development and shown that even children in first grade are sensitive to morphology in their spelling. In analysing two-morpheme words like '*bars*' or '*tuned*', even young children are more likely to include the final consonant ('r' or 'n') of the stem ('*bar-s*', '*tune-d*'), whereas in spelling one-morpheme words like '*Mars*' and '*brand*' they show the opposite trend, more often omitting the first consonant in a final consonant cluster, while transcribing the second. Similarly, Treiman, Cassar and Zukowski (1994) also showed that first- and second-grade American children demonstrate morphological awareness in their spelling of words with flaps, such as in the middle consonant of '*dirty*' or '*city*', which are often pronounced as /d/ in American English. Thus children are more likely to preserve the correct 't' spelling of the stem ('*dirt*') in a two-morpheme word ('*dirty*'), than in one-morpheme words ('*city*').

1.2.3. Theoretical Accounts of the Spelling Process

The above discussion about the processes involved in producing accurate spelling makes it clear that a number of different strategies may be called upon in spelling. However, two broad routes have been identified as essential in any theoretical account of spelling in English: a lexical route, whereby known spellings are retrieved directly from memory; and a phonological route, whereby spellings for unfamiliar words can be assembled using phoneme-grapheme correspondence. This framework, essentially, constitutes the backbone to the dual-process model of spelling (see Barry, 1994 for a full explanation of the model). Support for this model comes from cognitive neuropsychology, in which a number of case studies point to a dissociation between phonological and lexical processes in patients who either show selective impairment in phonological awareness while maintaining in-tact memory for known spellings or who, conversely, retain an ability to spell regular words but whose spelling is otherwise incorrect, although phonologically plausible. These dissociations suggest that both the lexical and phonological routes must be involved in the production of correct spelling in an irregular orthography like English. On the other hand, Hanley and McDonnell (1997) have been cited above as providing evidence that accurate spelling can remain intact, despite severe impairment of phonological ability. This indicates that, although phonic mediation may take place in normal spelling, it is not necessarily a pre-requisite of accurate spelling, since, as the Hanley and McDonnell case study demonstrates, accurate spellings can be retrieved via direct lexical access, rather than via phonological mediation.

An alternative to the dual-process model is that of a single network capable of processing both sound-letter and word-specific associations, such as that proposed in computational or connectionist models (see Brown & Loosemore, 1994 for a review). In computational models, learning to spell is envisaged as a process of associating pronunciations directly with their

orthographic representations, resulting in spelling behaviours or breakdowns very similar to those observed in real life, such as the kinds of deficits and dissociations described above. Furthermore, words which might be considered regular and which have many orthographic 'neighbours', (e.g. '*kill*'- '*hill*', '*will*', '*till*', etc.) and no, or very few, orthographic 'enemies' ('*kill*' - '*nil*') are learned more quickly in the model than words which might be considered inconsistent or ambiguous and which have no orthographic 'neighbours' and many 'enemies' (e.g. '*soap*' – '*hope*', '*rope*', etc). The implication of this is that there may be a sub-lexical level in spelling, intermediate between whole-word and phonemic levels, which is dependent on the rime (see also Kessler & Treiman, 2001; Treiman, 1992; Treiman *et al.*, 1995).

Ehri (1992) builds on the single network model in presenting a theoretical account, in which visual and phonological strategies are amalgamated from early on in literacy development. Her model requires neither the sequential phonological recoding nor the rote visual learning that is associated with the traditional dual-route view, but rather incorporates a phonological element directly with visual-semantic access, such that "a visual route is paved with phonological information" (*ibid*, p.114). Thus, in Ehri's model, a single 'visual-phonological route' involves forming connections (or 'amalgamations') between the visual cues seen in a word and its pronunciation in memory, such that, once such a route is set up, a spelling and its pronunciation can be retrieved directly from memory, without needing to resort to translation rules. (Note that this is very similar to Rack *et al.*'s (1994) 'direct-mapping' mechanism.) Indeed, in Ehri's model, orthographic representations are "amalgamated not just with phonological identities but also with syntactic and semantic identities" (Ehri, 1980, p.314). Thus, in the case of homophones ('*pear-pair*'), orthographic images which have been amalgamated to word meanings enable readers and writers to distinguish which spelling goes with which meaning and, in the case of homonyms ('*tear-tear*'), orthographic-semantic

amalgamations allow retrieval of the correct pronunciation. An advantage of this 'visual-phonological amalgamation' model is that it offers an explanation for the oft-quoted phenomenon of skilled spellers' ability to judge which of two or more phonologically plausible spellings simply 'looks' right, as well as why both skilled and less skilled readers with enough literary experience read familiar words more quickly than nonsense words (Ehri & Wilce, 1983, cited in Ehri, 1992).

1.3. SPELLING DEVELOPMENT

1.3.1. Children's Invented Spellings

As Gentry (1982) said, "developmental spelling levels may be determined only by observing spelling miscues, not by observation of words spelled correctly" (*ibid*, p.197). Thus children's misspellings are the "windows into the mind.... that allow the observer to determine the speller's level of development." It therefore seems appropriate to start a discussion of spelling development with a consideration of what such misspellings have taught us.

It is evident from naturalistic studies such as those of Read (1975, 1986) and Treiman (1993, 1998) that children's early attempts at spelling, though unconventional, nevertheless respect the phonological structure of written language, and that children use whatever material is available to them (such as knowledge of letter-names) to convey the sounds of words they are attempting to spell in writing. Both Read and Treiman cite examples of children's invented spellings which illustrate how children's initial errors are a consequence of how they have analysed the word to be spelled, such as 'BL' for '*bell*' where the child has analysed the word into the onset and rime ('b', followed by the letter name 'L') rather than into three separate phonemes ('/b/-/e/-/l/'), or 'JUMPT' for '*jumped*' where the child has analysed the word into

phonemes, but has failed to apply morphological analysis of the '-ed' ending signifying past tense. Other examples of children's spelling might illustrate not so much difficulty with analysing a word into phonemes, but rather difficulty in remembering the order of those phonemes when assigning letters to represent them, as in 'MLIK' for '*milk*' (Treiman, 1993, p.249).

It has also been shown that not all phonemes are alike in terms of how they are perceived by children (Read, 1975, 1986; Treiman, 1993; Treiman, Berch, Tincoff & Wetherston, 1993). For example, vowels often pose more categorization problems for children than consonants, with 'a' and 'e' commonly being confused (e.g. 'PAN' for '*pen*'), but not all consonants are alike either. For example, pre-consonantal nasals ('n', 'm', 'ng') and liquids ('l' and 'r') may be perceived as part of the vowel and consequently omitted (e.g. 'TET' for '*tent*', 'HAP' for '*help*' or 'OWD' for '*old*'). Evidence for this suggestion comes from Read's 'pointer' experiment (Read, 1975, 1986), in which he asked children to reproduce, side by side on two easels, two words that differed only with respect to a pre-consonantal nasal (e.g. '*bet*' – '*bent*'). Read found, that of the children who consistently failed to represent the nasal in their spellings of these words, the great majority attributed the difference between the two words to the vowel (placing the pointer over or on the vowel to indicate that this was where the difference lay), rather than to the following consonant. This implies that pre-consonantal nasals have a different phonological status within words ending in a cluster, compared with other word-final clusters. On the other hand, Snowling (1994) has suggested that difficulty with consonant clusters (including pre-consonantal nasals) may be due to the information-processing demands of the spelling task, rather than to the phonological properties of nasals. However, Read (1986) has pointed out that there are differences in the degree to which pre-consonantal nasals are represented (or omitted) in different languages, (such omissions being

less commonplace in French, compared with English and Dutch, for example) which suggests that these discrepancies must at least in part be due to language-specific differences, rather than solely due to the information-processing limitations of the beginner-speller.

Read's research (1975, 1986) also suggests that children's perceptions of certain sound combinations may differ from those of adults. For example, when asked to judge whether the initial sounds of '*truck*' and '*chicken*' or '*truck*' and '*turtle*' were similar or not, many children judged there to be a relationship between the former two words (i.e. 'tr' – 'ch') but not between the latter two ('tr' – 't'). It appears, therefore, that these children perceived the onset 'tr' in '*truck*' as one unit, which was similar in sound to 'ch'. However, a greater proportion of the older children in Read's study identified the first sound of '*truck*' with 't', so this again suggests a reciprocal relationship between phonological awareness and literacy. With print exposure, children become more aware of standard spelling and therefore alter their perception of the phonological make-up of words. Thus, insights gained from one domain affect their thinking in the other. This was also illustrated by Ehri and Wilce's (1980) demonstration of the influence of orthography on readers' conceptualisations of the phonemic structure of words (e.g. detecting the 't' in '*catch*' as a separate sound, while no separate 't' sound was detected in '*much*'). Stuart and Coltheart (1988) made much the same observation in terms of the inter-relatedness of phonological and orthographic analyses, when they noted that "Primitive phonological parsing into quasi-CVC [consonant-vowel-consonant] strings is refined by experience of orthography into a parse that allows multi-consonant groupings" (*ibid*, p.176), such that a child parsing a word like '*plum*' might initially perceive it as onset ('*p-*') and rime ('*-um*'), thus transcribing it as 'PUM', but after experiencing the "plosive + liquid" unit in print, the child might then infer that the onset 'pl-' is represented in spelling as two constituent parts.

Interestingly, however, Read (1986) notes that knowing how to read a word, does not necessarily immediately alter a child's perception of that word, since children who could correctly read '*truck*' and '*chair*' or '*dragon*' and '*jacks*' still believed these word pairs to begin with the same sound. Clearly these children had discovered that the same sound does not always correspond to the same spelling in English. Thus it is not so surprising that they judged different graphemes to correspond to the same sound, since two graphemes can sound the same (as in '*aisle* - *eye*' or in '*rain* - *grey*'), just as one grapheme may also have different pronunciations (as in '*eye* - *grey*' or '*aisle* - *rain*').

1.3.2. The Early Relationship of Spelling and Reading

Although children's spelling and reading may be considered to be "different and separate" at first by some (Goswami & Bryant, 1990, p.148), it is generally agreed that reading and spelling become increasingly inter-related with development. It is therefore difficult to consider a discussion of spelling acquisition, without also including some consideration of its development in relation to reading. Indeed, some researchers propose that reading and spelling are essentially the same (Ehri, 1997), although "pronouncing spellings [is] easier than writing spellings" (*ibid*, p.244). Ehri provides support for the claim that reading and spelling are closely related in an experiment (Ehri & Wilce, 1979, cited in Ehri, 1987, 1980), which tested the mnemonic strategies of 6- and 7-year-olds in a paired associate learning task. Children learned to recall nonsense words fastest when these had initially been accompanied by 'correct' corresponding spellings, whereas viewing misspellings made it especially hard to recall the nonsense words. Further support for the close relationship of reading and spelling comes from Ehri and Wilce (1987), in which they showed that reading and spelling rely on similar processes and that training beginners to spell improves their reading skill better than

training to match letters to isolated sounds. Similarly, Ehri and Robbins (1992) have shown that "reading and spelling are not executed independently. Rather information encountered in reading words is remembered and incorporated into spelling productions" (*ibid*, p.21).

However, other researchers (e.g. Goswami & Bryant, 1990) have noted that the "contrast between children's reading and spelling seems extremely sharp" (*ibid*, p.61). Bryant and Bradley (1980) also suggested that children start to read and spell in quite different ways and that, while reading depends heavily on visual chunks (e.g. '*-ight*' or '-ing') or even recognition of entire un-segmented words (e.g. recognising '*something*', but not '*some*' or '*thing*') their spelling, conversely, relies on segmenting words phoneme by phoneme as they transcribe them. Bryant and Bradley also showed that children sometimes spell words, which they cannot read (and vice versa). However, Gough, Juel and Griffith (1992) have challenged Bryant and Bradley's view that this denotes a discrepancy between reading and spelling, since, although children may on occasion show inconsistency between their spelling and reading, they also show inconsistency between what they can spell (or read) on one occasion but fail to spell (or read) on another. Thus, Gough *et al.* conclude that children read and spell in the same way, but do so inconsistently.

Most researchers do agree, however, that reading and spelling ability are highly correlated (see correlations from several studies cited in Ehri, 1997, p.257) and that, although there can be marked dissociation between reading and spelling skill (Frith, 1980; Frith & Frith, 1980), such dissociation is comparatively rare, accounting for approximately two per cent of the population (Frith, 1980, p.497). Nevertheless, the existence, albeit rare, of such 'unexpectedly poor' spellers who are nonetheless good readers must show that reading and spelling are not

entirely dependent on the same processes. While attendance only to first and last letters can allow accurate reading, such partial information cannot foster accurate spelling.

1.3.3. Stages of Literacy Development

1.3.3.1. Frith's Stage Model

Frith's (1985) model is one of the most influential and comprehensive theoretical accounts of reading and spelling development. Her model concedes the first stage in literacy development to logographic reading, in which the child recognizes and names a finite number of whole-word images in the environment, such as a McDonald's sign or other familiar labels, including his or her own name. This initial stage in reading then feeds into spelling, but the need to write urges the child towards sound-letter transcription, which denotes the start of a qualitatively different developmental stage, namely the alphabetic stage. Thus according to Frith, once a child has learned to break words up into phonemes in spelling, an alphabetic strategy becomes available to them and this strategy can then be applied to reading. (Note that Cataldo & Ellis, 1988, also found that phonological analysis transferred from spelling to reading). As the child then becomes more proficient at reading and less dependent on sound, progression into the third stage (the orthographic stage) becomes possible. This stage is reached first in reading, which in turn feeds back into spelling.

Difficulties in either spelling or reading in this model are conceived of as an inability to pass beyond one particular stage to the next. Thus children who are what Frith terms 'unexpectedly' poor spellers, but good readers (Group B spellers in Frith, 1980) are defined, according to this model, as having progressed to the orthographic stage in reading, but not beyond the alphabetic stage in spelling, whereas 'conventional' poor spellers (Group C in

Frith, 1980) have difficulty progressing beyond the alphabetic stage in both spelling and reading. Frith's model is therefore useful in providing a theoretical framework which embraces both reading and spelling and encapsulates the way in which development in one might lead to development in the other, as well as how failure to do so might result in problems in either domain, while at the same time providing an account of the asynchronous yet inter-related development of spelling and reading.

1.3.3.2. Ehri's Developmental Model

Ehri's (1987, also 1992, 1997) account of literacy development is similar to Frith's in some respects, although in her model the focus is less on discrete stages and more on integration between phonological and orthographic skills. Ehri's view of literacy acquisition also differs from Frith's, in that in her model reading and spelling are essentially founded on the same processes (1997). Ehri does, however, like Frith (1985), allocate 'logographic reading' to a pre-alphabetic stage, in which environmental cues, such as a McDonald's sign or Pepsi logo, are visually recognised. However, unlike Frith, Ehri does not equate this logographic stage with the beginning of reading, but suggests that this occurs during an intermediate stage of literacy development, which she denotes the 'partial phonetic' or 'semi-phonetic' level. Ehri and her colleagues (Masonheimer, Drum & Ehri, 1984, cited in Ehri, 1987) have provided evidence that 'logographic readers' do not actually pick up graphic information in their recognition of environmental cues. In a neat demonstration of the lack of evidence for 'logographic' reading, Masonheimer *et al.* showed that the majority of expert 'readers' of environmental cues and labels had difficulty identifying the same labels if the accompanying contextual cues were removed and also failed to notice any changes to the print (e.g. 'XEPSI' in place of 'PEPSI'), since they had not yet developed the prerequisite decoding skills. Thus, Ehri claims, there is little support for the notion that children gradually pick up graphic cues,

once they have accumulated enough experience with environmental print. Indeed, rather than learning to recognise words after repeated exposure, young children often identify a word by other means, such as recognising it (or any another arbitrary word) by an accompanying thumbprint, for example (Gough *et al.*, 1992).

It is during the 'partial alphabetic' or 'semi-phonetic' level of development, according to Ehri (1987, 1992, 1997), that novice readers and spellers begin to use partial phonetic cues, such as attending to first and last letters (e.g. writing 'BVR' for '*beaver*'). Ehri and Wilce (1985) showed that both 'novice' and 'veteran' beginner-readers are more able to learn partially phonetic spellings (such as 'JRF' for '*giraffe*') than visually distinctive but phonetically arbitrary spellings (such as 'WBC' for '*giraffe*'), whereas non-readers showed the opposite trend. This finding is offered as support for an initial semi-phonetic stage in literacy attainment, which precedes the full alphabetic level of literacy attainment (see also Rack *et al.*, 1994).

In order to operate at the full alphabetic level, children must unlock what Ehri (1992, 1997) and Gough *et al.* (1992) call the 'cipher'. Ehri (1987) cites an experiment, which attempted to teach one group of kindergartners to become cue readers and another group to become cipher readers, so as to observe differences in the reading and spelling skills of the two groups. The two groups were initially selected on the basis of knowing letter-sound relations and being able to read some words, but not being able to decipher nonsense words. The cipher group were taught to decode CVC (consonant-vowel-consonant) or CCVC (consonant cluster-vowel-consonant) nonsense words during their training, whereas the cue group rehearsed isolated letter-sound relations. In a series of post-training tests, cipher readers not only out-performed cue readers in their overall decoding skill, but also in their spelling and were more

successful in using a higher proportion of correct letters (both vowels and consonants, including consonant clusters) than the cue readers, indicating that the former were using more sound-letter cues and that their training in decoding consonant clusters had also taught them how to spell those sounds. Only with respect to a tendency to omit pre-consonantal nasals in their spelling (such as the 'm' in '*lamp*' or the 'n' in '*bond*') and in their performance in spelling initial and final letters did cipher readers not differ greatly from cue readers. Cue readers, on the other hand, were able to attend to partial cues in their spelling, producing many of the boundary letters correctly, but this also lead them to confuse similarly spelled words (such as '*lap*' and '*lamp*' or '*stab*' and '*stamp*') in their reading. Additionally cue readers differed from cipher readers in making semantic substitution errors in their reading (such as misreading '*lamp*' as '*light*' or '*lantern*'), a trend not shown by any of the cipher readers. (See also Stuart & Coltheart, 1988, for a similar analysis of errors). Ehri suggests that these findings show cue readers and cipher readers to differ in the way in which they learn to read and spell words out of context. She also suggests that poor readers are in effect cue readers, since they have weak decoding skills but are able to read many words by attending to partial phonetic cues. By the same token, weak deciphering skills may make it harder for these children to store accurate orthographic images in memory, which may lead in turn to poor spelling, even if attendance to partial cues and context allows them to read reasonably well (Group B spellers in Frith, 1980). In Ehri's model, therefore, problems in reading and spelling are seen chiefly in terms of lack of integration between phonological and orthographic processes.

The last level of literacy acquisition in Ehri's model, the consolidated alphabetic level (Ehri, 1997), is defined as the stage at which children learn about the structure of larger units in words consisting of letter sequences that recur across several words (*ibid*, p.255). This enables

readers and spellers to operate with chunks of recurring letters (e.g. '*-able*', '*-tion*'), so making it easier to decode multi-syllable words quickly and to retain specific spellings accurately in memory. At this stage they will also know and be able to use consolidated units such as rimes (e.g. '*–est*', or '*–ound*' endings) to read and spell new words by analogy with known words containing the same spelling patterns. Ehri appears, therefore, to be in agreement with Marsh and colleagues (Marsh, Friedman, Welch & Desberg, 1980) that an analogy strategy does not come into play until the later stages of reading and spelling acquisition.

This suggestion contrasts with Goswami's (1986) view that "even children who are not yet reading are capable of making analogies between the ends of words" (*ibid*, p.80), such as using the rime in '*beak*' to read '*peak*' (see section 1.2.2.3 above). However, in view of Ehri's (1987) finding that cue readers (i.e. those readers who have not yet unlocked the cipher) use only partial phonetic cues to read, Ehri and Robbins (1992) tested Goswami's findings in relation to analogy use in both pre-readers (non-decoders) and children who were able to decode simple CVC non-words. Their findings partly supported those of Goswami (1986) in that the decoders, who had been trained to read a number of phonetic spellings, could transfer their knowledge of the training words to read test words which shared the same rimes, whereas children with equivalent decoding skills but trained to read control words which shared only the same medial vowel sound as the test words, were not so successful in reading the test words. However, for the non-decoders, Ehri and Robbins found no difference in performance on the analogy and control words and therefore concluded that beginner-readers need adequate decoding skills in order to use analogy with known words to read new words. Furthermore, in a subsequent spelling recall task, there was very little difference in performance, even with decoders, between those trained in the analogy condition and their

counterparts trained in the control condition, although the results still favoured the former. However, although these findings do not support Goswami's suggestion that even non-readers can use analogy, they nevertheless challenge Marsh *et al.*'s (1980) view that children do not use analogy in reading or spelling until the age of ten (equivalent to fifth grade). Both Goswami (1986, 1988) and Ehri and Robbins (1992) found that kindergarten and first-grade children were able to use analogy, although the latter found evidence of analogy only in those classed as decoders.

1.3.3.3. Goswami's Interactive Analogy Model

While Frith's (1985) model of literacy development is clearly a stage model, which envisages qualitative changes in reading and spelling strategy at different points of development, Goswami's (1993) interactive analogy model focuses (like Ehri, 1992) primarily on the integration of phonological and orthographic skills. While Goswami's model is concerned mainly with reading development, it is nevertheless relevant to a discussion of spelling acquisition. Goswami bases her model on the assumption that children's knowledge of spoken language, and of the status of sub-syllabic units in spoken language, underpins their phonological awareness and that children bring this awareness to bear both on their reading (Goswami, 1986) and on their spelling (Goswami, 1988).

Goswami (1993) makes two main points with regard to the question of whether literacy acquisition develops in stages or not. The first relates to her phonological status hypothesis (Goswami, 1991), which is that "children's ability to learn about letter sequences.... should be enhanced when shared spelling units in words reflect the linguistic structure of the syllable" (*ibid*, p.1116), namely the linguistic units of onset and rime (see also Goswami & Bryant, 1990). If, as Goswami claims, the orthographic units of onset and rime are especially

salient in relation to the way children learn about letter sequences in English, "then the use of single grapheme-phoneme correspondences may follow rather than precede the use of orthographic units" in literacy development (Goswami, 1993, p.446; see also Goswami, 1986, 1988). This suggestion clearly has far-reaching implications in relation to stage theories, which propose that orthographic strategies in reading and spelling follow on from a preceding alphabetic or phoneme-based stage (Ehri, 1987; Frith, 1985; Marsh *et al.*, 1980). The second point relates not to the order in which different strategies develop, but to the suggestion that the relationship between phonological and orthographic knowledge is much more interactive than stage models would suggest, thus casting doubt on whether there is in fact any need to conceive of literacy development as a series of stages.

Treiman, Goswami and Bruck (1990) have provided some support for both these suggestions by showing that even first graders, whose knowledge of grapheme-phoneme correspondence was fairly good but not yet at ceiling (mean proportion correct, .78 – *ibid*, p.561), as well as third-grade children with both good and poor reading skills and adults, were all able to pronounce high-contingency non-words (i.e. those with more rime neighbours or 'friends' than 'enemies') significantly more accurately than low-contingency non-words (i.e. those with more 'enemies' than 'friends'), even though both sets of non-words were classifiable as 'regular' and could have been equally well pronounced using grapheme-phoneme correspondence (see also Bowey & Hansen, 1994). This finding implies that, even children who cannot yet be said to be reliable decoders are nevertheless sensitive to intra-syllabic phonological units (such as the rime) and not only can, but do use this sensitivity to help them to pronounce non-words and, furthermore, that this sensitivity is still operative in adults. This therefore challenges both the assumption of literacy developing in a series of qualitatively

distinct stages and the view that phonemic, rather than orthographic, units invariably form the first basis of literacy development in English.

1.3.3.4. Further Challenges to Stage Models of Development

Stuart and Coltheart (1988) have also questioned the existence of stages in literacy development. In a four-year longitudinal study, they looked at the relationship between children's initial phonological awareness, their development of letter-sound knowledge and their later reading proficiency, as well as at the types of errors that children of differing reading levels made in single word reading. They found that children who began learning to read well continued to do so, while those who began poorly continued to do so. They also found (in line with Bradley & Bryant, 1983 and Treiman & Baron, 1983 among others) that phonological skills and letter-sound knowledge were strongly related to reading proficiency. Their overall conclusion was, therefore, that while phonologically adept children will use their phonological knowledge to good effect when they come to read and spell, children who lack such skills "will perforce look upon the task of learning to read as one of committing visual strings to memory, using whatever features seem useful for this purpose. In other words, these children will have no option but to become 'logographic' readers" (*ibid*, p.164). While this may sound like an acknowledgement of precisely those stages in literacy development outlined above (logographic, partial-alphabetic and alphabetic), Stuart and Coltheart's interpretation is in fact very different. Their view is that since children use whatever skills they have at their disposal to learn to read (and spell) from the beginning, then it follows that "not all children pass through the same sequential stages", thus casting doubt on the need to conceive of literacy developing through distinct stages at all.

Other researchers have challenged the stage model assumption that morphological processes appear comparatively late in literacy development. For example, Treiman and her colleagues (Treiman & Cassar, 1996, 1997; Treiman *et al.*, 1994) have shown that even children in first grade are sensitive to morphology. Thus, although there is a general tendency for children to omit the first consonant in final consonant clusters (Read, 1975, 1986; Treiman, 1993; Treiman *et al.*, 1995), 'SIK' being a more common misspelling of '*sink*' than 'SIN' for example, even young children demonstrate morphological awareness in representing the final consonant of the stem in two-morpheme words like '*bars*' and '*tuned*' (Treiman & Cassar, 1996, 1997) or '*dirty*' (Treiman *et al.*, 1994) - see Section 1.2.2.5. This is inconsistent with stage theories, which claim that children initially adhere to purely phonological strategies in spelling and only later represent morphological relations in their spelling (Frith, 1985; Marsh *et al.*, 1980). While Nunes *et al.* (1997, p.638) point out that children's use of morphemes in spelling, as demonstrated by Treiman *et al.* (1994), was greater in second-grade than in first-grade, thus indicating that this ability does develop with age, the fact that this tendency was found even in first-graders does nevertheless provide evidence of an early awareness of morphemes in spelling. It may well be that an "understanding of root constancy", such as that between '*sail*' and '*sailor*', '*finance*' and '*financial*' or '*capacity*' and '*capacious*' (Henderson, 1980), might develop at a later stage, but simpler relations such as those denoted by the nominal plural or past tense suffix, are accessible even to children making their earliest attempts in spelling at kindergarten (Treiman & Cassar, 1996, Exp.2).

Perhaps one way of reconciling these, on occasion, conflicting findings is to conceptualise literacy development within a framework, in which children's phonological, orthographic and morphological strategies are not separable, but interact from the start. Indeed, such a framework was suggested by Snowling (1994), since "stage models of spelling development,

portraying the gradual replacement of phonological strategies by orthographic competence, do not adequately capture the intricacies of the learner's task. Models of the process of spelling development need to take into account the fact that neither the lexical nor the phonological strategies that children use are all-or-none processes. Nor do they work in isolation.... We propose instead that it is the interplay of these developing abilities that is critical to the acquisition of spelling" (*ibid*, p.121; see also Treiman 1994).

1.4. SPELLING DEVELOPMENT ACROSS LANGUAGES

1.4.1. Consistent versus Inconsistent Orthographies

In her landmark book *Beginning to Spell*, Treiman (1993) makes the observation that "a writing system with one-to-one relations from phonemes to graphemes would be easier for children to learn than a writing system with one-to-many relations from phonemes to graphemes" (*ibid*, p.59). Orthographies with more consistent one-to-one phoneme-grapheme correspondences are said to be more 'transparent' or more 'shallow' than those with less consistent one-to-many phoneme-grapheme relations, which are referred to as 'opaque', 'non-transparent' or 'deep'. Comparisons of spelling performance in English, which is considered to be a non-transparent or deep orthography, with performance in languages with comparatively more consistent orthographies show that children learning the former are indeed comparatively slower in their spelling acquisition.

For example, in a comparison of correct spelling performance and typical spelling errors made by English and German-speaking children in Grades 2, 3, and 4, Wimmer and Landerl (1997) showed that, although German-speaking and English children performed similarly on a number of words containing vowel digraphs (e.g. '*Boot - boat*'; '*Kohlen - coal*'; '*Stahl - steel*'

and '*Seele- soul*'), overall the German-speakers' correct spelling performance was markedly better than that of their English counterparts, even on words with multiple graphemes or vowel digraphs (e.g. '*Thron - throne*'; '*Freund - friend*'; '*Dieb - thief*'; '*tief - deep*'). German orthography, although not quite pertaining to Treiman's (1993) description of a writing system with one-to-one relations, is nevertheless considerably more consistent and transparent than English. It is perhaps not surprising, therefore, that the most noticeable difference between the English and German-speaking beginner-spellers in the Wimmer and Landerl study (1997, Exp.1) was in the much greater variety of different misspellings produced by the former compared with the latter (e.g. 22 versions of '*friend*' compared with just three of '*Freund*'), and this was noticeable even in words which the German-speaking children found comparatively hard (e.g. '*Kohlen*', '*Stahl*' and '*Seele*'), for which they produced respectively four, five and three different versions, compared with 17, 15 and 17 different spellings for the equivalent words by the English children. Thus, it would seem that English children show a greater degree of uncertainty in their spelling compared with German-speaking children, a probable consequence of the greater degree of inconsistency of English orthography.

Goswami (2000) endorses such an interpretation by suggesting that children learning to read and spell non-transparent orthographies (like English) acquire phoneme-level representations more slowly than children learning to read and spell transparent orthographies, since the "representation of phoneme-level information is thought to 'spurt' with the acquisition of literacy, because the feedback provided by graphemic information would help the child to represent segmental information at the phonemic level. Accordingly, the transparency of the language that the child is learning to read and spell would be expected to have an effect on how rapidly the child's phonological representations were restructured to represent segmental information at the phonemic level" (*ibid*, p.137).

Goswami, Gombert and Fraca de Barrera (1998) have demonstrated another consequence of the inconsistency of English orthography, however, in a demonstration of different patterns of the rime neighbourhood effect in different languages (English, French and Spanish). Although both children (in Grades 2, 3 and 4) and adults were shown, in all three languages, to be able to use analogy in order to read pseudo-words with many real-word neighbours or 'friends' (e.g. '*voop*', '*ketter*') much more quickly and accurately than pseudo-words with few real-word neighbours ('*joog*', '*terket*'), the effect varied considerably with the degree of transparency of the language. The more irregular the orthography, the stronger the effect. Thus, the effect was stronger in English than in French, but stronger in French than in Spanish. Furthermore, Goswami *et al.* (1998) also demonstrated a considerably greater difference in English between an orthographic neighbourhood effect (in which the pseudo-words maintained orthographic as well as phonological correspondence with several real word neighbours: '*loffee- coffee*') and a purely phonological neighbourhood effect (in which the pseudo-words were effectively homophones of orthographic neighbours: '*loffi - coffee*'), than was shown in French, in which there was much less of a difference. No comparison was even possible in Spanish, since it is well nigh impossible to find two spellings for the same sounds in a language with such a transparent orthography. This implies that orthographic rime neighbours may play an especially important role in English, since analogy with known words sharing the same spelling pattern would be expected to be most effective in an irregular orthography. Thus, analogy in spelling might also be expected to play a more important role in English, than in transparent orthographies in which analogy use would be much less visible. Gombert, Bryant and Warwick (1997) state as much in relation to reading in their comment: "If you imagine a written system in which every word is a consonant-vowel

monosyllabic word, there is no visible difference between analogical and alphabetic reading" (*ibid*, p.233).

1.4.2. Sources of Spelling Difficulty Across Languages

Thus far, the suggestion put forward has been that accurate spelling is more easily acquired in languages with consistent, transparent orthographies than in those with inconsistent, non-transparent orthographies. Treiman (1993) makes the suggestion, however, that although the lack of consistency of the English writing system is one source of difficulty, "it is by no means the only one" (*ibid*, p.59). Treiman suggests that other sources of difficulty for beginner-spellers include the tendency in some written languages, including English, to maintain morphemic consistency at the expense of phonemic consistency, as well as difficulty in representing consonant clusters and multiple graphemes. This section addresses some of these sources of spelling difficulty, comparing the spelling performance of English children in relation to children's performance in other alphabetic languages.

1.4.2.1. Consonant Clusters

Czech orthography is much more consistent and transparent than English. However, as Caravloas and Bruck (1993) have noted, there are also a far greater number of complex word-onset clusters in Czech than in English (258 in Czech compared with 31 in English). It might therefore not be surprising if Czech children were better at spelling complex word-onset clusters than English children, since they would gain considerably more experience in doing so. Conversely, however, since English contains a higher proportion and variety of word-final clusters than Czech (18% compared with 1.5% according to Caravolas & Bruck), one might expect English-speaking children to master spellings containing these more quickly than Czech children. However, this was not what Caravolas and Bruck found in their comparison

of consonant cluster spelling performance in 4- to 6-year-old Czech and English-speaking children. In a non-word spelling task, the Czech children produced, as expected, considerably more correct spellings of CCVC items than of CVCC items. However, they also produced considerably more correct spellings of both the CCVC and CVCC items than their English-speaking counterparts, who did no better in their performance on CVCC than on CCVC items. This may appear to be a surprising finding, since it would be expected that the English children would do better on the CVCC items. If, however, one considers that the transparency of the orthography, in which children are learning to read and write, may play a role in terms of the degree to which the consistency of the orthography allows beginner-spellers to form representations at the phoneme-level, as suggested by Goswami (2000), then it would follow that the English-speaking children might have performed comparatively poorly as a consequence of the non-transparency of English orthography, whereas the Czech children, in learning a transparent orthography had no such disadvantage. Caravolas & Bruck also point out that, although the phoneme-grapheme mappings of consonants are equally consistent in both languages, the vowel systems of Czech and English differ considerably. Indeed the phoneme-grapheme mappings of vowels are particularly inconsistent in English. Thus, Caravolas and Bruck conclude that "because Czech children learn to read and write a transparent orthography in which grapheme-phoneme correspondences are predominantly one-to-one, the written language input may play a dual role: it may serve to establish strong phonemic representations more quickly and at the same time may ease the task of learning to spell in general. In contrast, learning an orthography which presents many irregularities and exceptions at the phoneme-grapheme level may slow the rate at which the Anglophone learner acquires legal spelling-sound sequences" (*ibid*, p.26).

The suggestion that the English-speaking children in the Caravolas and Bruck study were weaker in their performance at the phonemic level in comparison to Czech children is further supported by the finding that the former showed a considerable difference in their ability to delete initial phonemes on CVC items, as opposed to their comparative inability to delete initial phonemes on CCV items, whereas the Czech children performed equally well on both items. Thus Caravolas and Bruck suggest that the English-speaking children were inclined to produce rimes as their answers on this task, deleting whole onsets, while Czech children operated consistently at the phonemic level, whether the stimuli were in Czech or English.

It would therefore seem that, although Treiman (1993) may be correct in suggesting that consonant clusters are likely to present some problems for all beginner-spellers, the transparency of the orthography in which they are learning to spell plays an important role in arming children with enough feedback to form phonemic-level representations. Thus, although Czech has a greater proportion of initial consonant clusters than English, the greater transparency of Czech orthography allowed the Czech beginner-spellers in the Caravolas and Bruck (1993) study to have relatively little difficulty (compared with their English-speaking counterparts) in representing both initial and end consonant clusters, simple or complex, at the phonemic level. Wimmer and Landerl (1997, Exp. 2) also showed that German-speaking children do not show the same degree of difficulty in spelling consonant clusters that Treiman (1993) has attributed to English children, possibly as a consequence of the greater degree of transparency of German orthography relative to English (see Section 1.4.1. above). Thus, despite the similarity of many German and English words containing consonant clusters (e.g. '*Wind - wind*'; '*Feld - field*'; '*steht - stands*'; '*schwimmt - swims*'), Wimmer and Landerl claim that German-speaking children, with up to only nine months literacy instruction, have relatively little difficulty in spelling consonant clusters. They also report a "near absence of

difficulties with the spelling of consonant clusters" in a group of Grade 2 children identified as suffering from specific spelling difficulties. No detailed information is offered as to the nature of these children's specific spelling difficulties, but consonant clusters do not appear to be a source of difficulty, since these children showed "only eight instances of phonemic misspellings of onset clusters and three misspellings of end clusters" (*ibid*, p.91).

1.4.2.2. Pre-consonantal Nasals

Read's observations (1975, 1986) with regard to the tendency in English-speaking beginner-spellers to omit pre-consonantal nasals has already been mentioned (Section 1.3.1). However, more can be learned from these observations if we consider them in the light of similar research in other orthographies, which reveal both similarities and differences across languages (Read, 1986, Chapter 4). As has already been pointed out, there are differences in the degree to which pre-consonantal nasals are represented (or omitted) in different languages. While Dutch children's early spelling attempts reveal a robust tendency to omit pre-consonantal nasals, as has also been observed in English beginner-spellers (Read, 1975, 1986; Treiman, 1993), French children show no such tendency. Read (1986) speculates that there may be a number of reasons for this discrepancy. For example, it may be that "the phonemic status of nasalised vowels in French accounts for this difference in spelling [....], since nasalised vowels contrast phonemically with oral vowels in French" (*ibid*, p.87). Alternatively, it may be that the distribution of nasalisation is greater in French, although Read suggests that the only difference in distribution is in open syllable-final nasalised vowels, which exist in French (e.g. '*bon*') but not in Dutch or English. A further reason, put forward by Read, is that, since nasalised vowels contrast phonemically with oral vowels in French, and since there is a greater distribution, specifically of syllable-final nasalised vowels, then it may also follow that literacy instruction in French focuses more explicitly on teaching

the spelling of nasalised vowels, than is typical of Dutch or English literacy instruction. Thus, French children's greater awareness of nasalised vowels in general, coupled with explicit instruction in how to represent nasalisation in writing, might lead them to be more consistent in their spelling of both nasalised vowels and of pre-consonantal nasals than their Dutch and English counterparts.

1.4.2.3. Morphemic Consistency

Apart from the inconsistency of the orthography and the preponderance of consonant clusters in English spelling, Treiman also attributes another source of spelling difficulty to the tendency to maintain morphemic consistency at the expense of phonemic consistency. This tendency is not necessarily unique to written English, however. Both Alegria and Mousty (1996) and Totereau, Thevenin and Fayol (1997) have pointed out that maintaining morphemic consistency at the expense of phonemic consistency is also a characteristic of French orthography. Indeed number morphology poses particular problems for French children, since the plural form of both nouns and verbs are not marked phonologically, although they are in written language (e.g. '*chien/ chiens*' and '*il joue/ ils jouent*' being indistinguishable in spoken French). Although English children have similar problems in transcribing number morphology, in that the spoken rendition of some past tense verbs and plural nouns sound different, but are written consistently (as in '*cats*', '*dogz*' and '*houziz*' for '*cats*', '*dogs*' and '*houses*' or '*droppt*', '*guidid*' and '*showd*' for '*dropped*', '*guided*' and '*showed*'), at least the relationship between oral and written language is audible, whereas French children are at a greater disadvantage in this respect (e.g. '*he plays/ they play*', compared with the silent endings of '*il joue/ ils jouent*'). The only audible indication of number in relation to nominal inflections in French is in the definite article, pronounced differently in singular and plural ('*le chien/ les chiens*'). It is not therefore surprising, at least

in relation to French, that the nominal plural is, according to Totereau *et al.*, acquired before the verb plural. Interestingly, however, they also point out that nominal inflections are acquired earlier than verb inflections in both French and English, even though both these inflections are audible in English. Thus, although the two languages differ in some respects, there are nevertheless similarities in relation to the acquisition of morphology.

Nunes *et al.* (1997) also claim that there are similarities in the developmental sequence illustrated in the spelling mistakes of English and French children, in that in both languages children initially adhere to a phonological strategy, but then over-generalize the application of a morphological strategy by occasionally adding the plural verb ending in French ('-nt') to plural nouns as well as verbs, just as children sometimes over-generalize the past tense suffix in English ('-ed') to nouns, as in '*sofed*' for '*soft*'(see Section 1.2.2.5. above).

1.4.3. Phonological Processes & Orthographic Representation Across Languages

The relationship between phonological awareness and literacy acquisition appears to be consistently reported across a variety of orthographies, irrespective of their degree of transparency, (Bradley & Bryant, 1983; Hatcher, Hulme & Ellis, 1994; Iversen & Tunmer, 1993; Kjeldsen, Niemi & Olofsson, 2003; Lundberg, Frost & Petersen, 1988; Schneider, Kuespert, Roth, Vise & Marx, 1997) and has even been reported in relation to learning to read in Chinese (Suk-Han Ho & Bryant, 1997). Early training in phonological skills can have a considerable impact on later literacy acquisition, provided it is systematic and consistent in its approach (Kjeldsen *et al.*, 2003; Lundberg *et al.*, 1988; Schneider *et al.*, 1997). Indeed there is now considerable evidence that phonological awareness is a general, rather than language-specific predictor of literacy acquisition, since it has been implicated as playing an instrumental role in a number of cross-linguistic studies (Caravolas & Bruck, 1993; Corneau,

Cornier, Grandmaison & Lacroix, 1999; Cosu, Shankweiler, Liberman, Katz & Tola, 1988; Landerl, Wimmer & Frith, 1997; Lindsey, Manis & Bailey, 2003; Lundberg *et al.*, 1988; Schneider *et al.*, 1997), although there is also increasing evidence that the relationship of phonological awareness and literacy development is a bi-directional one (Hecht & Close, 2002; Lindsey *et al.*, 2003; Wagner, Torgesen & Rashotte, 1994). Additionally, bi-lingual studies have shown that early phonological awareness skills carry over from one language to another (Corneau *et al.*, 1999; Lindsey *et al.*, 2003), although cross-linguistic transfer is not limited to phonological skills, since print awareness, letter-knowledge and rapid serial naming have also been shown to transfer from Spanish to English (Lindsey *et al.*, 2003). In the latter study, however, there was one variable (Concepts About Print) that appeared to differ in the degree to which it contributed to Spanish and English literacy acquisition, since it "accounted for unique variance in nearly every English measure but none of the Spanish measures" (*ibid*, p.492). The explanation offered for this anomaly by Lindsey *et al.* is that exposure to print may be more important for English than for Spanish, since letter-sound relations are less predictable in the former than in the latter. Thus, in Spanish it may not be so critical for beginner-readers and spellers to be exposed to print, since word-specific knowledge is also less critical.

It is also interesting to note that several studies investigating the effectiveness of phonological awareness training in relation to literacy development in English, have found that training in phonological awareness is most effective when it is linked explicitly to print experience, either through combining phonological awareness training with reading experience (Hatcher *et al.*, 1994), or by explicitly highlighting common sounds and spelling patterns between words and making direct links between orthographic patterns and their pronunciation (Bradley & Bryant, 1983; Iversen & Tunmer, 1993). If one takes Ehri's model of reading and

spelling into account, in which visual and phonological information become increasingly amalgamated as literacy skills develop, then it is not surprising that some training studies have found that the best gains are achieved in conditions which encourage this kind of visual-phonological linkage, particularly in a language like English, in which visual-phonological connections may be harder to form due to the inconsistency of its orthography.

The importance of phonological awareness in literacy development lies in its role in forming the foundation on which orthographic representations or 'amalgamations' are built (Ehri, 1992; Gough, Juel & Griffith, 1992). It has already been noted that these representations develop more slowly in inconsistent non-transparent orthographies, compared with consistent transparent orthographies (Caravolas & Bruck, 1993; Goswami, 2000; Wimmer & Landerl, 1997) and this has indirect repercussions in terms of how children tackle some common spelling problems, such as consonant clusters (Caravolas & Bruck, 1993; Wimmer & Landerl, 1997). Clearly, phonological awareness training that incorporates explicit links between print and sound, such as those mentioned above, can aid the development of orthographic representations, even in non-transparent languages. By the same token, phonological awareness alone is clearly not enough to promote accurate spelling procedures in non-transparent orthographies. "Even if the abilities involved in the elaboration of the system underlying phonological reading and spelling are necessary for the lexical system to develop, they are certainly not sufficient" (Alegria & Mousty, 1996). In languages like English and French, both of which belong to a "family of deep orthographic systems" (*ibid*, p.312), specific lexical knowledge is required in order to decide on the correct spelling of inconsistent or ambiguous phonemes. Phonologically acceptable spellings for the English word '*touch*', for example, might include '*tutch*' or '*tuch*', while in French the verb '*manger*' might by the same token be spelled as '*menger*' or '*manjer*' (Alegria & Mousty, 1996, p.313). Indeed,

according to the latter: "A rule-based strategy permits correct spelling of not more than half of the French words" (*ibid*, p.313). Nevertheless, French-speaking children, according to Alegria and Mousty, usually adhere to a simplified set of phoneme-grapheme correspondence rules at the initial stages of spelling, although they also show similar sensitivity to the kinds of orthographic convention (such as initial single 's', but double 'ss' in the middle of words) that has been observed by Treiman and her colleagues in English-speaking children (Cassar & Treiman, 1997; Treiman, 1993; Treiman & Cassar, 1997 – see Section 1.2.2.4). However, in subsequent stages of normal spelling development, French children show increasing awareness of inconsistent non-dominant graphemes (such as the phoneme /s/ transcribed as 'c' in '*cigarette*') and consistent context-dependent graphemes (such as nasal vowels, which are usually spelled with 'n', as in '*bon*', but are spelled with the letter 'm' before 'b' or 'p', as in '*nombre*', '*timbre*' or '*lampe*'), as well as increasing word frequency effects, all of which suggest the development of a lexical spelling procedure (Alegria & Mousty, 1996).

1.4.4. Implications for Teaching Spelling in English

While some orthographies, such as Italian and Spanish correspond to the ideal of "a writing system with one-to-one relations from phonemes to graphemes" (Treiman, 1993), others, such as English and, to a lesser extent French do not. The repercussions of this inconsistency are that the acquisition of correct spelling procedures in English may be comparatively slower relative to other, more transparent orthographies (Goswami, 2000; Wimmer & Landerl, 1997). But that is not the only likely repercussion. It is also likely that lexical spelling strategies, which focus on higher-level sound-spelling connections than the phonemic level, will be both more useful and more apparent in English literacy (Gombert *et al.*, 1997; Goswami *et al.*, 1998). Indeed, in an intervention study with a group of second-grade children with problems in spelling, Berninger and colleagues compared a number of treatments, all of

which combined a number of different sound-spelling connections at either the whole-word, phoneme-letter(s) or onset-rime level, and found the treatment which combined whole-word and onset-rime methods to be most effective and the one which achieved significantly better transfer to untrained words, compared with controls, who received training only at the smaller unit level (Berninger *et al.*, 1998).

However, since both phonological and lexical procedures are necessary for coming to grips with English literacy, it is likely that children will show varying degrees of skill in and dependence on these procedures. Indeed Bryant and Impey (1986) have provided direct evidence of this in relation to reading in normally developing 10-year-olds, who demonstrated divergence along a phonological-lexical spectrum. They suggested that, although children will often use a combination of both strategies, many also show "a considerable amount of specialisation in one strategy at the expense of the other" (*ibid*, p.136). This clearly has implications for the teaching of reading and spelling. Indeed, in relation to reading, Bryant and Impey suggest that teachers need to capitalise on whichever strategy a child uses most strongly, while at the same time encourage the use of other strategies. This is all the more important in spelling, since over-reliance on phonology at the expense of lexical, morphological or semantic strategies does not pay dividends. The reverse may also be true, if one assumes that the application of phoneme-grapheme correspondence rules is necessary in order to invent plausible spellings for unknown words.

However, as Ehri (1997) has indicated, an alternative way of processing spellings for unknown words is by analogy (see also Goswami, 1988). Goulandris (1994) has pointed out that, although applying analogical strategies may not always result in correct spelling (her example being '*head*' spelled by analogy with '*bed*', which would be '*hed*'), "such spellings

are no less correct than an alphabetic rendition" (*ibid*, p.419) and in fact are often identical to an alphabetic rendition (as in the example above). Furthermore, by linking the spelling of a new word to a known orthographic pattern in memory, precisely the kind of visual-phonological linkage may be activated, which has been shown to be so effective in previous training studies (Bradley & Bryant, 1983; Hatcher *et al.*, 1994; Iversen & Tunmer, 1993). Since the degree of consistency of a given orthography bears upon the ease with which children become skilled in reading and spelling, spelling procedures that promote consistency, such as the use of rime analogies and morphemic strategies, should also be promoted in teaching spelling. Conversely, if children become over-reliant on lexical strategies in their spelling, to the extent that they treat regular words as if they were irregular (such as spelling '*bed*' as '*bead*' in analogy to '*bread*' or '*head*'), then reversing the non-word reading procedure, used by Bryant and Bradley (1980) for children who could not read regular words which they managed to spell, might enable children to trigger sound-letter correspondence rules to produce correct spellings of regular words. Either way, children's invented spellings provide teachers with a 'window into their minds', allowing teachers to determine the degree to which children use one spelling strategy in relation to another.

While different children will use different strategies to varying degrees, it is evident from the work of Read (1975, 1986) and Treiman (1993) that there are certain types of spelling problem, which many children find difficult, even in more transparent orthographies. Drawing specific attention to these kinds of spelling problem and encouraging children to categorize words with the same beginning or end clusters, or find rimes containing pre-consonantal nasals (e.g. '*went*', '*bent*', '*sent*', '*tent*'), along the lines suggested by Henderson and colleagues (1980), would both provide practice with common spelling problems and help to foster visual-phonological links in memory.

2. CHAPTER 2: THEORETICAL FRAMEWORK

2.1. INTRODUCTION

This chapter outlines the theoretical framework within which the ensuing research thesis is set. It encapsulates the overall perspective of the thesis in relation to the research issues outlined in the preceding chapter.

2.2. THE FOUNDATIONS OF WRITTEN LANGUAGE

Much of the research outlined in Chapter 1 highlights issues that relate children's acquisition of reading and spelling to the structure and characteristics of spoken language. Thus, for instance, the English language differs in terms of its syllabic structure from spoken French, in which the end of one word is inextricably linked to the first part of the following word, as in the example '*pour une autre amie*' which is pronounced as '*/py/ry/no/tra/mi/*' not '*/pur/yn/otr/ami/*' (Sprenger-Charolles, Siegel & Bechennec, 1997, p.340). Similarly, an important characteristic of the English language is that morphological cohesion is maintained at the cost of phonological cohesion, a characteristic which it shares to a degree with French (Section 1.4.2.3), but which sets it apart from Italian, in which phonological cohesion is retained without compromising morphological unity (Perfetti, 1997). Thus, studies of the structure of spoken language provide an important foundation for research in written language (Treiman, 1992) and it is therefore appropriate to consider the syllabic structure of spoken English before embarking on research in the development of written English.

2.3. THE SYLLABIC STRUCTURE OF ENGLISH

The view that informs the ensuing research is that the syllabic structure of English is hierarchical in nature, rather than linear (Treiman, 1992, 1993). By this view, a word (e.g. '*stigma*') is divided into syllables ('*stig-ma*'), with each syllable in turn dividing into onset and rime units ('*st-ig*' and '*m-a*'), and some rimes dividing again into smaller units, namely a peak (or medial vowel) and coda or ending ('(*st*)-***i-g***'), with the smallest unit level being that of the phoneme ('/s/-/t/-/i/-/g/-/m/-/a/'). Similarly the onset of '*task*' would be '*t-*', with the rime ('*-ask*') dividing into a peak ('*a*') and coda ('*sk*') –see Treiman (1992, p.66). Units may thus relate to single phonemes, as in the onset '*t-*' and coda '*-g*', or to more than one phoneme as in the onset '*st-*' and the coda '*-sk*'. However, certain phonemes are more cohesive than others, which can affect their assignation to one unit as opposed to another. For example, liquids ('*l*' or '*r*') tend to be assigned to the peak, rather than to the coda (Treiman, 1984, Exp.3, cited in Treiman, 1992). Thus the word '*help*' would be divided into the sub-syllabic units '*h-el-p*', rather than '*h-e-lp*', whereas '*desk*' would be divided into the sub-syllabic units '*d-e-sk*', not '*d-es-k*'. This makes intuitive sense when one considers the pronunciation of words like '*walk*', '*talk*', '*calm*' or '*arm*', in which the pronunciation of the medial vowel is dependent on the ensuing liquid, such that '*al*' or '*ar*' are judged as one unit, rather than the liquid being assigned to the coda. This is an important consideration, since it not only affects the way in which children might perceive and transcribe such words (as in '*owd*' for '*old*'), but also the way in which sound-letter alignments are judged in experimental studies and this inevitably has implications for the resultant claims of such research (a point also made by Kessler & Treiman, 2001, p.612).

2.4. THEORETICAL AND PRACTICAL IMPLICATIONS FOR LITERACY RESEARCH AND EDUCATION

Just as the structure of spoken language provides an important foundation for research in written language, theories of reading and spelling development must invariably be underpinned by considerations of the structure of language and children's underlying awareness of linguistic structure. If words are divided into syllables, which comprise particular sub-syllabic units, which can in turn be divided into phonemic units, then models which only account for spelling at the phonemic level do not take the hierarchical structure of syllables and sub-syllabic units into account. Treiman *et al.* (1995) therefore suggested that: "just because the English writing system can be described, used and learned as an alphabet, it does not necessarily follow that it must be described, used and learned only at the level of graphemes and phonemes" (*ibid*, p.107). By the same token theories, which limit their considerations to spelling to the sub-syllabic level do not sufficiently take into account how these sub-syllabic units relate to phonemic units. The suggestion put forward here, therefore, is that a comprehensive theoretical account of spelling development would be one, which takes the hierarchical structure of spoken English into consideration at both the higher (sub-syllabic) and lower (phonemic) unit levels.

During recent years, there has been a great deal of debate about the nature of the relationship between children's use of sub-syllabic units (e.g. onset and rime) and smaller units in literacy development (see, for example: Bowey, 2002; Bryant, 1998, 2002; Goswami, 2002; Hulme, 2002; Hulme, Muter & Snowling, 1998; Hulme, Hatcher, Nation, Brown, Adams & Stuart, 2002; Muter, Hulme, Snowling & Taylor, 1997). This debate has not been fuelled so much by disagreement as to the existence of both onset-rime and phoneme-level strategies, but rather

by lack of consensus as to the relative importance of each in relation to literacy development and the order in which they develop in relation to reading and spelling. One argument relates to the claim made by Bryant and Goswami (1990) that rhyming ability predicts early literacy skills (see also Cataldo & Ellis, 1988; Bryant *et al.*, 1990), whereas the converse argument advanced by Muter, Hulme and colleagues is that segmentation skills, rather than rhyming, predict early literacy progress.

There are a number of issues that are relevant to both these claims. The first concerns the structure of spoken English and the way this informs the characteristics of written English (Kessler & Treiman, 2001; Treiman *et al.*, 1995); the second concerns children's awareness of the phonological structure of spoken English and the degree to which children show evidence of this awareness in their reading (Treiman *et al.*, 1995, Exp.3) and spelling (Treiman, 1993, 1994; Treiman, Berch, Weatherston & Tincoff, 1993); and the third concerns the degree to which children can build on this awareness and make use of different kinds of contextual cues in their spelling (Goswami, 1988; Treiman, 1994; Treiman & Cassar, 1996) and reading (Bowey & Hansen, 1994; Goswami, 1986, 1991, 1993; Goswami & Mead, 1992; Treiman, Goswami & Bruck, 1990). For example, Kessler and Treiman's (2001) analyses of both adults' and children's vocabulary, and the degree to which the knowledge of certain units affects the consistency of the spelling of other units, showed that the majority of vowel types are spelled significantly more accurately if the coda is taken into account and that some vowel types are similarly affected by knowledge of the onset, although knowledge of onsets is much less influential on vowels than knowledge of coda sounds. Furthermore, children from as early as six months into Grade 1 at primary school have been shown to be sensitive to the underlying consistency of larger orthographic and phonological units, specifically rime units, in their reading (Treiman *at al.*, 1995, Exp.3) and spelling (Treiman, 1992, p.89). Treiman

and colleagues suggest that children show sensitivity to these units in written English because they bring their knowledge of phonological units in spoken English to bear on the process of acquiring written language and this readiness is then strengthened by direct experience with print and their observation that orthographic rime units often have stable, frequently recurring pronunciations. These types of spelling pattern are no accident, linguistically speaking. When pronunciations change as language develops, but spellings remain the same (as in the examples of '*night*', '*light*' and '*eight*' – Section 1.1), these spellings may appear 'irregular' but nevertheless remain consistent for words sharing these spelling patterns. Thus it is likely that the phonological structure of the language plays a role in the development of the language as a whole, as well as in relation to its development in children (Treiman *et al.*, 1995).

If this is indeed the case, then conceptualisations of the English writing system, which view the spelling or reading process simply at the level of the phoneme, are incomplete. The practical implications of this would then be that it may be beneficial to beginner-spellers and readers to draw attention to the relationships between vowels and codas and, possibly to a lesser extent, between onsets and vowels in order to bring out these consistencies in English spelling. This does not mean ignoring analysis at the phonemic level, however, but rather consideration of phonemic relations within the context of higher sub-syllabic relations (Kessler & Treiman, 2001, p.611).

3. CHAPTER 3: EXPERIMENT 1

3.1. INTRODUCTION

Previous research on literacy attainment in English has advocated a number of ways of conceptualising the course of development in reading and spelling, and has consequently placed varying degrees of emphasis on the different underlying processes and the way in which these processes interact with each other. Chapter 1 has already discussed the most influential of these different theoretical standpoints. The present intention is to consider some of the implications of Goswami's (1993) interactive analogy model in relation to spelling development specifically.

Goswami's model conceives of literacy skills developing, not through a sequence of distinct stages (c.f. for example, Frith, 1985) but, rather, through an interactive relationship between orthographic and phonological factors, which underpin the child's phonological knowledge, which in turn allows for increasingly refined use of orthographic transfer for decoding and spelling new words (see also Snowling, 1994, and Treiman, 1994). One of the benefits of this model is that it does not place greater emphasis on either visual or phonological skills, since the two are intimately connected (as is also the case in Ehri's model, 1992). This is particularly relevant in the context of learning how to spell an irregular orthography like English, where employing consistent sound-letter mappings does not reliably lead to correct spelling. Orthographic transfer of known spelling patterns to new words may offer a more useful strategy in a language in which there are often a number of ways of representing the same sound. Furthermore, an awareness of analogous spelling patterns lends some consistency to the spelling process (Kessler & Treiman, 2001; Treiman *et al.*, 1995), which in

turn helps to reduce the confusion that might otherwise prevail in a language where there are at least seven ways of reproducing the sounds of both /o/ and /i:/ on paper (see Treiman, 1993, p.73).

One assumption of the interactive analogy model, however, is that children's early orthographic analogies themselves reflect onset-rime knowledge, since the claim is that children who are starting to learn to read make more analogies between shared spelling units that reflect onset ('*trim – trot*') and rime ('*beak – peak*') than between units of corresponding length that do not reflect onset or rime (such as '*desk –risk*,' or '*beak– bean*', Goswami, 1991). This claim is relevant to the issue, discussed in Chapter 1, of the whether the foundations of literacy development are grounded initially in phoneme-based (i.e. small unit) or rime-based (i.e. large unit) strategies, and which of these is most influential in relation to reading or spelling performance.

In two of her early studies on children's use of orthographic analogies, Goswami (1986, 1988) used the now classic 'clue word' paradigm to show that children are able to use analogy at the larger unit level ('*beak-bean*'; '*beak-peak*') to help them to read or spell new words by analogy with a known (clue) word right from the earliest beginnings of learning to read and write. Having previously established that young children used analogy in their reading (Goswami, 1986), Goswami was particularly interested in finding out whether they would also choose to make analogies in spelling (Goswami, 1988) when 'the consistency of the relationship between spelling and sound differs for reading and spelling (*ibid*, p.21), since similar sounding words are not always spelled in the same way (e.g. '*perch*', '*birch*, '*search*', and '*lurch*' – Goswami's examples), whereas words with the same spelling pattern are more likely to be pronounced in the same way (with a few notable exceptions, such as '*speak-*

steak'). Goswami's first experiment of her 1988 study established that 5- to 7-year-olds were indeed able to use analogy with a clue word ('*beak*') to help them spell new analogous words ('*peak*'), when the clue word had been read out to them and remained in view. This study employed three conditions to test that it was the recognition of common sequences of letters, rather than simply the number of shared letters, which helped children to make analogies with the clue word. She therefore included a three-common-letters condition ('*beak-lake*'), as well as two analogous conditions (beginning: '*beak-bean*', and end: '*beak-peak*') in her design, but found that the only improvement in spelling occurred in the in the analogous conditions, concluding that children did not make analogies on the basis of common letters, but only on the basis of analogous letter sequences. Furthermore, she found that the children made significantly more analogies in the end analogous (rime) condition, than in the beginning analogous (onset-peak) condition, and therefore concluded that, although children showed evidence of making analogies in both these conditions, they found it easier to make rime analogies than analogies based on the onset and peak.

Nation and Hulme (1996), in a study which adopted Goswami's 'clue word' paradigm, used the same conditions as Goswami (1988) but with the addition of a medial vowel condition: onset-vowel ('*corn-cord*'), rime ('*corn-born*'), medial vowel ('*corn-lord*') and three common letters ('*corn-cone*'). Apart from the addition of the medial vowel condition, their study employed the same procedure as Goswami's (1988, Exp.1). Like Goswami, they found that children did not use analogy in the three-common-letters condition, but only in the three analogy conditions. However, they did not replicate her finding that children used analogy at the level of the rime substantially more than at any other level. Rather they found no difference in the degree to which children were able to use analogy in their spelling in the three analogy conditions (i.e. at the levels of onset-vowel, vowel-only and rime), and

therefore concluded that there was no evidence of children showing a preference for rime analogies, over analogy at any other level, but rather that children were equally adept at making analogies at the smaller unit level (medial vowel or peak) as at the larger unit levels of rime and onset-peak.

In her 1993 study on analogy use in relation to reading development, however, Goswami had found that there was some evidence of the degree of 'graphemic overlap', as she called it (Goswami, 1993, Exp.2 and 3), between the clue and test word influencing the degree of transfer shown, rather than just the size of the unit. She had therefore suggested that vowel digraphs might be "more salient than single vowels or other shared single graphemes" (*ibid*, p.461) in encouraging analogy use in reading. It is therefore possible that this was the case in Nation and Hulme's (1996) study on analogy use in spelling which employed vowel digraphs in the medial vowel condition ('*corn-lord*'; '*hark-farm*'; '*seed-feet*'; '*beat-leap*'), and that this was the reason for the different result in their study compared with that of Goswami's (1988) analogy study.

In a second experiment, Goswami (1988) investigated children's willingness to use analogy in spelling to generalize from a taught word like '*speak*' to spell test words which were analogous ('*beak*'), ambiguous ('*meek*') or unrelated ('*tour*'). In this experiment, Goswami was interested in two things: first, whether children could make analogies from taught words to spell new words, when the taught words were not visible during testing; and second, whether children would still show willingness to use analogy in spelling, even when one of the taught word conditions comprised inconsistent word-pairs like '*speak-steak*'. She found that young children were willing and able to use analogy to help them in the spelling process, since only the analogous words (and not the ambiguous or unrelated words) were spelled

significantly better in the analogy test than at pre-test. However, to her surprise she also found that children were able to use analogy, irrespective of which word pairs they had been trained on (consistent-analogous: '*speak-leak*'; inconsistent: '*speak-steak*'; or unrelated: '*speak-loan*'). She therefore concluded that children not only showed evidence of making analogies from a known word to spell new analogous words, but that they were also willing to use analogy in their spelling, even in the face of orthographic inconsistency in the language.

Perhaps this is not so surprising, however, since, as Goulandris (1994) has pointed out, rhyming words often contain high-contingency predictable spelling patterns, which provide spellers with useful clues for generalising to other words and which, moreover, in an irregular orthography like English are at least as likely and usually more likely to enable spellers to access correct spelling patterns, than use of phoneme-to-grapheme (sound-to-letter) correspondence rules. In a regular orthography, such as Spanish, in which comparison between two (or more) orthographic representations of the same sound is almost impossible, analogy may have much less relevance (Goswami *et al.*, 1998). In English, however, in which more than one orthographic representation may be used to convey the same sound, analogy is much more likely to aid the decision making process.

It might be useful, therefore, to teach children who are learning how to spell in English to use analogy in their spelling, rather than basing teaching methods over-much on phoneme-based strategies. However, the analogy teaching sessions in Goswami's study (1988, Exp.2) were of only brief duration (one individual session of five to ten minutes) and it is unlikely that they would have had a lasting effect. Intervention spread over a number of weeks might be expected to have a more enduring effect. It would clearly also be important to ascertain that children knew how to spell several exemplars of a given spelling pattern before they were

able reliably to generalize from it to form new words (c.f. Savage & Stuart, 1998, Exp.2). Additionally, the intervention studies that have proved most successful in relation to improving literacy skills in the past have been those that made the link between phonology and orthography explicit (c.f. Ball & Blachman, 1991; Bradley & Bryant, 1983; Byrne & Fielding-Barnsley, 1989, 1991; Cunningham, 1990; Hatcher *et al.*, 1994). Thus, teaching children how to use analogy in spelling, in a way that makes the phonemic-orthographic link explicit and which allows them to find several examples of words which are analogous to a clue word, should both benefit their ability to use analogy and improve their correct spelling performance. However, it should also be noted that all the intervention studies mentioned above also ensured that at least one of their experimental groups included a control group who received some form of alternative training, so as to confirm that any post-training advances shown by the intervention group were indeed an effect of the specific training involved, rather than merely an effect of intervention *per se*. An intervention study proposing to investigate the effect of teaching children how to use analogy on their subsequent spelling performance would therefore need to incorporate an alternative (non-analogy) activity for the controls.

Additionally, it might be useful to establish whether children make analogies at the level of the coda (word ending), as well as at the level of the peak, rime and onset-peak. According to Walton (1995), children use the identity of the final phoneme (i.e. the coda) as an important clue in making rime analogies in reading (see also Kessler & Treiman, 2001). It is not known, however, whether the coda is also influential in analogy use in spelling, independent of the rime. Thus, for example, analogy with the single '*l*' ending of the clue word '*sail*' would result in the correct spelling of '*nil*', rather than the more usual double '*ll*' ending (as in '*hill*', '*bell*', '*till*', '*tell*', etc); and analogy with the '*tch*' ending of the clue word '*pitch*', would result in the correct spelling of '*fetch*', where an alternative orthographic representation of the

same final sound might be '*ch*' (as in '*much*', '*such*', '*rich*' or '*which*'). Similarly, analogy with the medial vowel digraph in '*rain*' would result in the correct spelling of '*paid*', rather than an orthographically incorrect (although grammatically logical) spelling such as '*payed*'.

3.2. AIMS OF EXPERIMENT 1

Experiment 1 was designed to lead on from those of Goswami (1988, 1993) and Nation and Hulme (1996), in that it incorporated teaching intervention in analogy use with an exploration of children's use of analogy in spelling at both the large and small unit level. It also went further than either of the previous spelling studies, in that a coda (final phoneme) condition was incorporated into the design and the individual intervention sessions were both much longer in duration than those employed by Goswami (1988, Exp.2) and spread over several weeks. Experiment 1 was carried out to establish, first, whether teaching intervention in analogy use in spelling could improve the spelling performance of 5- to 7-year-old primary school children; second, which specific orthographic units (onset+peak, peak, rime or coda) were most influential in children's analogy use and correct spelling; and third, whether analogy use or phoneme-based strategies contributed most to variance in spelling performance.

3.3. METHOD

3.3.1. Participants

The participants were 36 primary school children (18 boys and 18 girls) from two carefully matched rural village schools. The schools involved were both from the same rural primary school cluster, similar in size, environmental setting and pupil background. Most importantly,

100% of pupils had English as their first language and each of the schools involved had the same early-years (*KS1*) classroom structure. Both schools employed reading instruction based on the National Literacy Strategy, which combines the use of phonics with contextual cues and sight-word reading. All the children had normal or corrected-to-normal vision. No children were excluded from the study, apart from one child, who moved to another school and another, who joined half way through the study. Since neither of these children completed all the tests, their data have not been included in the results or analyses.

Eighteen participants were in Year 1 (mean age 6.01, *SD* 0.28) and eighteen in Year 2 (mean age 6.92, *SD* 0.27). Children from both years were randomly divided between two groups (Groups A and B), with eighteen in each group. The groups were carefully matched to provide, as far as possible, equal ratios of male/female and older/younger pupils and equal numbers of pupils from the two schools in each group, so as to control for possible effects of different teaching methods across schools (Savage & Stuart, 1998). A one-way ANOVA was performed to ensure that there were no significant age differences between the children in each of the groups ($F(1,35) = .059, p = .810$).

3.3.2. Materials

3.3.2.1. Intervention Materials

These comprised a selection of single consonants and vowels, as well as common consonant blends ('br', 'cr,' 'dr', 'nt', 'nd', etc.), vowel digraphs ('ai', 'oo', 'oa'), rimes ('-ell', '-all', '-ill', '-ace', '-ice', '-ight', '-atch', '-etch', '-itch', '-utch', '-addle', '-iddle', '-uddle') and word endings ('-ll', '-ce', '-tch', 'le', '-ck', '-lk') presented in cardboard cut-out format, which the children could combine to form words, alternating the onsets, peaks, rimes or endings so as to form examples of words with the same analogous spelling pattern. The children were also

provided with paper and pencils so as to write down any words, which they had thought of, and which were analogous with the target clue word for that week.

3.3.2.2. Test Materials

These comprised three separate lists, the first of which was used to gauge children's initial spelling performance, with the other two being used for the subsequent post-experimental tests (Appendix 1). These latter word lists comprised six groups of words, each group containing a clue word ('*room*') and four analogous test words ('*roof*', '*shoot*', '*loom*', '*swim*') corresponding to the four analogy units under consideration (onset+peak, peak, rime and coda). Separate word lists were used for Years 1 and 2, with different words presented at each test.

3.3.3. Design

The experiment employed a mixed design, investigating the effect of analogy intervention in spelling on an experimental group (Group A), as measured by their correct spelling performance in subsequent tests following an intervention programme, compared with the correct spelling performance of controls (Group B) who did not receive analogy intervention, but who participated in reading practice with the experimenter. The experiment took place during the second half of the second term and first half of the third term of the academic year. An initial spelling test (at Time 1) was administered to both groups just before the half-term break of the second (Spring) term, prior to any teaching intervention / non-intervention, so as to gauge children's initial spelling performance. Following the five-week long analogy intervention programme, in which only the experimental group (Group A) took part, a further test was administered to both groups at the end of the Spring term (Time 2). A final test was administered to both groups again approximately five weeks later at the start of the following

term (Time 3), so as to gauge the durability of any intervention effects present at Time 2. The main variables of interest were therefore 'group' (A or B) and 'time' (1, 2 or 3), with the dependent variable being the spelling scores. The prediction was that the intervention group's spelling performance would improve more from Time 1 to Time 2, relative to that of the non-intervention group, as a result of the analogy intervention / non-intervention.

3.3.4. Procedure

3.3.4.1. Testing and Intervention Procedure

Separate word lists were drawn up for the three spelling tests at Times 1, 2 and 3. Additionally, different lists were used for Years 1 and 2 (see Appendix 1), both to avoid ceiling effects and so as to target the spelling tests appropriately to the two age-groups. The word lists were based on the reading and spelling schemes employed by participating schools. The rationale was that unless children were familiar with the sounds and spelling patterns within the words used in the experiment, they would be unable to spell new words by analogy.

The initial test (at Time 1) was to gauge children's spelling performance prior to the intervention programme: analogy use was not tested at this point. In the subsequent tests (at Times 2 and 3) the children were asked to write down both the clue word and the four analogous words in each word-group. After verbally presenting each clue word, the researcher told the children that it "shared some of the same sounds and same spelling as the following words", after which the four analogous test words were presented. No further instruction was given as to how the children were to use the clue word to help them spell the test words. Apart from the clue word, which was always presented first, the order of presentation of the

analogous test words was randomised. All words were presented first in isolation and then in sentence context.

The intervention programme took place once a week over a five-week period, for approximately 25 minutes per session, in a small classroom away from the main classes. The same instructions were used at each intervention session and the same format was employed each week, starting with either an introduction in the first week or a resume of the previous week's work in subsequent weeks. Each session introduced a new target clue word, with which the children were encouraged to find and write down analogous words. Thus '*room*' was presented by the researcher as a clue word which shared "some of the same sounds and same spelling" as words like: '*root*' (shared onset+peak), '*hoof*' (shared peak), '*broom*' (shared rime) and '*hum*' (shared coda). Additionally, the stimuli included some words with single medial vowels ('*black*'; '*pitch*'), others with vowel digraphs (e.g. '*rain*'; '*boat*') and some words with single letter endings ('*rain*'; '*boat*'), but others with more complex endings ('*black*'; '*bell*'; '*pitch*'; '*face*'). The children were encouraged to use the materials provided to help them think up their own analogous words, which shared the same onset+peak, peak, rime, or coda as the clue word. This method of combining instruction with child-led exploration of spelling patterns in such a way as to make the phonemic-orthographic link explicit is similar to that used by Bradley in her 'Simultaneous Oral Spelling' method (specifically Step 7), which stipulates: "The child learns with the help of plastic letters to generalize from that word to others which share the same sounds and spelling sequences" (Bryant & Bradley, 1985, p.140).

If the children found words that shared only visual or phonological similarity with the clue words, but which were not truly orthographically analogous with the clue word, this

discrepancy was pointed out to them by the researcher and they were encouraged to think of words which might be truly analogous with the clue word. Thus, if the clue word under consideration was '*black*', children were encouraged to find analogous words like '*blab*' or '*blank*', rather than words which were visually similar, but did not maintain phonological correspondence with '*black*', such as '*blare*' or '*blame*', or words which contained the same sounds, but did not correspond orthographically, such as '*like*' or '*break*' (the endings of which do not correspond with the '*ck*' coda of '*black*'). Equally, every effort was made to maintain phonological-orthographic correspondence between the clue words and the test words at Times 2 and 3. So for example in the Year 1 test at Time 2, where the clue word was '*black*' the analogous test words were: '*bland*', '*cram*', '*stack*' and '*chuck*'.

Children not participating in the analogy intervention programme (Group B) continued with their normal school activities but were additionally seen once a week for individual reading practice with the experimenter during the intervention period. The time spent individually with each child in Groups A and B was thus fairly equal.

3.3.4.2. Scoring Procedure

Spelling performance at each test (Times 1, 2 and 3) was scored first on the basis of the number of correct spellings, and then again for phonological plausibility (PP), and finally for evidence of analogy use. The PP score was intended to reflect a child's development in terms of their ability to represent the individual phonemes in a word, even though their spelling might not necessarily be correct, (although a correct spelling would clearly also have to be phonologically plausible). So, for example, if the word '*rain*' was spelt as '*rane*', '*rayne*', '*rayn*' or even '*ran*', each of these was considered to be phonologically plausible although

incorrect, but '*rn*' which fails to represent the medial phoneme, would not be accepted as phonologically plausible.

The analogy use score was intended to differentiate between use of analogy with a clue word at the level of the onset+peak, peak, rime and coda. The rationale here was to investigate which of the units (onset+peak, peak, rime or coda) predominate in children's use of analogy in spelling and which, if any, of these most contributes to spelling performance. Analogy use was marked according to whether the child used the same spelling for the appropriate unit/s which shared the same sound/s as the clue word, as for example in '*rain*' and '*raid*'. Thus a spelling of the word '*spook*' as '*spoock*' when the clue word was '*moon*', was accepted both as providing evidence of analogy use at the level of the peak ('*oo*') and as being phonologically plausible, even though it was incorrect. However, a spelling like '*payed*' for '*paid*', when the clue word was '*rain*', was not accepted as providing evidence of analogy use, since analogy with the peak ('*ai*') is not shown, but it was accepted as being phonologically plausible. In cases where a child misspelled the clue word (as in '*rayn*' for '*rain*') but then produced spellings which showed clear use of analogy based on their own misspelling (as in '*rayn*' and '*rayd*'), these too were scored for analogy use, but received only one point rather than two.

3.4. RESULTS

Apart from for the initial test prior to intervention / non-intervention, three separate scores were produced in spreadsheet format for each spelling of every child: correct; phonologically plausible; and evidence of analogy use. Correct scores at Time 1 were out of a maximum of 12, which was doubled so as to be comparable to scores at Times 2 and 3, which were out of a maximum of 24.

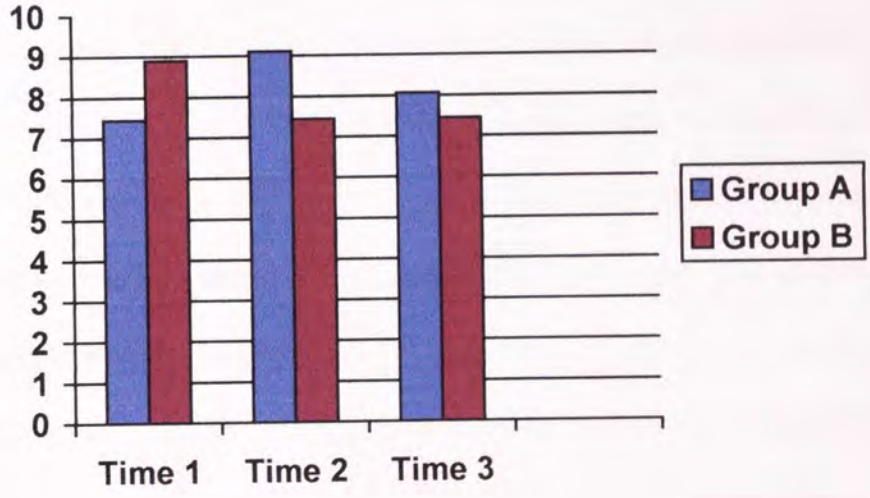
3.4.1. Correct Spelling Performance

The prediction was that intervention in analogy use in spelling would improve the correct spelling performance of the intervention group (Group A), relative to the non-intervention group (Group B). The results show this prediction to have been upheld, since Group A made large gains in their correct spelling performance from Time 1 to Time 2, overtaking the performance of Group B (Table 3.1). Testing at Time 3 (five weeks after post-experimental testing at Time 2) showed Group A to have fallen back slightly from their position at Time 2, but to have maintained their lead over Group B. The latter group, on the other hand, fell back in their correct spelling performance from Times 1 to 2, but stayed at the same level from Times 2 to 3.

Table 3.1: Comparison of the mean correct spelling scores for Groups A and B at Time 1 (before intervention/non intervention), Time 2 (after intervention/non intervention) and Time 3 (five weeks after Time 2)

	Time 1		Time 2		Time 3	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Group A (*n*: 18)	7.44	4.79	9.11	5.20	8.06	4.93
Group B (*n*: 18)	8.89	6.18	7.44	5.90	7.44	5.36
Total (*n*: 36)	8.17	5.50	8.28	5.55	7.75	5.08

Figure 3.1. Chart illustrating mean correct group spelling scores at Times 1, 2 and 3



A preliminary two-way analysis of variance (ANOVA) was used to assess the statistical significance of the two main factors of interest in terms the effect of the intervention/non intervention on spelling performance. These were 'time', which had repeated measures (for

Times 1, 2 and 3) and 'group' (A/B) and their interaction (time x group). The overall effect of time was not statistically significant (F (2,68) = .585, p = .560), but the interaction of time with group was significant (F (2,68) = 4.728, p = .012). The main between-subjects effect of group was also not significant (F (1,34) = .027, p = .872). Post hoc analyses were carried out to test the predictions in relation to the interaction of time with group, so as to ascertain whether the gains in correct spelling on the part of Group A from Time 1 to Time 2 were statistically significant compared with the spelling performance of Group B at Times 1 and 2. Analyses were therefore carried out, again using repeated-measures two-way ANOVAs, to examine three possible pairings: Time 1/2 x Group A/B; Time 1/ 3 x Group A/B/; and Time 2/3 x Group A/B. In each case, the level of significance was adjusted to account for one third of the alpha level (p < .017) according to the Bonferroni method. In the first of these analyses (Time 1/2 x Group A/B), neither of the main effects of time and group was significant (F (1,34) = .039, p = .846 and F (1,34) = .044, p = .950 in each case), but the interaction of time with group was significant (F (1,34) = 7.547, p = .010), as predicted. In the second analysis (Time 1/3 x Group A/B), neither of the main effects was significant (time: F (1,34) = .561, p = .459 and group: F (1,34) = .061, p = .807), nor was their interaction (F (1,34) = 3.414, p = .073). Finally, in the third analysis (Time 2/3 x Group A/B) neither of the main effects of time or group was significant (F (1,34) = 1.697, p = .201 in both cases), nor was their interaction (F (1,34) = .428, p = .517). Taken together these results indicate that the significant time x group interaction in the preliminary ANOVA arose due to Group A's improved spelling performance and Group B's corresponding drop in performance from Times 1 to 2. No significant differences were shown for either group from Time 2 to Time 3, or from Time 1 to Time 3.

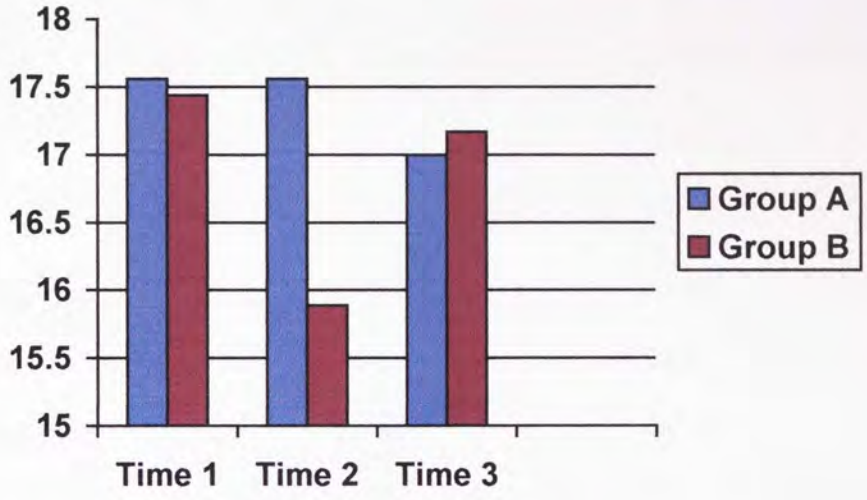
3.4.2. Phonologically Plausible Spelling Performance

The results for phonologically plausible (PP) spelling show the intervention group (Group A) to have maintained a consistent level of performance at Times 1, 2 and 3. Group B also maintained a consistent level of PP spelling at Times 1 and 3, but appeared to show a slight drop in performance at Time 2. Table 3.2 shows the mean PP scores for both groups at Times 1, 2 and 3. Figure 3.2 illustrates these findings as a chart. Again the maximum score at each test was 24.

Table 3.2: Comparison of the mean phonologically plausible (PP) spelling scores for Groups A and B at Times 1, 2 and 3

	Time 1		Time 2		Time 3	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Group A (*n* 18)	17.56	4.48	17.56	5.46	17.00	5.44
Group B (*n* 18)	17.44	5.97	15.89	7.35	17.17	5.55
Total (*n* 36)	17.50	5.20	16.72	6.44	17.08	5.42

Figure 3.2. Chart illustrating mean group PP scores at Times 1, 2 and 3



A repeated-measures two-way ANOVA was carried out to test the statistical significance of any differences between group PP scores at Times 1, 2 and 3. Neither of the main effects of time or group was statistically significant (F (2,68) = 1 .149, p = .323 and F (1,34) = .086, p = .771 respectively), nor was the interaction of time with group (F (2,68) = 1.851, p = .165). Thus the apparent drop in PP spelling on the part of Group B at Time 2 was not significant, nor were there any other significant group or time differences in phonologically plausible spelling performance.

3.4.3. Analogy Use Scores

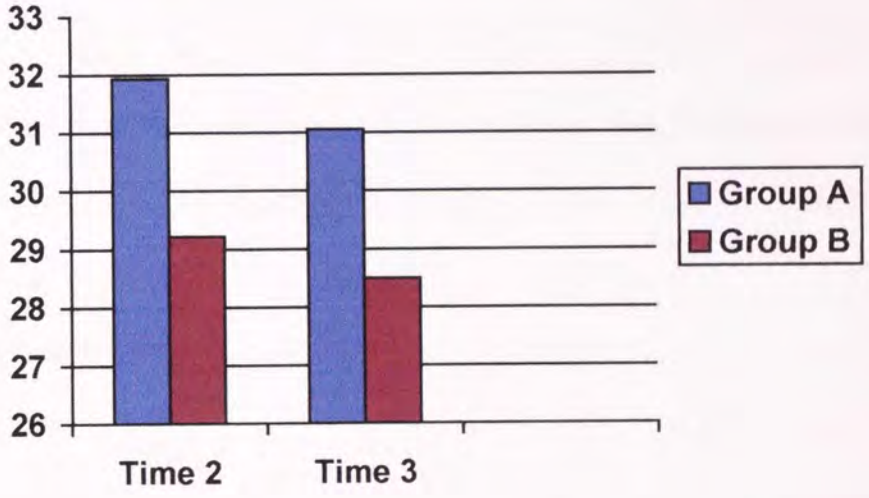
Analogy was not assessed at Time 1, since the children had not been given the words to be used in analogy until Time 2. Not surprisingly, the analogy use scores for Group A, who had been coached in analogy use, were slightly higher than those of their non-intervention counterparts. Inspection of Table 3.3 shows the mean analogy use scores for Groups A and B

at Times 2 and 3. Scores for each test were out of a maximum of 48. Figure 3.3 illustrates these findings as a chart.

Table 3.3: Comparison of the mean analogy scores at Times 2 and 3 for Groups A and B.

	Time 2			Time 3		
	Mean	*SD*	*n*	Mean	*SD*	*n*
Group A	31.94	7.88	18	31.06	6.72	18
Group B	29.22	8.24	18	28.5	7.42	18
Mean total	30.58	8.07	36	28.77	7.78	36

Figure 3.3. Chart illustrating mean analogy scores at Times 2 and 3 for Groups A and B.



A repeated-measures two-way ANOVA was carried out to test the statistical significance of any differences in group analogy scores. The factors were analogy, with two levels (at Times 2 and 3) and group, also with two levels (A/B). Neither of the main effects of analogy and

group was statistically significant (F (1,34) = .953, p = .336 and F (1,34) = 1.218, p = .277 respectively), nor was their interaction (F (1,34) = .010, p = .920).

3.4.4. The Relationship between Correct Spelling, PP and Analogy Use

In order to explore the relationship between correct spelling performance, phonological plausibility (PP) and analogy use, correlations were carried out for these variables and age at Times 2 and 3 (Table 3.4). Inspection of Table 3.4 shows correct spelling to have been highly correlated with analogy and phonological plausibility (PP), both at Time 2 and at Time 3. Time 2 and Time 3 correct spelling were also strongly correlated, as were Time 2 and Time 3 analogy and Time 2 and Time 3 phonological plausibility. Analogy and phonological plausibility also correlated highly with each other, both at Time 2 and at Time 3. Age was not highly correlated with any of these variables, although it was significantly (p<.05) correlated with phonological plausibility at Times 2 and 3.

Table 3.4: Pearson correlations for correct spelling, PP, analogy use and age at Times 2 and 3

	AGE	T2.CORR	T2.PP	T2.AN	T3.CORR	T3.PP	T3.AN
AGE	-	.125	.329*	.237	.259	.374*	.292
T2.CORR	-	-	.839**	.847**	.897**	.693**	.762**
T2.PP	-	-	-	.828**	.781**	.871**	.774**
T2.AN	-	-	-	-	.724**	.713**	.800**
T3.CORR	-	-	-	-	-	.791**	.805**
T3.PP	-	-	-	-	-	-	.751**
T3.AN	-	-	-	-	-	-	-

**Correlation is significant at the level of p<.01 (2-tailed)

* Correlation is significant at the level of p<.05 (2-tailed).

So as to explore these correlations further, regression analyses were carried out using the Time 2 or Time 3 correct spelling scores as the criterion variables and the Time 2 or Time 3 analogy use and PP scores as the predictor variables. The first of these related to the sample as a whole at Times 2 and 3. These indicated analogy use and PP both to be significantly predictive of correct spelling, although analogy appeared to be a stronger predictor than PP, particularly at Time 3 (Table 3.5).

Table 3.5: Summary of the models in which analogy use and PP scores were entered simultaneously as predictors of correct spelling at (A) Time 2 and (B) Time 3

(A) Criterion variable: T2 correct spelling; Predictors: T2 Analogy and T2 PP

Model	R	R^2	Adjusted R^2	Predictor	Std Beta Coef.	Sig.
1	.882	.777	.764	Analogy	.486	.002
				PP	.436	.005

(B) Criterion variable: T3 correct spelling; Predictors: T3 Analogy and T3 PP

Model	R	R^2	Adjusted R^2	Predictor	Std Beta Coef.	Sig.
1	.846	.715	.698	Analogy	.512	.001
				PP	.391	.009

Separate regression analyses for Groups A and B, however, using the same criterion and predictor variables at Times 2 and 3, showed analogy use to be more predictive of correct spelling than PP for the intervention group, whereas the reverse pattern was shown for the controls (Tables 3.6 and 3.7).

Table 3.6: Summary of the models for Group A in which analogy and PP were entered simultaneously as predictors of correct spelling at (A) Time 2 and (B) Time 3

(A). Criterion variable: T2 correct spelling; Predictors: T2 Analogy and T2 PP

Model	R	R^2	Adjusted R^2	Predictor	Std Beta Coef.	Sig.
1	.903	.815	.776	Analogy	.590	.008
				PP	.350	.094

(B). Criterion variable: T3 correct spelling; Predictors: T3 Analogy and T3 PP

Model	R	R^2	Adjusted R^2	Predictor	Std Beta Coef.	Sig.
1	.908	.824	.786	Analogy	.654	.0001
				PP	.299	.063

Table 3.7: Summary of the models for Group B in which analogy and PP were simultaneously entered as predictors of correct spelling at (A) Time 2 and (B) Time 3

(A). Criterion variable: T2 correct spelling; Predictors: T2 Analogy and T2 PP

Model	R	R^2	Adjusted R^2	Predictor	Std Beta Coef.	Sig.
1	.921	.847	.815	Analogy	.341	.112
				PP	.698	.005

(B). Criterion variable: T3 correct spelling; Predictors: T3 Analogy and T3 PP

Model	R	R^2	Adjusted R^2	Predictor	Std Beta Coef.	Sig.
1	.841	.707	.645	Analogy	.232	.471
				PP	.724	.043

These results demonstrate that Groups A and B showed a different balance of analogical and phonological strategies in their spelling, which may have been a function of the intervention/ non-intervention. Although caution should be taken in applying interpretation, if this were the case, it would indicate that it was the analogy coaching, rather than the intervention *per se,* that had the effect of improving the experimental group's spelling performance.

3.4.5. Unit by Unit Comparisons of Analogy Use

The prediction in relation to correct spelling performance broken down by unit was that there would either be a preference for rime analogy (as shown by Goswami, 1988) or no notable difference in the degree to which different units contributed to analogy use in spelling (Nation & Hulme, 1996).

Table 3.8 permits a comparison of the analogy use scores for Groups A and B, broken down by unit and by time. The maximum correct analogy score for each unit was six.

Table 3.8: Mean correct analogy use scores by unit, by group and by time*

	Group A (*n*18)		Group B (*n*18)		Total (*n* 36)	
	Time 2	Time 3	Time 2	Time 3	Time 2	Time 3
Unit	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (SD)	Mean (SD)
On+pk	2.17 (1.43)	2.06 (1.51)	1.83 (1.76)	1.89 (1.53)	2.00 (1.59)	1.97 (1.50)
Peak	2.39 (1.58)	1.50 (1.47)	2.00 (1.53)	1.61 (1.46)	2.19 (1.55)	1.56 (1.44)
Rime	2.61 (1.58)	2.50 (1.62)	1.89 (1.68)	1.83 (1.54)	2.25 (1.65)	2.17 (1.60)
Coda	1.94 (1.48)	2.00 (1.41)	1.72 (1.71)	2.11 (1.68)	1.83 (1.58)	2.06 (1.53)

Note: *Analogy words only given at Times 2 and 3.

A repeated-measures three-way ANOVA was used to assess the significance of the comparative contributions of the different units to correct spelling. The three factors were 'unit' (with four levels), 'time' (with two levels) and 'group' (with two levels). Neither of the main effects of unit or time was significant (F (3,102) = 1.665, p = .179 and F (1,34) = 1.697, p = .201 respectively), nor was the main effect of group (F (1,34) = .428, p = .517). Neither of the interactions of time with group or unit with group was significant (F (1,34) = 1.697, p = .201 and F (3,102) = 1.624, p = .188 respectively), but the interaction of unit with time was significant (F (3,102) = 2.874, p = .040). This therefore suggests that significantly different patterns of analogy at the four unit levels may have been used at Time 2 and Time 3.

Post hoc analyses were therefore carried out to assess the significance of any possible unit by time differences in analogy performance. The four analyses were therefore Time 2 onset+peak *vs* Time 3 onset+peak, Time 2 peak *vs* Time 3 peak, Time 2 rime *vs* Time 3 rime, and Time 2 coda *vs* Time 3 coda. In each case the level of significance was adjusted to account for one quarter of the alpha level (p<.013). These showed no significant unit by time differences in the degree to which the onset+peak, rime or coda respectively contributed to correct spelling (F (1,35) = .018, p = .893; F (1,35) = .179, p = .674; F (1,35) = 1.239, p = .273 in each case), but there was a significant difference in the degree to which the peak contributed to correct spelling at Times 2 and 3 (F (1,35) = 7.315, p = .010).

3.5. DISCUSSION

Experiment 1 was conducted to establish whether intervention in analogy use in spelling could improve spelling performance in 5- to 7-year-old school children. The fact that the group of children which received intervention in analogy use in spelling (Group A) markedly

improved their correct spelling performance from Time 1 to Time 2, and indeed surpassed the correct spelling performance of Group B, who had not taken part in the analogy intervention but only practised reading during the intervention period, implies that analogy intervention did indeed have a positive effect on the former group's correct spelling performance. It is also encouraging that this positive effect was still apparent, although only as a strong trend, even five weeks after post-experimental testing. The fact that analogy proved to be highly predictive of the intervention group's correct spelling performance, whereas phonological plausibility was a much higher predictor for the controls, also implies that the two groups were using different strategies in their spelling. The different balance of analogical and phonological strategies shown by the two groups in their spelling may have been a function of the intervention/ non-intervention. If this were the case, although caution should be taken in applying interpretation to these results, they do indicate that it was the analogy coaching, rather than the intervention *per se,* that had the effect of improving the experimental group's spelling performance.

However, these results were not entirely conclusive since there were no marked differences in the analogy use scores for Groups A and B at Time 2 (Table 3.3), which is difficult to reconcile with the claim that it was analogy use that made the difference to the intervention group's correct spelling performance. It should be pointed out, however, that the analogy use scores indicated use of analogy at the level of the individual units: they did not necessarily reflect correct analogy use across the whole word. It may be, therefore, that although Group B was equally as able to make analogies with specific units as the intervention group, these children were less adept, without the aid of intervention, at using analogy strategically to produce correct spellings.

While the intervention group's correct spelling performance improved from Time 1 to Time 2, the performance of the controls declined over the same period. This may have been due to task demands inherent in the clue word test. Both Groups A and B were given the same test at Times 2 and 3, but whereas the analogy intervention made sense of the task for the former, this may not have been the case for the latter, who had not received analogy intervention. Thus, even though the task requiring the children to spell by analogy with a clue word was quite demanding, the intervention group was able to benefit from the task, whereas the reverse was the case for Group B, who may have been lead to question their spelling ability and consequently deteriorated in their performance at Time 2. The fact that they did not improve in their performance at Time 3 indicates that they did not benefit from practice in using the clue word task, but continued to find the task demanding. This interpretation is supported by the finding that the two groups used a different balance of analogical and phonological strategies in their spelling (Tables 3.6 and 3.7), since those children who had not received analogy coaching (Group B) did not make use of analogy with the clue word to aid their spelling performance.

Although these results are far from clear cut, the improved correct spelling performance of the intervention group in relation to the controls and the finding that analogy is at least as predictive of the variance in correct spelling as phonological plausibility (Table 3.5) would indicate that intervention in analogy use in English spelling can improve correct spelling performance. This finding has important implications for the teaching of spelling in schools, at least in relation to English spelling, since phoneme-based strategies alone do not consistently lead to correct spelling in an irregular orthography. The suggestion is, therefore, that English school children might benefit from instruction in using orthographic analogies in their spelling in addition to, or in combination with, phoneme-based strategies.

As to the question of which specific orthographic units aid children most in making analogies in their spelling, the findings overall suggest that there is no notable difference in the degree to which children can make use of analogy at different unit levels, at least with respect to those under consideration here. It is noteworthy, however, that the results indicated a marked difference in the degree to which the peak contributed to correct spelling at Times 2 and 3. The difference in peak analogies was marked for both groups (Table 3.8), but this may simply have been a consequence of vowel spelling patterns that were relatively well represented at Time 2 being less well represented five weeks later at the start of a new school term (Time 3). It is notable that "vowels are by far the most inconsistent syllable part" (Kessler & Treiman, 2001, p.611) in English spelling, so it might be expected that greater inconsistency would lead to less secure representation of vowel spelling patterns in children whose spelling ability is still developing.

Overall, however, the results in relation to analogy use at the different unit levels appear to favour the argument put forward by Nation & Hulme (1996) that children are equally able to use analogy at both large (e.g. onset+peak and rime) and small (peak or coda) unit levels, and offer no support for Goswami's (1988) conclusion that children favour rime analogies over analogies at any other unit level. It should be noted, however, that both Nation and Hulme's (1996) study in relation to spelling and Goswami's (1993) study in relation to reading also incorporated a comparison of analogy use by different age-groups. Goswami's (1993, Exp. 2 and 3) showed children of differing degrees of literary ability making "increasingly refined" orthographic analogies (*ibid*, p.468) as their skills developed, initially showing a preference for larger unit analogies (e.g. at the level of the rime) but showing increasing ability to use analogy to an equivalent extent at both small (e.g. peak) and large unit levels, provided that

there was enough 'graphemic overlap' between the units in question. Nation and Hulme (1996), on the other hand, found that children were equally able to use analogy at large and small unit levels, regardless of their spelling ability. Further investigation is needed to elucidate these findings. It may be that children simply rely on different patterns of analogy to assist in spelling different words. Alternatively, it may be, as Goswami's (1993) interactive analogy model would predict, that children become more able to use analogy at a variety of unit levels as their spelling skills develop. A future study would need to consider possible changes in patterns of analogy use by comparing analogy use at the levels of onset+peak, peak, rime and coda in two different age-groups.

The intention is, therefore, to carry out a replication of this study, again using two age-groups but with a larger sample of children. A replication of this study with a larger sample of children would be useful in confirming the beneficial effect of the analogy intervention. Analysis of possible differences in patterns of analogy for the two age-groups might also help to confirm which orthographic units children find most salient in spelling at different points in development.

4. CHAPTER 4: EXPERIMENT 2

4.1. INTRODUCTION

Experiment 1 investigated the effect of analogy intervention in improving the correct spelling performance of 5- to 7-year-old English primary school children, by comparing the spelling performance of an intervention group with that of controls before and after analogy intervention/ non-intervention. Intervention in analogy use was found to have a significant effect on the intervention group's spelling performance in comparison with controls, and this effect was still apparent as a strong trend five weeks later. The fact that analogy use was found to be highly predictive of correct spelling for the intervention group, but not for the non-intervention group, was interpreted as an indication that it was the intervention in analogy use, rather than simply the intervention *per se*, that had been influential in improving the intervention group's performance compared with that of their non-intervention counterparts. Investigation of the specific contribution to correct spelling of different orthographic unit levels (onset+peak, peak, rime or coda) showed no marked difference in the extent to which children used analogies at these levels.

However, these results were not entirely clear-cut since there were no marked differences in the analogy use scores for Groups A and B at Time 2, which might be considered difficult to reconcile with the claim that it was the analogy intervention that lead to the improved spelling performance of the intervention group. It was therefore considered desirable to replicate this study using a larger sample of children, since doubling the sample size used in Experiment 1 would be expected to achieve more robust effects.

Additionally, Experiment 1 did not address the question of how analogy use develops as spelling performance improves, or whether children show an increasingly 'refined' use of orthographic analogies, as Goswami's (1993) interactive analogy model would predict. This was the focus of her three-part study on reading development, in which she considered the salience of both large unit analogies, such as onset-vowel ('*bug-bun*', '*beak-bean*', '*swing-swim*') and rime ('*bug-rug*', '*beak-peak*', '*bump-lump*') and small unit analogies, such as the onset ('*trim-trot*'), medial vowel ('*bug-cup*', '*beak-heap*') or coda ('*bump-camp*') at different stages in relation to analogy use in reading. According to Goswami (1993) the children in her Experiment 1, who were of a younger reading age than those in the latter experiments, showed transfer at the large unit level ('*bug-rug*', '*bug-bun*') but not at the level of the medial vowel only ('*bug-cup*'), whereas children at a slightly more advanced reading level (Goswami, 1993, Exp.2) were able to use analogy at both large and small unit levels ('*beak-bean*'; '*beak-peak*'; '*beak-heap*') to help them to read new words, but did not show transfer in a three common letters condition ('*beak-bank*'), since this was not orthographically analogous. This developmental pattern of analogy use in reading would appear to be in line with that predicted by her interactive analogy model, namely showing an 'increasingly refined use of analogy'. However, Nation and Hulme (1996) also used Goswami's 'clue word' paradigm to investigate the development of analogy use in spelling. Their sample of children was of a comparable age to those in Goswami's studies of 1993 (and to those in Experiment 1 of the present thesis) but was divided into three groups delineating three levels of spelling ability: lower, age-appropriate and advanced. Their stimuli consisted of the same conditions as those in Goswami's Experiment 2 (1993): onset-vowel ('*corn-cord*'), medial vowel ('*corn-lord*'), rime ('*corn-born*') and three common letters ('*corn-cone*'), but, unlike Goswami, they found that all three groups, whatever their spelling ability, were able to use analogy at the level of the medial vowel to the same degree as onset-vowel and rime analogies. Thus, it

appeared from the Nation and Hulme study that there was no evidence of children using increasingly refined patterns of analogy as their spelling progressed, but rather that children could use small and large-unit analogies to an equivalent extent from early on. The children in Experiment 1 of the present thesis also showed no evidence of favouring large-unit over small-unit analogies, but a comparison of different year-groups might show evidence of a shift in analogy use, as indicated by Goswami's (1993) study.

However, Goswami's conclusion in her Experiments 2 and 3 (1993) was that the degree of 'graphemic overlap' ('*beak-heap*' or '*corn-lord*', as opposed to '*swing-crib*', for example) between analogous words would also be likely to influence the degree of transfer shown. Indeed, the children in Goswami's Experiment 3 (1993) showed evidence of making significantly more large-unit analogies ('*swing-swim*' or '*bump-lump*') than small-unit analogies, when the latter comprised a lesser degree of graphemic overlap ('*swing-crib*' or '*bump-camp*', rather than '*beak-heap*'). Thus it is not entirely clear whether Nation and Hulme's (1996) finding in relation to medial vowel (peak) analogies was at least partially due to the degree of graphemic overlap between the clue word and test words.

In the light of these combined findings, it was therefore considered desirable to carry out a replication of Experiment 1 with a larger sample of children, again using intervention and non-intervention groups and, additionally, to include a comparison of the patterns of analogy used by the two year-groups, so as to observe whether there was any evidence of 'increasingly refined orthographic analogy' use at different developmental stages (Goswami, 1993), or not.

4.2. AIMS OF EXPERIMENT 2

The purpose of this experiment was to investigate whether teaching young children to use analogy in English spelling would positively affect their spelling performance after intervention, compared with that of a control group after no analogy intervention. Additionally, the aim was to investigate the comparative contributions of analogy and phonology to variance in spelling performance and to investigate the comparative contributions to analogy use of both large and small orthographic units (onset+peak and rime, or peak and coda) in two age-groups of children (primary Years 1 and 2).

On the basis of the findings of Experiment 1 in relation to the intervention effect on the spelling performance of the intervention group, as compared with that of no analogy intervention on the control group, the prediction for Experiment 2 was that some difference would be shown between the two groups (A and B) across the three tests (at Times 1, 2 and 3) since, although the two groups would be expected to be similar in their performance at Time 1, a considerable difference would be expected at Time 2, which would either remain the same or become less marked at Time 3. The prediction would therefore be that overall differences would be expected in relation to time effects. The prediction in relation to group effects would be that no difference would be shown overall, since similarity at Time 1 would be likely to cloud any differences at Times 2 and 3. Group x time interactions would be expected, but only in relation to Times 1 and 2, and to a lesser extent possibly at Times 1 and 3, driven by improved performance by Group A. No group x time interactions would be expected at Times 2 and 3.

4.3. METHOD

4.3.1. Participants

Experiment 2 was an extension of Experiment 1, incorporating 36 children from the original sample and an additional 30 children from another school. The total sample thus comprised 66 primary school children (29 girls and 37 boys) from three carefully matched rural village schools. Half the children were in Year 1 (mean age 5.92, *SD* 0.30) and half in Year 2 (mean age 6.87, *SD* 0.28). Children from both Years were randomly divided between an intervention (Group A) and a control group (Group B). Each of the groups comprised 33 pupils in total.

The groups were carefully matched to provide, as far as possible, equal ratios of male/female and older/younger pupils and equal numbers of pupils from the three schools in each group, thus controlling for possible effects of different teaching methods across schools (Savage & Stuart, 1998, p.90). A one-way ANOVA confirmed that there were no significant age differences between the children in the two groups (F (1,65) = .001, p = .972). A one-way ANOVA was also performed to ensure that there were no significant age differences between the children who comprised the original sample for Experiment 1 and the additional children (F (1,65) = 1.06, p = .306). All three schools were from within the same rural primary school cluster, similar in size, environmental setting and pupil background. All the schools had the same early-years (*KS1*) classroom structure and employed the same reading instruction based on the National Literacy Strategy, combining the use of phonics with contextual cues and sight-word reading. All the children had English as their first language and had normal or corrected-to-normal vision. No children were excluded from the study.

4.3.2. Materials

Both the intervention and test materials comprised exactly the same selection of consonant blends, single letters, vowel digraphs, rimes and word endings as were used in Experiment 1 (see 3.3.2.1 and 3.3.2.2).

4.3.3. Design

This experiment was designed to replicate Experiment 1 so as to gauge the effect of intervention in analogy use on the spelling performance of an intervention group, as compared with that of a control group who received no analogy intervention, but using a larger sample of children. It was therefore essential that this replication took place exactly one year after the first experiment, so as to ensure that the additional sample of children had reached the same level of literacy instruction at school as the original sample in Experiment 1. As Experiment 1, the experiment took place during the second half of the second term and the first half of the third term. The same mixed design was used as for Experiment 1, employing two groups of children: an experimental group (Group A), who participated in an analogy intervention programme, and a control group (Group B) who followed normal classroom activities, but additionally partook in reading practice with the experimenter, as for Experiment 1 (3.3.4.1). An initial spelling test (at Time 1) was administered to both groups just before the half-term break in the second (Spring) term prior to any teaching intervention taking place, so as to gauge the pre-experimental spelling performance of each group. The five-week long analogy intervention programme, in which only the experimental group (Group A) participated, took place during the second half of the Spring term. This was followed by a second test just before the end of the same term (at Time 2), administered to both groups. A final test was administered to both groups again approximately five weeks later following the children's return to school after the Easter holiday (at Time 3), so as to gauge the durability of any

intervention effects present at Time 2. The main variables of interest were therefore 'group' (A /B) and 'time' (1, 2 and 3), with the dependent variable being the spelling scores.

4.3.4. Procedure

4.3.4.1. Testing and Intervention Procedure

Exactly the same procedure was employed for both the intervention programme and for the pre- and post-experimental tests, as for Experiment 1 (3.3.4.1).

4.3.4.2. Scoring Procedure

The same procedure was used and the same criteria applied as for Experiment 1 (3.3.4.2), resulting in three scores for each spelling produced at each of the post-experimental tests, on the basis of correct spelling, phonological plausibility (PP) and analogy use. The pre-experimental test at Time 1 was scored on the basis of correct or phonologically plausible spelling only, since the clue words to be used in analogy were not given until Time 2.

4.4. RESULTS

Responses to the spelling tests at Times 1, 2 and 3 were collected and recorded in spreadsheet format. Maximum scores for correct and phonologically plausible (PP) spelling at each test were 24, while the maximum score at each test for analogy use was 48. (For an explanation of scoring see 3.3.4.2). Analogy was not assessed at Time 1, since the words that the children were to use in analogy were not given until the test at Time 2. Correct spelling scores were broken down by unit (onset+peak, peak, rime and coda) to ascertain which unit/s contributed most to correct spelling performance. The maximum correct spelling score for each unit was six at each test (at Times 2 and 3), or 12 when the two tests were summed.

The results were analysed using a preliminary repeated-measures analysis of variance (ANOVA), so as to establish the statistical significance of any group or time differences and their interactions, followed by post hoc analyses. Additionally an independent samples t-test was used to confirm that there were no significant performance differences between the old and new samples in terms of either their correct or phonologically plausible (PP) spelling performance (F (1,64) = -.948, p = .347; F (1,64) = -1.768, p = .084 respectively) at the start of the study. Linear regressions were also employed to ascertain the comparative predictive effects of age, analogy use and phonological plausibility on variance in spelling performance.

Comparisons by year, by group and by time were also made in relation to the contributions of the different word units under consideration (onset+peak, peak, rime and coda) so as to explore possible differences in patterns of analogy use by the two year-groups (Years 1 and 2) or by the two experimental groups (A and B) across the two tests when analogy use was measured (Times 2 and 3). The statistical significance of any differences was again established using a repeated-measures ANOVA.

4.4.1. Correct Spelling Performance

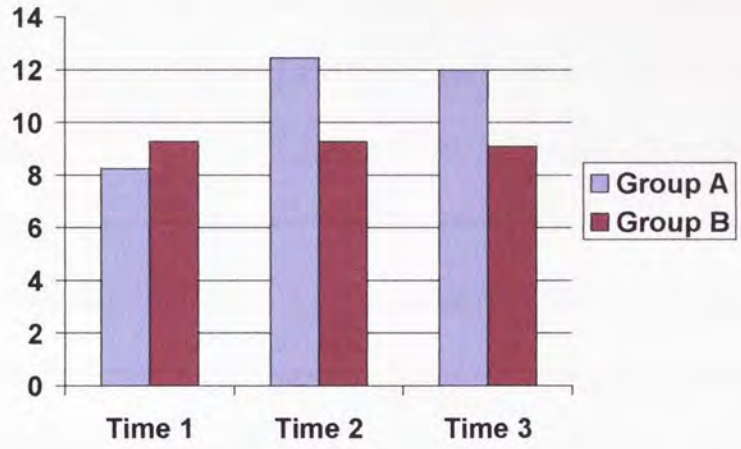
The prediction was that testing at Times 1 and 2 would show an interaction between the two groups, with Group A improving in their performance, but Group B either staying the same or, on the basis of the results of Experiment 1, dipping slightly. However, since it was expected that both groups would either remain the same or show a slight decrease in their performance at Time 3, no interaction was predicted in relation to Times 2 and 3.

Inspection of Table 4.1 shows the intervention group (Group A) to have improved in their spelling performance from Time 1 to Time 2 as predicted, with the performance on the part of the controls (Group B) remaining unchanged over the same period. This indicates that teaching intervention in analogy use in spelling did improve the spelling performance of Group A, compared with that of Group B, and that this effect was maintained at Time 3. Both groups remained at much the same level of performance from Time 2 to Time 3. Figure 4.1 illustrates these findings as a chart.

Table 4.1: Comparison of the means for Group A and Group B correct spelling scores at Times 1, 2 and 3 (before and after intervention, and five weeks later)

	Time 1		Time 2		Time 3	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Group A (*n* 33)	8.24	5.19	12.45	6.15	12.00	6.93
Group B (*n* 33)	9.27	5.91	9.27	6.39	9.09	5.93

Figure 4.1. Chart illustrating mean group correct spelling scores at Times 1,2 and 3



A preliminary repeated-measures two-way analysis of variance (ANOVA) was used to assess the statistical significance of the two main effects: time, which had three levels (1, 2 and 3) and group, which had two (A/B) and their interaction (time x group). As predicted, the effect of time was statistically significant (F (2,124) = 11.904, $p < .0001$), as was the interaction of time with group (F (2,124) = 13.028, $p < .0001$). The main effect of group was not significant (F (1,62) = 1.451, $p = .233$). This was to be expected since performance by the two groups at Time 1 may have neutralised group differences at Times 2 and 3.

However, since the above overall analysis was of limited use in terms of testing the predictions in relation to specific pairings of time with group, (such as the expected interaction of time with group at Times 1 and 2, but no expected time x group interaction at Times 2 and 3), post hoc analyses were subsequently carried out. These comprised three repeated-measures two-way ANOVAs to examine three possible pairings: Time 1 vs. Time 2

x Group A and B; Time 1 vs. Time 3 x Group A and B; and Time 2 vs. Time 3 x Group A and B. In each case the 0.05 significance level was adjusted to account for one third of the alpha level ($p < .017$) according to the Bonferroni method. In the first of these analyses (Time 1 vs. 2 x Group A/B), the effect of time was found to be significant, as was the interaction of time with group (F (1,64) 17.551, $p < .0001$ in each case), but the effect of group was not significant (F (1,64) = .616, $p = .435$). The second analysis again showed the effect of time (1/3) to be significant (F (1,64) = 10.811, $p = .002$), as was the interaction of time with group (F (1,64) = 13.121, $p = .001$), while the effect of group was again not significant ($p = 1.46$). The significant interaction of time (1/2) with group indicated the intervention applied to Group A, but not to Group B, to have been effective; the subsequent significant interaction of time (1/3) with group indicated that the effect evident at Time 2 still prevailed five weeks later at Time 3, after the Easter break. The third analysis (Times 2/3 with Groups A/B) was expected to find no significant time differences, nor any significant interaction of time with group, as was indeed the case (F (1,64) = 1.040, $p = .312$ and F (1,64) = .191, $p = .664$ respectively), indicating that performance at Times 2 and 3 remained stable. No significant group differences were found either (F (1,64) = 3.933, $p = .052$).

4.4.2. Phonologically Plausible Spelling Performance

The prediction in relation to phonologically plausible spelling performance was that there would be no overall time or group differences.

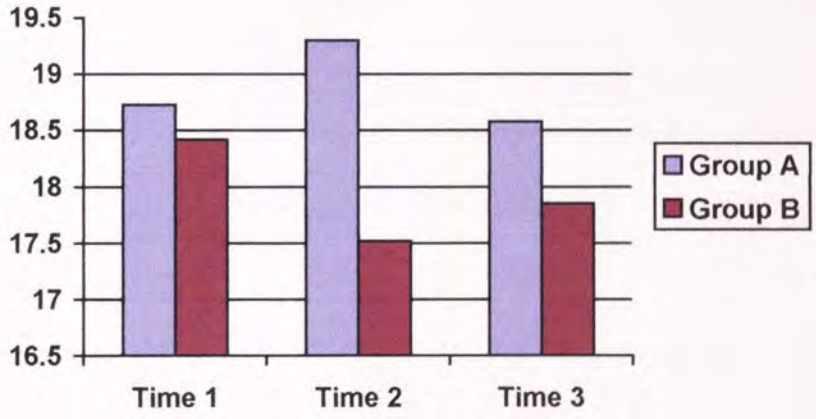
The results showed phonologically plausible spelling performance on the part of both groups at Times 1, 2 and 3 to have remained fairly stable, although the intervention group showed a slight increase in their phonologically plausible spelling from Time 1 to Time 2, dropping back at Time 3 to roughly the same score as at Time 1, whereas the controls dipped slightly in

their performance from Time 1 to Time 2, but maintained much the same level of performance from Time 2 to Time 3 (Table 4.2). Figure 4.2 illustrates these findings as a chart.

Table 4.2: Comparison of the mean PP scores for Groups A and B at Times 1, 2 and 3

	PP - Time 1			PP – Time 2			PP – Time 3		
	Mean	*SD*	*n*	Mean	*SD*	*n*	Mean	*SD*	*n*
Group A	18.73	4.82	33	19.30	4.78	33	18.58	5.03	33
Group B	18.42	6.24	33	17.52	7.01	33	17.85	5.88	33

Figure 4.2. Chart illustrating mean group PP scores at Times 1, 2 and 3



A repeated-measures two-way analysis of variance (ANOVA) was used to assess the statistical significance of the two main effects: time, which had three levels (1, 2 and 3) and group, which had two (A/B) and their interaction (time x group). As predicted, neither the effect of time nor that of group was statistically significant (F (2,128) = .512, p = .600; F

(1,64) = .494, p = .485 respectively), nor was the interaction of time with group (F (2,128) = 2.261, p = .108).

4.4.3. Analogy Use Scores

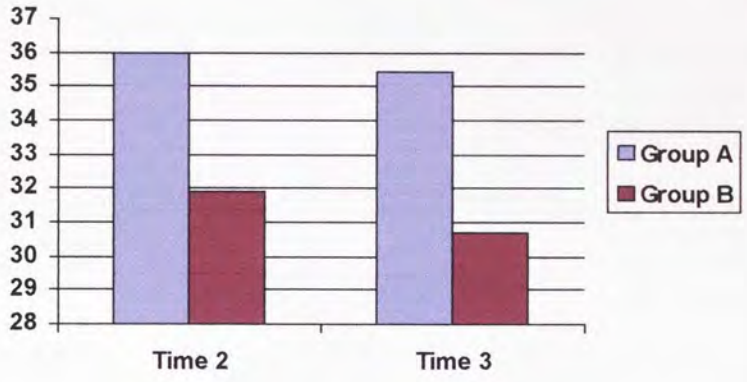
The prediction in relation to analogy use in spelling was that a general group difference would be shown, with Group A exceeding the performance of Group B, since the former had received analogy coaching, whereas the latter had not. No overall time differences were predicted, nor any group x time interaction.

The results showed Group A to have scored considerably higher than Group B in their use of analogy at both Times 2 and 3. Neither group dropped significantly in their analogy scores from Time 2 to Time 3. Table 4.3 permits comparison of the mean analogy use scores for both groups at Times 2 and 3. Figure 4.3 illustrates these findings as a chart. Analogy was not assessed at Time 1, since the words to be used in analogy were not given until Time 2.

Table 4.3: Comparison of mean group scores for analogy use at Times 2 and 3

	Time 2: Mean	*SD*	Time 3: Mean	*SD*
Group A (*n* 33)	36.00	8.36	35.45	8.67
Group B (*n* 33)	31.91	7.80	30.70	7.96

Figure 4.3. Chart illustrating mean group analogy use scores at Time 2 and 3



A repeated-measures two-way ANOVA was used to assess the statistical significance of the main effects (Time 2 vs. Time 3 x Group A vs. Group B). No significance was found for the effect of time (F (1,62) = 2.421, p = .125) nor for the interaction of time with group (F (1,62) = .395, p = .532), but the effect of group was found to be statistically significant (F (1,62) = 5.334, p = .024), indicating that the intervention group, who had been coached in analogy use in spelling, was indeed using analogy significantly more than the controls, who had received no analogy intervention.

4.4.4. The Relationship between Correct Spelling, PP and Analogy Use

In order to explore the relationship between correct spelling performance, phonological plausibility (PP) and analogy use, correlations were carried out for these variables and age at Times 2 and 3 (see Table 4.4).

Table 4.4: Pearson correlations for correct spelling, PP, analogy use and age at Times 2 and 3

	AGE	T1.CORR	T1.PP	T2.CORR	T2.PP	T2.AN	T3.CORR	T3.PP	T3.AN
AGE	-	.222	.411**	.128	.311*	.148	.177	.342**	.203
T1.CORR	-	-	.670**	.718**	.656**	.597*	.696**	.659**	.588**
T1.PP	-	-	-	.713**	.864**	.687**	.694**	.842**	.663**
T2.CORR	-	-	-	-	.822**	.901**	.925**	.765**	.861**
T2.PP	-	-	-	-	-	.814**	.770**	.890**	.757**
T2.AN	-	-	-	-	-	-	.836**	.752**	.849**
T3.CORR	-	-	-	-	-	-	-	.791**	.911**
T3.PP	-	-	-	-	-	-	-	-	.784**
T3.AN	-	-	-	-	-	-	-	-	-

**Correlation is significant at the level of $p<.01$ (2-tailed)

* Correlation is significant at the level of $p<.05$ (2-tailed).

Inspection of Table 4.4 shows correct spelling to have correlated highly with both analogy and phonological plausibility (PP), at Time 2 and at Time 3, and PP to have correlated highly with correct spelling at Time 1 (analogy was not assessed at Time 2). Time 2 and Time 3 correct spelling were also strongly correlated with each other, as were Time 2 and Time 3 analogy, and Time 1, Time 2 and Time 3 phonological plausibility. Analogy and phonological plausibility also correlated highly with each other, both at Time 2 and at Time 3. Age correlated significantly, though less highly, with phonological plausibility at all three times.

In order to explore the relationship between correct spelling, phonological plausibility and analogy use further, regression analyses were carried out using the Time 2 and Time 3 correct

spelling scores as the criterion variables and the Time 2 and Time 3 analogy use and PP scores as the predictor variables. The objective was to find out, first, if analogy use and PP were equally predictive of correct spelling and, second, whether one was a better predictor than the other for either of the two groups (as found in Experiment 1). Age was also entered as a predictor variable, since the significant correlations between phonological plausibility and age indicate that variance in spelling performance might be related to variance in age to some degree. Table 4.5 summarises the results for the total sample for Times 2 and 3.

Table 4.5: Summary of the models in which age, analogy use and PP scores were entered simultaneously as predictors of correct spelling at (A) Time 2 and (B) Time 3

(A). Criterion variable: T2 correct spelling

Predictors: age; T2 analogy use; T2 PP

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.916	.839	.831	Analogy	.663	.0001
				PP	.303	.002
				Age	-.064	.244

(B). Criterion variable: T3 correct spelling

Predictors: age; T3 analogy use; T3 PP

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.920	.847	.840	Analogy	.745	.0001
				PP	.224	.009
				Age	-.045	.398

Separate regression analyses for the intervention and non-intervention groups at both Times 2 and 3 showed a similar pattern, with analogy use being more predictive of correct spelling than PP for both groups (Tables 4.6 and 4.7 respectively).

Table 4.6: Comparison of the predictive effects of analogy use and PP on correct spelling for (1) Group A and (2) Group B at Time 2

(1). GROUP A: Criterion variable: T2 correct spelling scores

Predictor variables: age; T2 analogy use; T2 PP

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.938	.880	.868	Analogy	.734	.0001
				PP	.236	.049
				Age	-.004	.957

(2). GROUP B: Criterion variable: T2 correct spelling scores

Predictor variables: age; T2 analogy use; T2 PP

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.893	.797	.776	Analogy	.513	.003
				PP	.468	.010
				Age	-.155	.118

Table 4.7: Comparison of the predictive effects of analogy use and PP on correct spelling for (1) Group A and (2) Group B at Time 3

(1). GROUP A: Criterion variable: T3 correct spelling scores

Predictor variables: age; T3 analogy use; T3 PP

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.943	.889	.877	Analogy	.776	.0001
				PP	.208	.038
				Age	-.008	.894

(2). GROUP B: Criterion variable: T3 correct spelling scores

Predictor variables: age; T3 analogy use; T3 PP

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.890	.792	.771	Analogy	.618	.0001
				PP	.343	.054
				Age	-.082	.427

At Time 2 (Table 4.6), although both analogy and PP were highly predictive of spelling for both groups, analogy was even more strongly predictive of spelling for the intervention group than for the controls, thus indicating that it was the greater application of analogy use in spelling which was at the root of the intervention group's superior correct spelling performance at Time 2. However, at Time 3 (Table 4.7), although both analogy and PP were again strongly predictive of correct spelling for the intervention group, this was not the case for the controls, since although analogy was now more strongly predictive than at Time 2, PP

just failed to be significantly predictive. This implies that the non-intervention group may have tried to apply analogy in their spelling but, without the benefit of analogy coaching, at a slight cost to phonological plausibility.

4.4.5. Unit by Unit Comparisons of Analogy Use

The prediction in relation to correct spelling performance broken down by unit was that there would be no notable difference (on the basis of the results for Experiment 1) in the degree to which the units, onset+peak, rime or coda, contributed to correct spelling. Table 4.8 permits comparison of correct analogy use scores for Years 1 and 2, broken down by group, by unit and by time. The maximum correct analogy score for each unit was six.

Overall, the results for Experiment 2 showed marginally more analogies to have been made at the level of the rime than at any other unit level. Comparison between Year 1 and Year 2 showed most analogies to have been made at the level of the rime in the case of the former, but most analogies to have been made at the level of the peak for the latter. Group by group comparison also showed the rime to have contributed most to analogy use for Group A, but results were less clear-cut for Group B, who showed a rime preference at Time 2 but no preference for the rime over the onset+peak or coda at Time 3. A time by time comparison of the means across years and groups also showed a marginal overall preference for rime analogies.

Table 4.8: Mean correct analogy use scores for (1) Year 1, (2) Year 2 and (3) their overall total, broken down by unit, by group and by time

(1). Yr.1:	Group A (*n* 17)		Group B (*n* 16)		Total Y1 (*n* 33)		
	Time 2	Time 3	Time 2	Time 3	Time 2	Time 3	Total T2+3
Unit	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
On+pk	3.00 (1.22)	3.00 (2.00)	2.31 (1.66)	1.56 (1.79)	2.67 (1.47)	2.30 (1.88)	2.48 (1.68)
Peak	2.88 (1.76)	1.88 (1.40)	1.94 (1.81)	1.25 (1.24)	2.42 (1.82)	1.58 (1.39)	2.00 (1.66)
Rime	3.47 (1.77)	3.94 (1.56)	2.56 (1.50)	2.63 (1.75)	3.03 (1.68)	3.30 (1.76)	3.17 (1.71)
Coda	2.88 (1.76)	2.88 (1.69)	2.13 (1.89)	2.19 (1.28)	2.52 (1.84)	2.55 (1.52)	2.53 (1.68)

(2). Yr.2:	Group A (*n* 16)		Group B (*n* 17)		Total Y2 (*n* 33)		
	Time 2	Time 3	Time 2	Time 3	Time 2	Time 3	Total T2+3
Unit	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
On+pk	2.94 (1.84)	3.13 (1.82)	2.47 (1.91)	3.06 (1.82)	2.69 (1.86)	3.09 (1.79)	2.89 (1.82)
Peak	3.63 (1.54)	3.13 (2.13)	2.88 (1.65)	2.88 (1.87)	3.24 (1.62)	3.00 (1.97)	3.12 (1.79)
Rime	3.38 (1.89)	3.06 (2.29)	2.47 (2.12)	2.00 (1.41)	2.90 (2.04)	2.52 (1.94)	2.71 (1.98)
Coda	2.75 (1.77)	3.00 (2.13)	1.76 (1.60)	2.53 (2.00)	2.24 (1.73)	2.76 (2.05)	2.50 (1.89)

(3).Total:	Group A (*n* 33)		Group B (*n* 33)		Total Y1+Y2 (*n* 66)		
	Time 2	Time 3	Time 2	Time 3	Time 2	Time 3	Total T2+3
Unit	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
On+pk	2.97 (1.53)	3.06 (1.88)	2.39 (1.77)	2.33 (1.79)	2.68 (1.66)	2.69 (1.86)	2.69 (1.76)
Peak	3.24 (1.68)	2.48 (1.91)	2.42 (1.77)	2.09 (1.77)	2.83 (1.76)	2.29 (1.84)	2.56 (1.81)
Rime	3.42 (1.80)	3.52 (1.97)	2.51 (1.82)	2.30 (1.59)	2.97 (1.86)	2.91 (1.88)	2.94 (1.86)
Coda	2.81 (1.74)	2.94 (1.89)	1.94 (1.73)	2.36 (1.67)	2.38 (1.78)	2.65 (1.79)	2.52 (1.78)

In order to assess the significance of any differences in analogy use by unit a four-way repeated-measures ANOVA was performed. The factors were: unit, which had four levels (onset+peak, peak, rime and coda); time with two levels (2/ 3); year (1/2); and group (A/B). The main effect of unit was found to be statistically significant (F (3,186) = 7.797, $p < .0001$), indicating that there were significant differences in the degree to which analogies were made at the different unit levels. No significance was found for the effects of time (F (1,62) = 1.226, $p = .272$) or year (F (1,62) = .538, $p = .466$), but the effect of group was found to be marginally significant (F (1,62) = 3.937, $p = .052$) due to the greater number of analogies made across all units by the intervention group (Group A) in comparison with controls (Table 4.8). A significant interaction was found for the effects of unit with year (F (3,186) = 24.049, $p < .0001$), triggered by the different patterns of analogy use shown by the two year-groups, most notably at the levels of the peak and rime. A significant interaction was also found for the effects of unit with time (F (3,186) = 5.005, $p = .002$) driven by the peak, which showed a decrease from Time 2 to Time 3, and the coda, which showed an increase over time (Table 4.8). The interaction of time with year also bordered on statistical significance (F (1,62) = 3.799, $p = .056$). A significant three-way interaction was therefore found for the effects of unit x time x year (F (3,186) = 4.495, $p = .005$).

However, since a single ANOVA was inadequate in terms of testing the significant contribution to correct spelling of each unit, post hoc analyses were subsequently performed to assess the statistical significance of each of six possible unit combinations (onset+peak vs peak; onset+peak vs. rime; onset+peak vs. coda; peak vs. rime; peak vs. coda; rime vs. coda) in their contribution to correct spelling and their interactions with the effects of year, group and time. Six four-way ANOVAS were therefore performed to explore these effects. In each case the 0.05 significance level was adjusted to account for one sixth of the alpha level ($p =$

<.008), according to the Bonferroni method. The rime was found to be statistically more significant than any of the other units (rime vs. onset+peak: $F(1,62) = 7.585, p = .008$; rime vs. peak: $F(1,62) = 17.012, p < .0001$; and rime vs. coda: $F(1,62) = 17.697, p < .0001$), but no significant differences were found between the contributions of any other units (onset+peak vs. coda: $F(1,62) = 2.865, p = .096$; onset+peak vs. peak: $F(1,62) = 2.261, p = .138$; and peak vs. coda: $F(1,62) = .159, p = .691$). No significant differences were found for the main effects of group or year across any of the unit by unit analyses, but a significant effect of time ($F(1,62) = 7.963, p = .006$) was found in the comparison of the rime vs. peak, presumably driven by the drop in the degree of analogies made at the level of the peak from Time 2 to Time 3, as observed above. The decrease in peak analogies made from Time 2 to Time 3, coupled with the observed increase in the number of coda analogies made over the same period, also gave rise to a significant interaction of unit with time in the peak vs. coda analysis ($F(1,62) = 15.737, p < .0001$). Significant interaction of time with year was found only in relation to the analyses for onset+peak vs. peak ($F(1,62) = 9.721, p = .003$) and onset+peak vs. coda ($F(1,62) = 8.378, p = .005$). Significant unit x year interactions were found for the analyses of the units: onset+peak vs. rime ($F(1,62) = 21.162, p < 0001$); peak vs. rime ($F(1,62) = 71.969, p < .0001$); onset+peak vs. peak ($F(1,62) = 18.311, p < .0001$); and peak vs. coda ($F(1,62) = 28.108, p < .0001$), confirming that the two year-groups showed substantially different patterns of analogy use at these unit levels.

4.5. DISCUSSION

Experiment 2 was designed to extend and replicate the investigation carried out in Experiment 1 into the effect on correct spelling performance of intervention in analogy use in spelling and into the comparative predictive effects of analogy use and phoneme-based strategies in

relation to correct spelling performance. Additionally the aim was to investigate the comparative contributions of four word units (onset+peak, peak, rime and coda) to analogy use in correct spelling in relation to two age-groups: primary Years 1 and 2.

The results confirm the finding, in Experiment 1, that teaching children to use analogy in spelling can be effective in improving correct spelling performance. A comparison of the pre- and post-experimental spelling performance of the analogy intervention group (Group A) and their non-analogy intervention counterparts (Group B) showed the former to have made impressive gains in their correct spelling from Time1 to Time 2, whereas the latter's performance remained the same during this period (Table 4.1). Furthermore, although the controls had initially performed better than the intervention group in their spelling performance at Time 1, the latter were convincingly overtaken by the former at Time 2, indicating an even greater intervention effect in the present experiment than was shown in Experiment 1. Additionally, the intervention group remained convincingly ahead of the controls and the difference in scores for the two times was negligible, indicating that the effect shown at Time 2 was still robust and enduring five weeks later at Time 3.

The results of the present study in relation to analogy use by the two groups are much more clear-cut than for Experiment 1. Overall, although no marked differences were shown in the PP scores for the two groups (Table 4.2), distinct differences were shown in the degree to which the two groups used analogy in their spelling (Table 4.3). The distinct superiority in analogy use performance on the part of the intervention group, as compared with the controls at both Time 2 and Time 3, coupled with the lack of any distinct group differences in the PP scores, lends strong support to the interpretation put forward in Experiment 1 in relation to the respective contributions of analogy use and phonological plausibility to correct spelling

performance. Given that the intervention group in the present study proved, not surprisingly, to be markedly better at using analogy than the non-intervention group, and given that there were no marked differences between the two groups in their ability to use phonological plausibility in their spelling, it would appear that the marked difference between the two groups' spelling performances from Time 1 to Times 2 and 3 was driven primarily by analogy use in spelling on the part of the intervention group.

Further support for this interpretation can be drawn from the results of the separate regression analyses for the two groups. Although both analogy and PP were strongly predictive of variance in correct spelling overall, analogy use was shown to be even more highly predictive of correct spelling for the intervention group than it was for the controls at Time 2 (Table 4.5). Conversely, at Time 3, when the clue word task was more familiar to both the intervention and non-intervention groups, analogy was equally predictive of spelling for both groups. It appears, therefore, that it was indeed the intervention in analogy use that had the positive effect in improving the correct spelling performance of the intervention group at Time 2, compared with that of the controls, rather than just intervention *per se*. However, the finding that analogy use was more predictive of correct spelling for both groups also implies that the inclusion of the clue word, coupled with the instruction to use the sounds and spelling of the clue word to help spell the test words, may in itself have led *both* groups to use analogy in their spelling. It therefore appears that there may have been an additive effect in operation here for the intervention group – i.e. the effectiveness of tuition in analogy use *plus* the effectiveness of instructing the children to try to use the sounds and spelling of the clue word to help spell the test words. Further research will need to investigate this possibility.

Additionally, however, the results also suggest that the intervention group may have been more adept at combining orthographic and phonological strategies in their spelling than the controls, who had not had the benefit of analogy coaching. Indeed, it appears that the latter may have over-applied analogy at a cost to phonological strategies at Time 3 (Table 4.6).

As to which unit, if any, contributed most to analogy use and correct spelling, the results overall indicated analogy use at the level of the rime to make the greatest contribution to correct spelling than analogy at any other unit level. This finding contrasts with that of Experiment 1, in which no major differences were found in the contribution to correct spelling made by any of the units under investigation. The finding of the present study lends support to Goswami's conclusion that, overall, children find rime analogies to be more useful than analogy at other unit levels, at least with regard to spelling (Goswami, 1988, Exp. 1).

However, it should be noted that both Goswami (1988, Exp. 1) and Nation and Hulme (1996, Exp. 1) employed written clue words that remained in full view of participants in their respective studies, whereas both the present experiment and Experiment 1 used a verbal clue word paradigm. An extension of the present experiment, using the same intervention and non-intervention groups as for Experiment 2, but using written rather than verbally presented clue words, would therefore be needed so as to establish whether presenting the clue word in written format would achieve the same result as the present experiment.

Consideration of the different patterns of analogy use shown by the two year-groups (Table 4.8) indicated differences at the levels of the onset+peak, peak and rime, with the younger year-group appearing to favour rime analogies more than the older year-group, but the older children favouring analogy at the levels of the onset+peak and peak more than the younger

year-group. The Year 2 children appear, therefore, consistent with Nation and Hulme's finding (1996), to have been able to use analogy at the single phoneme level of the peak, although they also showed a preference for peak analogies over analogy at the level of the rime or coda, which was not found in the Nation and Hulme study. However, the older year-group's preference for analogy at the level of the peak, in contrast with the younger year-group's preference for rime analogies might also be consistent with Goswami's suggestion, in relation to her interactive analogy model, that children show 'increasingly refined' use of orthographic analogy (i.e. at the level of smaller orthographic units) as their literacy skills develop (Goswami, 1993). It may be, therefore, that the contrasting patterns in analogy use for the two different year-groups in the present study represent a developmental shift in spelling, away from analogy use at the level of the rime, towards a more refined use of analogy in spelling and an increased ability to use analogy at a smaller unit level (i.e. at the level of the peak), although no difference was shown between the two year-groups at the level of the coda.

However, such a claim cannot be made confidently in the case of the present investigation, since different word-lists were used for the two different year-groups. Rather than showing that different strategies come into play at different points in spelling development, it may be that the contrasting patterns in analogy use demonstrated by the two year-groups in this study simply showed that different strategies are required for spelling different words. Further research will need to address this possibility.

Consideration was also given to the differences shown in the two year-groups' patterns of analogy at Times 2 and 3 (Table 4.8). This highlighted time differences between the two year-groups, who displayed contrasting analogy use patterns at the two test times in the degree to

which they made analogies at the levels of onset+peak, peak and coda. These differences are difficult to interpret, since the words in the tests at Time 2 and Time 3 were carefully matched in terms of their phonological-orthographic similarity and similar patterns of analogy use would therefore have been expected at Times 2 and 3. Furthermore, since no overall effects of either time or year were found in this study, it is unlikely that performance differences across the two times by the two year-groups can be attributed to the changed words in the different tests. Nevertheless, a future study, in which both year-groups would be asked to spell the *same* words (i.e. both word-lists), would allow further consideration of this matter.

In conclusion, the present experiment was undertaken as a replication of Experiment 1, using a larger sample of participants, to investigate whether teaching intervention in analogy use could be effective in improving the correct spelling performance of 5- to 7-year-old English primary school children. The results clearly indicated that it could. Furthermore, the present experiment demonstrated an even stronger and more enduring intervention effect than was shown in Experiment 1, since the effect in the present study was still robust five weeks after the completion of the five-week long intervention programme. The positive effect of the analogy intervention programme on the correct spelling performance of the experimental group, coupled with their greater ability to combine orthographic and phonological strategies in spelling, compared with the controls, provides strong support for the conclusion in Experiment 1, that English primary school children might benefit from instruction in using orthographic analogies in their spelling.

Further research is needed, however, with regard to the results of the present study and the conflicting findings of Goswami (1988) and Nation and Hulme (1996) in relation to whether children show any evidence of using increasingly refined patterns of analogy in their spelling

as literacy skills develop (Goswami,1993). Since both Goswami (1988, Exp. 1) and Nation and Hulme (1996, Exp. 1) employed written, rather than verbally presented clue words in their studies, an extension of the present investigation with the same intervention and non-intervention groups, but using written clue words might be desirable. Furthermore, since the present investigation used different word-lists for the two year-groups under consideration, a further study employing the same words for both year-groups would be useful in establishing whether children use differing patterns of analogy at different points in their spelling development, or whether any observed differences in analogy use are actually a product of the different words being used in analogy with certain units being more salient for spelling some word patterns, whereas other units might be more relevant to others.

5. CHAPTER 5: EXPERIMENT 3

5.1. INTRODUCTION

Experiment 2 investigated whether teaching 5- to 7-year-old children to use analogy in spelling would positively affect their spelling performance compared with that of controls, who received no analogy intervention, and whether different age-groups (primary Years 1 and 2) would show similar or contrasting patterns of analogy use in their spelling. The results in relation to the former question provided clear and robust evidence that teaching children to use analogy in spelling can indeed be effective in improving correct spelling performance. In relation to the latter question, the results overall provided support for Goswami's (1988) finding that children find rime analogies greatly more accessible in spelling than analogy at any other unit level. The younger year-group in Experiment 2 particularly showed evidence of this pattern. The older year-group, on the other hand, appeared to show a markedly contrasting pattern, favouring analogy at the level of the peak and onset+peak. This finding was in part consistent with Nation and Hulme (1996), to the extent that the children in their study were also able to use analogy at the levels of the onset-vowel and vowel (or peak). The conclusion was therefore that the contrasting patterns in analogy use shown by the different year-groups in Experiment 2 might reflect a developmental shift away from the rime, towards analogy use at the smaller unit level, representing increasing refinement in analogy use in relation to spelling in line with the predicted development in relation to analogy use in reading, as outlined in Goswami's (1993) interactive analogy model. However, since there were methodological differences between the verbal presentation of the clue word in Experiment 2, and the visual presentation of the clue word employed by both Goswami (1988, Exp. 1) and Nation and Hulme (1996, Exp. 1), no firm conclusion could be reached in support

of either of these two studies. It was therefore proposed that employing a procedure in line with that used by Goswami (1988) and Nation and Hulme (1996), whereby the clue words were presented visually and remained present during testing, might bring about a more conclusive result.

A study on analogy use in reading by Muter, Snowling and Taylor (1994) carried out a similar comparison of reading performance when the clue word was presented visually and remained present, compared with reading performance when the clue word was not present. Two groups of children were taught to read a set of clue words which were analogous to a set of target test words. One group was required to read the target words when the clue words were present, while the other group was required to read the target words when the clue words were not present. Muter *et al* found that, although both groups of children used analogy with the clue words to a significant extent, the degree to which analogies were made was much greater when the clue words were present. A similar outcome would therefore be expected in relation to spelling, if spelling performance and analogy use were compared when the clue words either spoken but not visually presented (as in Experiment 2 in the present thesis) or spoken and written, so that they remained visually present (as in Goswami, 1988, Exp.1 and Nation & Hulme, 1996, Exp.1).

A further conclusion of Experiment 2 was that the 'clue word' paradigm itself, coupled with the instruction given to the children to use the sounds and spelling of the clue words to help them to spell the test words, was conducive to analogy use by both the intervention and the control groups. However, the intervention group, who had benefited from coaching in analogy use in spelling was also, not surprisingly, more adept at using analogy than the controls. It was therefore suggested that an additive effect was demonstrated by the intervention group in

their spelling performance – i.e. the effect of using analogy with the clue word *plus* the effect of the analogy intervention. Support for this interpretation was drawn from the finding that analogy use was more predictive of variance in spelling performance for both the intervention and the non-intervention groups, although the former group appeared to be more adept at using analogy strategically and combining orthographic and phonological strategies in their spelling.

5.2. AIMS OF EXPERIMENT 3

Experiment 3 was therefore designed to establish how children's spelling performance and analogy use in spelling differ when the clue words, on which they are asked to base their spelling of a series of analogous words, are presented in either of two conditions: verbal presentation with the clue word not visually present (as in Experiment 2) or verbal *and* written format, with the clue word remaining present during testing (as in Goswami, 1988 Exp. 1 and Nation & Hulme, 1996 Exp.1). The experimental design also allowed consideration to be given to which word unit/s children were most likely to base their analogies on in spelling (onset+peak, peak, rime or coda) at different points in literacy development (primary Years 1 and 2) in either presentation condition. Additionally, consideration was given to whether children would show any difference in their spelling performance and the degree to which they used analogy in their spelling, depending on whether they had previously received intervention in analogy use in spelling or not (in Experiment 2).

The prediction in relation to spelling performance and analogy use in the two presentation conditions (spoken only vs. spoken+written) was that the children's spelling performance

would improve and the degree to which they would use analogy would be greater when the clue words were presented in the spoken+written format and remained in view during testing, than when the clue words were only spoken and were not present during testing. This was Muter *et al.*'s (1994) finding relating to reading performance and analogy use in reading. The prediction in relation to spelling performance and analogy use by the two groups of children (i.e. those who had previously taken part in the analogy intervention programme, compared with those who had not) was, on the basis of the results of Experiment 2, that both groups would use analogy in their spelling, but that the intervention group would show a more strategic use of analogy, resulting in a higher proportion of correct spellings than the controls. Finally, the prediction in relation to the patterns of analogy use shown by the two year-groups (Years 1 and 2) was that the children in both year-groups would show either equal degrees of analogy use at both larger and smaller unit levels (onset+peak and rime vs. the peak and coda), as was the case in Nation and Hulme (1996), or much greater use of analogy at the level of the rime than at any other unit level (as was the case in Goswami, 1988) or, alternatively that the two year-groups would show qualitatively different patterns of analogy in their spelling, with the younger group displaying a preference for rime analogies and the older group showing evidence of 'increasingly refined' analogy use and an ability to make smaller unit (e.g. peak) analogies in spelling, which would be in line with Goswami's (1993) interactive analogy model in relation to reading.

5.3. METHOD

5.3.1. Participants

The participants were exactly as for Experiment 2, employing exactly the same groups of children at the same ages (section 4.3.1), since the present experiment comprised the spelling

test at Time 3 of Experiment 2, using the spoken-only presentation of the clue word, and a further test a week or so later, using the spoken+written presentation condition with the clue word remaining present during testing.

5.3.2. Materials

The materials comprised the same word lists as were used for Experiment 2 at Time 3 for the spoken-only presentation condition in the present experiment, and differed only with respect to the words used in the spoken+written presentation condition. The materials for both presentation conditions included six groups of words, each comprising a clue word plus four test words relating to one of four analogous word units (onset+peak, peak, rime and coda), exactly as for Experiment 2, except that the clue words used in the spoken+written condition were written on sections of coloured card and remained visually present during testing. A full list of words used in both conditions is included in the Appendix 2.

5.3.3. Design

Experiment 3 was designed as an extension to Experiment 2, employing the same mixed design but investigating the effect of clue word presentation in two conditions (spoken-only and written+spoken) on the correct spelling performance and analogy use of two year-groups (primary Years 1 and 2) and in two groups of children (Groups A and B), the first of which had previously been coached in analogy use in spelling, whereas the second had received no such intervention (Experiment 2). The spoken-only condition comprised the spelling test given at Time 3 in Experiment 2; the spoken+written condition was used in a further test one to two weeks later. There were thus three main effects under consideration: clue word presentation condition (spoken-only vs. written+spoken); year-group (1 vs. 2); and

intervention/ non-intervention (Group A vs. B). The dependent variables in each case were the children's spelling scores.

5.3.4. Procedure

5.3.4.1. Testing Procedure

Exactly the same procedure was used for both presentation conditions, apart from the addition of the visually presented clue word in the spoken+written presentation condition, which remained present during testing. Thus, whereas the clue word in the spoken-only condition was presented verbally by the researcher and the children were required to write it from memory (Time 3 in Experiment 2), in the spoken+written presentation condition, the clue word was first presented to the children visually and the children were required to read it out loud if they could, after which the word was repeated by the researcher and the children were required to copy it down. The researcher then proceeded, as for Experiment 2, with the instruction that the children should try to use 'the sounds and spelling' of the clue word to help them to spell the four test words. This was the only instruction given to the children. The test words shared either the same onset+peak, same peak, same rime or the same coda as the clue word. The clue word remained in view while the children were given the four analogous test words. The order of presentation was randomised exactly as for Experiment 2. The clue word was removed after the children had been tested on their spelling of the analogous words relating to that clue word, and the next clue word was then presented to the children. The two tests relating to the two presentation conditions (i.e. spoken-only and written+spoken) were presented to the same children at least a week apart and using different, but carefully matched words, for the two tests. Thus, for example, where the spoken-only clue word had been '*tell*' and the analogous words '*test*', '*shelf*', '*dell*' and '*spill*', the clue word in the written+spoken

condition was '*well*' and the analogous test words were '*went*', '*held*', '*shell*' and '*still*' (Appendix 2).

5.3.4.2. Scoring Procedure

Exactly the same scoring procedure was used and the same criteria applied as for Experiments 1 and 2, resulting in three scores (correct spelling, phonologically plausible spelling, and evidence of analogy with the clue word) in relation to spelling performance in each condition (spoken-only and spoken+written).

5.4. RESULTS

Responses were collated in spreadsheet format. Maximum scores for correct and phonologically plausible (PP) spelling in each presentation condition were out of a maximum of 24, as in Experiment 2, while the maximum score in each presentation condition for analogy use was again 48. Correct spelling scores in each condition were broken down by unit (onset+peak, peak, rime and coda), as for Experiment 2, so as to investigate which unit level/s of analogy use most contributed to correct spelling. The maximum score for correct spelling broken down for each unit was six.

Results were analysed using a preliminary repeated-measures three-way analysis of variance (ANOVA) to assess the statistical significance of the main effects of presentation condition (spoken-only vs. spoken+written), group (intervention vs. non-intervention), and year (Year 1 vs. Year 2) and their interactions. Linear regressions were also employed to explore the comparative predictive effects of age, analogy use and phonological plausibility on variance in spelling.

Unit by unit comparisons were made of analogy use patterns in the two presentation conditions (spoken-only vs. written +spoken) by the intervention and non-intervention groups and by Years 1 and 2. A repeated-measures four-way ANOVA was used to assess the significance of the main effects of unit, presentation, year and time, plus their interactions

5.4.1. Correct Spelling Performance

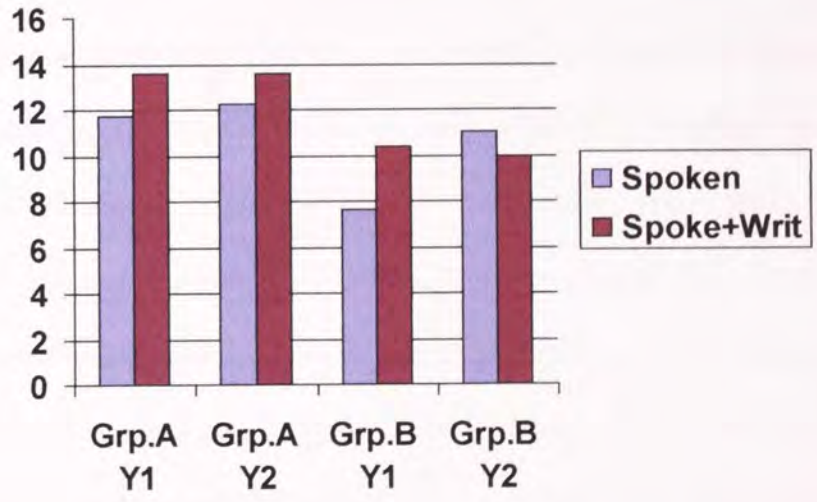
The prediction was that correct spelling performance when the clue word was presented in the spoken+written condition and remained visible during testing would be superior to spelling performance when the clue word was only spoken and not in view. Table 5.1 allows comparison of the correct spelling means in the two presentation conditions (spoken-only vs. spoken+written) broken down by year (1/2) and group (A/B). Figure 5.1 illustrates these results as a chart.

Table 5.1 shows correct spelling performance overall to have been better when the clue word was presented in the spoken+written condition than when it was presented in the spoken-only condition. The only group to whom this did not apply was that of the Year 2 children in Group B. Overall the younger year-group appeared to have benefited from the presence of the clue word more than the older children. Group A, who had previously received intervention in analogy use in spelling (Experiment 2), also appeared to be convincingly ahead of Group B, who had received no such intervention previously, in both the spoken-only and the spoken+written presentation conditions. This was to be expected, since the former group may have been able to make better use of the visual presence of the clue word, given their previous coaching in analogy use.

Table 5.1: Comparison of the means for correct spelling when the clue word was presented in the spoken-only (SPOKE) and spoken+written (S+W) conditions, shown by group and year

	GROUP A			**GROUP B**		
	Year 1 (*n*17)	Year 2 (*n*16)	A.Tot. (*n*33)	Year 1 (*n*16)	Year 2 (*n*17)	B.Tot. (*n*33)
	Mean *SD*	Mean *SD*	Mean *SD*	Mean *SD*	Mean *SD*	Mean *SD*
SPOKE	11.71 (6.07)	12.31 (7.94)	12.00 (6.93)	7.63 (4.96)	11.00 (6.28)	9.36 (5.85)
S+W	13.59 (5.06)	13.63 (7.02)	13.61 (5.99)	10.38 (6.25)	10.00 (5.57)	10.18 (5.82)

Figure 5.1. Chart illustrating mean correct group spelling scores for the two clue word presentation conditions (spoken-only and spoken+written), shown by group and year



A repeated-measures three-way analysis of variance (ANOVA) was used to assess the statistical significance of the main effects of presentation condition (spoken-only vs.

spoken+written), group (A vs. B), and year (1 vs. 2) and their interactions. This showed the effect of presentation condition to be statistically significant (F (1,62) = 9.519, p = .003), as was the effect of group (F (1,62) = 4.702, p = .034). The effect of year was not significant, however (F (1,62) = .280, p = .599), although the interaction of year with presentation was significant (F (1,62) = 4.564, p = .037). This confirms the view that the younger year-group benefited significantly more than the older children from the presentation of the clue word in the spoken + written condition (Table 5.1).

5.4.2. Phonologically Plausible Spelling Performance

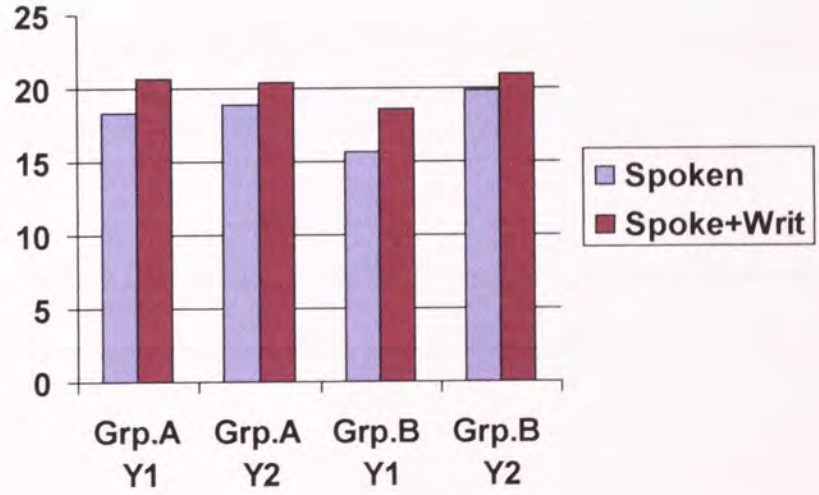
The prediction in relation to phonologically plausible spelling was, as for correct spelling, that performance would benefit from the visual presence of the clue word and therefore be better in the spoken+written condition than in the spoken-only presentation condition, when no visual clue was present.

Inspection of Table 5.2 shows that, overall, phonologically plausible spelling did improve when the clue word remained present, compared with when it was not present. This finding was consistent across both groups and across both years (Table 5.2). The mean PP scores for the two groups again showed Group A to be marginally ahead of Group B in their performance in both conditions. Year by year comparison showed the younger year-group in Group B to have gained most benefit from the presence of the clue word in the written+spoken condition. Figure 5.2 illustrates these findings as a chart.

Table 5.2: Comparison of the means for phonologically plausible spelling when the clue word was presented in the spoken-only (SPOKE) and spoken+written (S+W) conditions, shown by group and year

	GROUP A			GROUP B		
	Year 1 (*n*17)	Year 2 (*n*16)	A.Tot. (*n*33)	Year 1 (*n*16)	Year 2 (*n*17)	B.Tot. (*n*33)
	Mean *SD*	Mean *SD*	Mean *SD*	Mean *SD*	Mean *SD*	Mean *SD*
SPOKE	18.29 (3.93)	18.88 (6.09)	18.58 (5.03)	15.69 (6.91)	19.88 (3.94)	17.85 (5.88)
S+W	20.65 (3.12)	20.38 (5.33)	20.52 (4.27)	18.56 (5.83)	21.00 (3.28)	19.82 (4.78)

Figure 5.2. Chart illustrating mean phonologically plausible spelling scores for the two clue word presentation conditions (spoken-only and spoken+written), shown by group and year



A repeated-measures three-way ANOVA was performed to assess the statistical significance of the main effects: presentation x group x year. This showed the effect of presentation condition to be highly significant (F (1,62) = 39.379, $p < .0001$), but neither of the effects of group or year were statistically significant (F (1,62) = .4.22, $p = .518$ and F (1,62) = 2.173, $p = .145$ respectively), although the interaction of year with presentation was significant (F (1,62) = 4.359, $p = .041$). This further confirms the view put forward earlier that the younger year-group benefited significantly more than the older children from the spoken + written presentation of the clue words (Table 5.2).

5.4.3. Analogy Use Scores

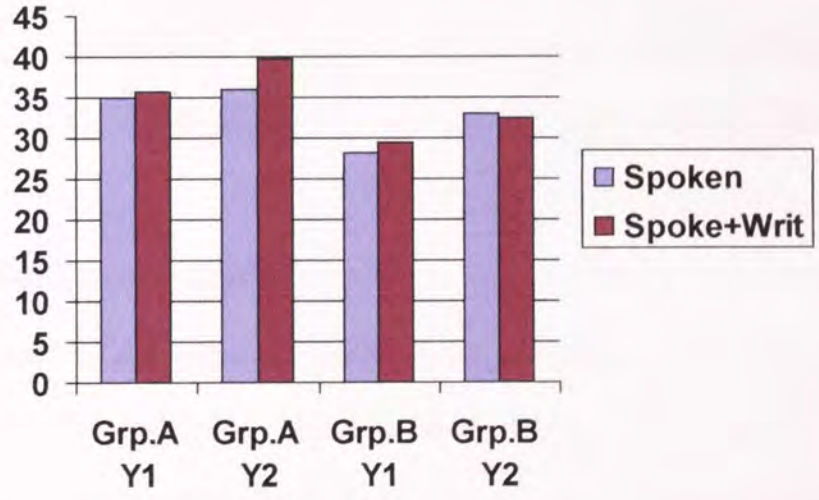
The prediction in relation to analogy, was that the group who had previously benefited from analogy intervention (Group A) would show a superior performance in analogy use, compared with the controls (Group B), but that both groups would show evidence of a higher degree of analogy use when the clue word was present, compared with when it was not present. Since, the younger year-group would not be expected to have such well-defined representations of the clue words in memory, it was also expected that the younger year-group would benefit most from the presence of the clue word.

The means for analogy use in spelling in both presentation conditions, broken down by group and year are shown in Tables 5.3 and illustrated as a chart in Figure 5.3.

Table 5.3: Comparison of the mean analogy use scores when the clue word was presented in the spoken-only (SPOKE) and spoken+written (S+W) conditions, shown by group and year

	GROUP A				GROUP B			
	Year 1 (*n*17)		Year 2 (*n*16)		A.Tot. (*n*33)			
	Mean	*SD*	Mean	*SD*	Mean	*SD*		
SPOKE	34.88	(7.98)	36.06	(9.57)	35.45	(8.67)		
S+W	35.82	(8.60)	39.75	(7.96)	37.73	(8.41)		
	Year 1 (*n*16)		Year 2 (*n*17)		B.Tot. (*n*33)			
	Mean	*SD*	Mean	*SD*	Mean	*SD*		
SPOKE	28.25	(8.09)	33.00	(7.34)	30.69	(7.96)		
S+W	29.56	(10.47)	32.47	(9.29)	31.06	(9.82)		

Figure 5.3. Chart illustrating mean analogy use scores for the two clue word presentation conditions (spoken-only and spoken+written), shown by group and year



Overall, the visual presence of the clue words in the spoken+written condition benefited both groups in their use of analogy in spelling, although the older year-group in Group B showed no benefit. As predicted, the group which had previously been coached in analogy use (Group

A) were shown to be convincingly ahead of the group who had not received analogy coaching (Group B), across both clue word presentation conditions. Overall Group A also benefited more from the presence of the clue word than Group B, again as predicted. However, the prediction in relation to the younger year-group benefiting more than their older counterparts from the presence of the clue word was only upheld in relation to Group B. In contrast, the Year 2s in Group A appeared to benefit more from the presence of the clue word than any other sub group (Figure 5.3).

A repeated-measures three-way ANOVA was performed to assess the statistical significance of the main effects of presentation, group and year in relation to analogy use. This showed the effect of presentation to fall short of statistical significance (F (1,62) = 3.128, p = .082), but the effect of group to be significant (F (1,62) = 8.418, p = .005). Thus the children who had received coaching in analogy were confirmed in their ability to make better use of analogy in spelling across both presentation conditions, than the children who had received no such coaching. The effect of year was not significant however (F (1,62) = 2.541, p = .116), nor was the interaction of presentation with year (F (1,62) = .087, p = .769).

5.4.4. The Relationship between Correct Spelling, PP and Analogy Use

A number of regression analyses were carried out so as to explore the relationship between correct spelling, phonological plausibility (PP) and analogy use in spelling. The objectives were, first, to ascertain whether analogy use and PP were similarly predictive of correct spelling for the entire sample, or whether analogy use appeared to be more highly predictive of variance in spelling than PP and, second, whether analogy use and PP were similarly predictive of spelling performance both for those children who had previously received analogy intervention in spelling in Experiment 2 (Group A) and for those who had received

no such intervention (Group B), or whether analogy would be even more predictive of correct spelling the PP for the intervention group, as was suggested by the results for Experiment 2. The experimental design also allowed consideration of the predictive effects of analogy and PP on correct spelling in two clue word presentation conditions: spoken-only, when the clue word was not in view during testing, and spoken+written, when the clue word remained present during testing. Age was also entered as a predictor of correct spelling, despite its low predictive effects on spelling performance in Experiment 2, since it was considered likely that age might prove to be a significant predictor of variance in spelling when the clue word remained present during testing, particularly for the younger children, for whom the representation of the clue words in memory might not have been so well established as for the older children.

Table 5.4 summarises the regressions for the total sample in both clue word presentation conditions: spoken-only (when the clue word was not in view) and spoken+written (with the clue word in view during testing).

Table 5.4: Summary of the models in which age, analogy use and PP scores were entered simultaneously as predictors of correct spelling in two conditions: (1) spoken-only (clue word not present) and (2) spoken+written (clue word present)

(1). Criterion variable: correct spelling in spoken-only condition

Predictors: age; analogy use; PP in spoken-only condition

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.920	.847	.840	Analogy	.745	.0001
				PP	.224	.009
				Age	-.045	.398

(2). Criterion variable: correct spelling in spoken+written condition

Predictors: age; analogy use; PP in spoken+written condition

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.925	.855	.848	Analogy	.713	.0001
				PP	.291	.0001
				Age	-.140	.007

Both analogy use and PP were shown to be significant predictors of variance in spelling performance, regardless of whether the clue word was present during testing or not. Interestingly, age was shown to be a significant predictor of variance in spelling when the clue word remained in view during testing, but not when it was absent. However, the negative effect shown for age predicted that the younger children should have benefited more than the older children from the presence of the clue word in the spoken+written presentation condition, which was precisely in line with the results.

Tables 5.5 and 5.6 summarise the regressions for Groups A and B respectively in both clue word presentation conditions: spoken-only (with no clue word in view) and spoken+written (with the clue word in view during testing).

Table 5.5: Summary of the models for Group A in which age, analogy use and PP scores were entered simultaneously as predictors of correct spelling in two conditions: (1) spoken-only (clue word not present) and (2) spoken+written (clue word present)

(1). Criterion variable: correct spelling in spoken-only condition

Predictors: age; analogy use; PP in spoken-only condition

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.943	.889	.877	Analogy	.776	.0001
				PP	.208	.038
				Age	-.008	.894

(2). Criterion variable: correct spelling in spoken+written condition

Predictors: age; analogy use; PP in spoken+written condition

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.920	.847	.831	Analogy	.707	.0001
				PP	.302	.005
				Age	-.122	.119

Table 5.6: Summary of the models for Group B in which age, analogy use and PP scores were entered simultaneously as predictors of correct spelling in two conditions: (1) spoken-only (clue word not present) and (2) spoken+written (clue word present)

(1). Criterion variable: correct spelling in spoken-only condition

Predictors: age; analogy use; PP in spoken-only condition

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.890	.792	.771	Analogy	.618	.0001
				PP	.343	.054
				Age	-.082	.427

(2). Criterion variable: correct spelling in spoken+written condition

Predictors: age; analogy use; PP in spoken+written condition

Model	R	R2	Adjusted R2	Predictor	Std Beta Coef.	Sig.
1	.927	.859	.844	Analogy	.649	.0001
				PP	.358	.007
				Age	-.186	.021

The separate regression analyses for the intervention and non-intervention groups revealed a similar pattern for both groups in the spoken-only condition, with analogy being significantly predictive of variance in spelling for both groups, but PP falling just short of being a strong predictor for Group B, although it was strongly predictive for Group A. However, PP was shown to be highly predictive of spelling for both groups, when the clue word remained in view, although analogy was shown to be even more highly predictive of spelling for both groups in both conditions. Interestingly, however, a slightly different pattern emerged for the

two groups with respect to age, which was shown to be a significant predictor of variance in spelling for Group B (but not Group A) when the clue word was present. Again, the negative effect shown for age predicted that the younger children in the non-intervention group would benefit comparatively more than the older children from the presence of the clue word. Presumably the presence of the clue word was predictive of better spelling for the younger children in the non-intervention group because it gave them access to spelling patterns that they might otherwise not have been sure of. Conversely, all the children who had been coached in analogy would have had the opportunity to form representations of several exemplars of the spelling patterns that they were using in analogy, so the younger children in this group might not have benefited from the presence of the clue word to the same degree as those in the non-intervention group. Hence age was not a strong predictor of correct spelling for the intervention group, but only for the non-intervention group when the clue word was present.

5.4.5. Unit by Unit Comparisons of Analogy Use

One of the aims of Experiment 3 was to ascertain whether the participants in this study would either all show the same pattern of analogy use, or whether the two year-groups would show differing patterns of analogy, with the younger year-group showing a preference for rime analogies, and the older children showing a move towards analogy at the level of the peak, as was found in Experiment 2 (Table 4.9). The spoken+written presentation of clue word in the present study was methodologically the same as in Goswami's (1988) and Nation and Hulme's (1996) investigations. The present investigation, however, also allowed comparison of correct analogy performance by the two year-groups at the four different unit levels (onset+peak, peak, rime and coda) across two presentation conditions: spoken-only (as in

Experiment 2) and spoken+written (as in Goswami, 1988 and Nation & Hulme, 1996, Exp. 1 in both respects).

Comparison of the mean correct analogy use scores broken down by unit showed marginally more analogies to have been made at the level of the rime than at any other unit level overall (Table 5.7). Year by year comparison of the same measures also showed the rime to have contributed most to correct analogy use for both year-groups in the spoken+written presentation condition, but the younger year-group also to have benefited particularly from the presence of the clue word at the level of the peak (Table 5.7).

Table 5.7: Comparison of mean correct analogy use scores by unit and by year in the (1) spoken (spoken-only) and (2) written (spoken+written) presentation conditions

1. Spoken:	Year 1 (*n* 33)			Year 2 (*n* 33)			TOT(*n*66)
	Group A	Group B	Y1.Tot	Group A	Group B	Y2.Tot	
On+Pk(*SD*)	3.00 (2.00)	1.56 (1.46)	2.30 (1.88)	3.00 (1.81)	3.06 (1.82)	3.03 (1.79)	2.66(1.86)
Peak (*SD*)	1.88 (1.49)	1.25 (1.24)	1.58 (1.39)	3.07 (2.19)	2.88 (1.87)	2.97 (1.99)	2.26(1.84)
Rime (*SD*)	3.94 (1.56)	2.63 (1.75)	3.30 (1.76)	2.87 (2.23)	2.00 (1.41)	2.41 (1.86)	2.86(1.85)
Coda (*SD*)	2.88 (1.69)	2.19 (1.28)	2.55 (1.52)	2.87 (2.13)	2.53 (2.00)	2.69 (2.04)	2.62(1.78)
2. Written:	Year 1 (*n* 33)			Year 2 (*n* 33)			
	Group A	Group B	Y1.Tot	Group A	Group B	Y2.Tot	
On+Pk(*SD*)	3.29 (1.40)	2.44 (1.41)	2.88 (1.45)	3.20 (2.04)	2.24 (1.75)	2.69 (1.93)	2.78(1.69)
Peak (*SD*)	3.65 (1.32)	2.88 (1.78)	3.27 (1.59)	2.60 (2.06)	2.06 (1.48)	2.31 (1.77)	2.80(1.73)
Rime (*SD*)	4.24 (1.48)	3.25 (2.29)	3.76 (1.95)	4.13 (1.85)	3.18 (1.96)	3.59 (1.95)	3.68(1.94)
Coda (*SD*)	2.41 (1.84)	1.81 (1.47)	2.12 (1.67)	3.33 (2.06)	2.59 (1.58)	2.94 (1.83)	2.55(1.79)

Group by group comparison of the same measures (Table 5.7) also showed the rime to have contributed most to correct analogy use for both Group A (prior analogy intervention) and Group B (no prior intervention) in the spoken+written presentation condition, whereas in the spoken-only condition, a rime advantage was shown for the younger children (Year 1) across both groups, while a preference for onset+peak or peak analogies was show for the Year 2 children.

A repeated-measures four-way ANOVA was used to assess the significance of the main effects of unit, presentation, year and time, plus their interactions. The effect of unit was found to be highly significant (F (3,186) = 16.832, $p < .0001$), as was the effect of presentation (F (1,62) = 9.519, $p = .003$) and their interaction (F (3,186) = 6.682, $p < .0001$). The effect of year was not significant (F (1,62) = .280, $p = .599$), although the interactions of year x unit and year x presentation were both significant (F (3,186) = 6.013, $p = .001$ and F (1,62) = 4.564, $p = .037$ respectively), as was the three-way interaction of unit x presentation x year (F (3,186) = 20.227, $p < .0001$), driven by the opposing trends for the two year-groups in the two presentation conditions (Table 5.7). The effect of group was also significant (F (1,62) = 4.702, $p = .034$), confirming the children who had previously received analogy intervention (Group A) to have made a greater degree of correct analogies across all units and in both presentation conditions, compared with the controls (Group B).

However, since a single ANOVA was of limited use in assessing the comparative contributions of the different individual units to correct spelling, a series of separate four-way ANOVAs were subsequently carried. Six separate analyses were used to explore the significant effects in six possible pairings: onset+peak vs. peak; onset+peak vs. rime; onset+peak vs. coda; peak vs. rime; peak vs. coda; rime vs. coda and their interactions with

the effects of presentation, year and group. In each case the 0.05 significance level was adjusted to account for one-sixth of the alpha level ($p < .008$), according to the Bonferroni method. The effect of unit was found to be statistically significant in each of the pair-wise analyses for the onset+peak vs. rime ($F(1,62) = 22.205, p < .0001$), peak vs. rime ($F(1,62) = 34.541, p < .0001$), and rime vs. coda ($F(1,62) = 31.817, p < .0001$), indicating that significantly more rime analogies were made overall than analogies at the levels of onset+peak, peak or coda. No other unit analogy differences were found to be significant. The effect of presentation was also statistically significant in each of the pair-wise analyses for the onset+peak vs. rime ($F(1,62) = 10.797, p = .002$), peak vs. rime ($F(1,62) = 24.986, p < .0001$) and rime vs. coda ($F(1,62) = 9.363, p = .003$), indicating that significantly more correct analogies were made overall when the clue word was presented in the spoken+written condition and remained in view, than when it was presented in the spoken-only condition. Significant interactions of unit x year were also revealed in the pair-wise analyses for onset+peak vs. rime and rime vs. coda ($F(1,62) = 9.765, p = .003$ and $F(1,62) = 14.315, p < .0001$ respectively) and of presentation x year in the analyses for the onset+peak vs. peak ($F(1,62) = 30.617, p < .0001$), peak vs. rime ($F(1,62) = 8.736, p = .004$), peak vs. coda ($F(1,62) = 9.400, p = .003$) and rime vs. coda ($F(1,62) = 8.409, p = .005$, indicating again that there were significant differences in the two year-groups' patterns of analogy in the two presentation conditions. Significant interactions of unit with presentation were also revealed in the pair-wise analyses for the onset+peak vs. rime ($F(1,62) = 9.188, p = .004$), peak vs. coda ($F(1,62) = 9.120, p = .004$) and rime vs. coda ($F(1,62) = 12.400, p = .001$). Not surprisingly, significant unit x presentation x year interactions were found at all unit levels bar rime vs. coda – i.e. at the levels of onset+peak vs. peak ($F(1,62) = 10.210, p = .002$), onset+peak vs. rime ($F(1,62) = 12.827, p = .001$), onset+peak vs. coda ($F(1,62) = 13.545, p$

$< .0001$), peak vs. rime ($F(1,62) = 47.225, p < .0001$) and peak vs. coda ($F(1,62) = 46.344, p < .0001$).

The most substantial differences in the two year-groups' patterns of analogy use in the two presentation conditions were observed at the levels of peak (where a substantial improvement was seen in the Year 1 score, compared with a decrease in the Year 2 score) and at the level of the rime, where both years benefited from the clue word remaining visible, particularly the Year 2 sample who made the greatest gain at this unit level (Table 5.7). No overall effects of year or group were found to be significant in any of the above analyses.

5.5. DISCUSSION

Experiment 3 was designed to investigate three things: first, children's spelling performance and their use of analogy in spelling when the clue word was presented visually (spoken+written), as in Goswami (1988) and Nation and Hulme (1996), compared with when the clue word was verbally presented (spoken-only), as in Experiment 2 of the present thesis; second, the contributions to correct spelling of four different units (onset+peak, peak, rime and coda) at different points of spelling development (primary Years 1 and 2); and third, any differences in participants' spelling performance and the degree to which they used analogy, depending on whether they had previously received intervention in analogy use in spelling or not (in Experiment 2).

The prediction in relation to spelling performance and analogy use in the two presentation conditions (spoken only vs. spoken+written) was that children's spelling performance would show an overall improvement in the latter condition when the clue word remained in view

during testing, as would the degree to which they showed evidence of analogy use in their spelling. This was Muter *et al.*'s (1994) finding in relation to reading performance and analogy use in reading. The prediction relating to any group differences in spelling performance and analogy use in the two presentation conditions was that both groups would show evidence of using analogy in their spelling, but that the intervention group would show a greater degree of analogy use across both presentation conditions, resulting in a higher proportion of correct spellings than the controls. This was the finding of Experiment 2, where an additive analogy effect was evident for the intervention group (i.e. a clue word instruction effect as well as an analogy intervention effect), although the non-intervention group also showed evidence of using analogy in their spelling (a clue word instruction effect) but to the slight detriment of phonologically plausible spelling, at least at Time 3 (Table 4.7). Support for this suggestion was drawn, in Experiment 2, from the finding that analogy was highly predictive of correct spelling for both groups of children, but that analogy was even more strongly predictive of correct spelling for the intervention group than for controls, at least at Time 2 (Table 4.6). Additionally PP was also strongly predictive of correct spelling, particularly for the intervention group, suggesting that the analogy coaching had been beneficial in teaching this group how to combine orthographic and phonological strategies in spelling to good effect.

The results in the present experiment indicated the presence of the clue word (in the spoken+written presentation condition) to have been greatly beneficial in improving both correct and phonologically plausible spelling performance. The marked interaction between the effects of clue-word presentation and year-group in relation to both correct and phonologically plausible (PP) spelling further demonstrated the beneficial effect of the presence of the clue word on both correct and PP spelling for the younger year-group in

particular. The results in relation to analogy use in the two presentation conditions, showed no great benefit to have been wrought by the presence of the clue word, although group differences between those children who had previously been coached in analogy use and those who had not, were clearly apparent across both conditions (Table 5.3; Figure 5.3).

The finding that the presence of the clue word greatly enhanced spelling performance overall is clearly in line with the same finding in relation to reading in Muter *et al*'s (1994) investigation. However, it was predicted that analogy use would also be substantially enhanced by the presence of the clue word, as was the case in the Muter *et al* (1994) study, but the results in the present experiment do not provide much support for this finding in relation to analogy use overall, although correct analogy use was of course notably improved by the visual presence of the clue word, since correct analogy use was equated with correct spelling performance and marked group differences remained across both presentation conditions in relation to correct spelling.

The finding in the present study that the presence of the clue word was particularly beneficial to correct and PP spelling performance in the younger year-group is not surprising, since the younger children would have been expected to have access to less secure representations of the sounds and spelling patterns of the clue words than the older children, so they would have been most likely to benefit from having a visual representation of the clue words in front of them. Rather more interesting perhaps, since the instruction to use the clue words directed the children towards analogy use rather than phoneme-based strategies in their spelling, is the finding that overall phonological plausibility improved considerably when the clue words remained visually present during testing, as compared with when they were not presented visually. Perhaps this is not so surprising, however, since 'analogical' and 'phonological'

strategies in spelling are not necessarily mutually exclusive: on the contrary, the ability to combine these strategies is a mark of skilled spelling. Indeed, both analogy use and phonological plausibility were shown to be highly predictive of spelling ability, both in the present study and in Experiment 2, and analogy is itself an important aspect of phonological awareness, particularly in an irregular orthography like English.

Interestingly, age was also shown to be a significant predictor of spelling ability but only when the clue word was present during testing. However, the negative effect shown for age also suggested that the younger should have improved in their spelling more than older children, when the clue word remained in view during testing, and this was indeed the case. Similarly, the separate regressions analyses for the intervention and control groups (Tables 5.5 and 5.6 respectively) revealed age to be a significant predictor of variance in spelling, along with analogy and PP, for the non-intervention group when the clue word remained visible in the spoken+written condition, but only analogy and PP, not age, to be significantly predictive of spelling for the intervention group, whether the clue word was present or not. Again, the negative effect shown for age in the case of the former group predicted that the younger children would do better in their spelling than the older children when the clue words were present. The suggestion would be, therefore, that the presence of the clue word during testing was predictive of spelling success for the younger children in the non-intervention group because it gave them access to spelling patterns that they would otherwise not have been sure of. Conversely, all the children who had previously been coached in analogy would have had the opportunity to form representations of several exemplars of the spelling patterns that they were using in analogy, so the younger children in the intervention group might not have benefited from the presence of the clue word to the same degree as those in the non-

intervention group. Hence age was not a strong predictor of spelling success for the intervention group, but only for the non-intervention group when the clue word was present.

As to which of the four units contributed most to analogy use in relation to correct spelling in the two clue word presentation conditions, the prediction was that the children in both year-groups would show either equal degrees of analogy use at both larger and smaller unit levels (onset+peak and rime vs. the peak and coda), as was the case in Nation and Hulme (1996), or much greater use of analogy at the level of the rime than at any other unit level (as was the case in Goswami, 1988) or, alternatively that the two year-groups would show qualitatively different patterns of analogy in their spelling, with the younger group displaying a preference for rime analogies and the older group showing evidence of 'increasingly refined' analogy use and an ability to make smaller unit (e.g. peak) analogies in spelling, which would be in line with Goswami's (1993) interactive analogy model in relation to reading. The unit by unit comparisons of correct analogy use in the present experiment showed unequivocally that the rime was more influential in relation to analogy use and correct spelling than any other unit under consideration when the clue word remained visible (as in Goswami, 1988 and Nation and Hulme, 1996), and this was the case for both year-groups. These results clearly support those of Goswami (1988), who also found the rime to be the most influential unit of analogy in spelling, while challenging those of Nation and Hulme (1996), who found no difference in the degree to which children made analogies at the levels of the rime, onset+peak or peak. However, closer inspection of the patterns of analogy use by the two year-groups revealed some major differences in the degree to which analogies were made at the four unit levels by the two year-groups in the two clue word presentation conditions. Specifically, the Year 1 sample showed an increase in peak analogies when the clue words were present, whereas the Year 2 children showed an increase in rime analogies when the clue word was present. It is

unlikely, therefore, that these contrasting patterns of analogy use in the two year-groups signify a developmental shift in spelling away from large unit analogies towards a more refined use of analogy in line with the pattern predicted in reading by Goswami's interactive analogy model (1993), particularly since both year-groups actually showed a preference for rime analogies overall when the clue words remained in view (Table 5.7). It may be, therefore, that the contrasting patterns of analogy use demonstrated by the two year-groups are attributable to the different word-lists used to assess the spelling performance of each of the two year-groups. It would therefore clearly be desirable to compare the analogy use patterns of both year-groups in spelling the same words, so as to ascertain whether the contrasting patterns of analogy use in the present experiment were due to different words being used in analogy, or to developmental differences between the two year-groups. It is hoped that further research will allow a conclusion to be reached on this matter.

6. CHAPTER 6: EXPERIMENT 4

6.1. INTRODUCTION

Experiments 1, 2 and 3 looked at whether children benefit from spelling intervention in the use of analogy in spelling and whether providing children with a clue word, either presented in spoken format or in both written and spoken format, enables them to use analogy to spell groups of words which share certain phonological and orthographic correspondences with the clue words. Experiments 1 and 2 concluded that children did indeed benefit from spelling intervention in the use of analogy in spelling. Experiment 3 concluded that children were better able to use analogy in their spelling when the clue words remained in view during testing, irrespective of whether they had previously benefited from spelling intervention or not, although the children who had received tuition in analogy outperformed those who had not, both in terms of their correct spelling performance and in terms of their use of analogy. In both Experiments 2 and 3 (although not in Experiment 1) even the children who had not previously received tuition in analogy use were nonetheless able to use analogy in their spelling, albeit to a lesser degree than those who had received analogy coaching. The suggestion was, therefore, that the ability to use analogy demonstrated by the non-intervention group was an effect of the clue word presentation and the instruction to use the 'sounds and spelling' of the clue words to help spell the analogous test words, whereas the superior ability to use analogy demonstrated by the intervention group was an additive effect of both clue word instruction *and* teaching intervention in analogy use. Support for this interpretation was found, in Experiments 2 and 3, in the highly predictive effects of analogy use on variance in spelling for both the intervention and non-intervention groups.

Additionally, Nation and Hulme (1996, Exp. 2) found that children were able to use analogy with priming (real) words in order to spell a series of non-words which shared phonological similarity with the real words at the level either of initial consonant and vowel (onset+peak), medial vowel (peak) or rime (e.g. '*green-/grib/*'; '*green-/pim/*'; '*green-/trin/*'). In this experiment Nation and Hulme compared two groups of children in their spelling of non-words. The first (experimental) group heard real words that acted as primes for phonologically similar non-words (as in '*green-/grib/*'); the second (control) group heard unrelated 'prime' words which bore no phonological similarity with the ensuing non-words (e.g. '*horse- /grib/*'). The dependent measure in each case was the number of times the children used the critical spelling pattern present in the real words to spell non-words. Nation and Hulme found that children used the critical spelling pattern more often in the primed (related) condition than in the control (unrelated) condition, suggesting that the children were making analogies with the priming real words in order to spell the non-words. Their conclusion to this experiment was that "children can make analogies when spelling unfamiliar words and that such an effect is not simply because the clue word [in their Exp. 1 and Goswami's Exp.1 of 1988] acts as a visual cue" (Nation & Hulme, 1996, p.430). The finding that the children in the priming condition showed evidence of using analogy, whereas those who heard an unrelated word, which was in no way analogous with the test words did not, again supports the suggestion made above that children can and do use analogy in their spelling wherever it is appropriate to do so, irrespective of whether they have received coaching in analogy use or not.

Unlike Goswami (1988), Nation and Hulme (1996) found no evidence of children favouring rime analogies in their spelling over analogy at any other unit level. Both Nation and Hulme's

analogy studies (Exp. 1 and 2, 1996) concluded that an equal analogy effect was shown, regardless of whether the clue words or primes shared onset-vowel, medial vowel or rime with the target words. The findings of Experiments 1- 3 of this thesis with respect to the specific units which most predominate in analogy use (onset+peak, peak, rime or coda) were rather less conclusive, however. Experiment 1 had established that there was no great difference in the degree to which children made analogies at the different unit levels, whereas both Experiments 2 and 3 found a decisive overall preference for rime analogies over analogy at any other unit level. However, both these latter experiments employed a larger sample of children than Experiment 1 and their findings might therefore be considered more robust than those of the former.

Additionally, however, when the two year-groups (Years 1 and 2) were compared in their use of analogy at the four unit levels in Experiment 2, contrasting patterns emerged for the different age-groups, with the Year 1 sample showing a preference for rime analogies and the Year 2 sample showing a preference for analogy at the levels of the peak and onset+peak. However, when the two year-groups' use of analogy was compared in the two clue word presentation conditions in Experiment 3, any year-group differences appeared to be ironed out in the spoken+written condition, with both year-groups favouring rime analogies over analogy at other unit levels.

It should be remembered, however, that different words were used for the two year-groups. It is therefore possible, that the contrasting patterns of analogy use shown between different age-groups were in fact attributable to the *different words used*, rather than to any developmental change in analogy use on the part of the different age-groups. This would, after all, not be so surprising, since it has been shown that analogy (at least in relation to

reading) is of greater use in some languages, than it is in others (Goswami, *et al.*, 1998). It therefore follows that using analogy in spelling may be more salient for certain spelling patterns than for others, even with respect to the same language. The suggestion is therefore that testing both year-groups with the same clue and test words in the same presentation condition may be the only way to resolve the conflicting findings of Experiments 1 - 3. This would then allow a resolution to be reached as to whether there is any evidence of children showing an increasingly 'refined' use of analogy, (moving from analogy at the larger unit level to an increasing ability to use analogy at smaller unit levels, as claimed by Goswami, 1993 in her interactive analogy model in relation to reading development), or whether children are all equally able to use analogy in their spelling, irrespective of clue word or prime type and irrespective of spelling ability, as claimed by Nation and Hulme (1996).

6.2. AIMS OF EXPERIMENT 4

The primary purpose of Experiment 4 was therefore to establish whether three age-groups of children (Years 1, 2 and 3) would show contrasting patterns of analogy use at the different unit levels (onset+peak, peak, rime or coda) when they were given the same clue and test words, or whether they would show similar patterns of analogy across the different unit levels. Furthermore, in giving children of differing ages the same test words, the purpose was also to check that the original word-lists, which had been gauged to be appropriate for the levels of literacy attainment reached by Years 1 and Year 2, were in fact appropriately targeted. The prediction was that the Year 1 children would be able to spell more words correctly from the Year 1 wordlist than from the Year 2 wordlist, both in the random and analogous conditions, while the Year 2 children would outperform the Year 1 children in correctly spelling words from both the Year 1 and Year 2 wordlists in both conditions, with

the Year 3 children outperforming both the younger age-groups in spelling both wordlists in either condition.

An additional purpose of Experiment 4 was to investigate children's use of analogy in spelling, without intervention, by asking children to spell words which were presented either in random order (with no clue or prime words present) or in analogous groupings, using the 'clue word' paradigm. The prediction (based on the findings of Experiments 2 and 3 in the present thesis and of the priming study by Nation & Hulme, 1996) was that a significant majority of children would produce a superior correct spelling performance when words were presented in analogous groups, than when presented in random lists. The hypothesis was that, in the analogous presentation condition, the children would be able make analogies with the spelling patterns present in the clue words to help them to spell the analogous test words, whereas when the same words were presented in random lists, no such clues would be available.

6.3. METHOD

6.3.1. Participants

The participants were 39 English school children in Years 1, 2 and 3, all from one village primary school. The mean age of the Year 1 group was 6.01 (*SD* 0.30), with the mean ages of the Year 2 and Year 3 samples respectively 6.97 (*SD* 0.27) and 7.85 (*SD* 0.24). There were 11 participants in Year 1 (five boys and six girls), 14 in Year 2 (seven boys and seven girls) and 14 in Year 3 (six boys and eight girls). The only children to be withheld from taking part were three children who were technically in Year 1, but who in fact did all their schoolwork with the Reception year. All the children were from the same primary school and all spoke English

as their first language. None of the children had diagnosed auditory problems, and all had normal or corrected-to-normal vision.

6.3.2. Materials

The materials comprised the same two wordlists used in Experiments 1 and 2 for Years 1 and 2 respectively. The only difference in the present experiment was that all the words in both wordlists were presented to all three year-groups (Years 1, 2 and 3). All children were therefore tested in spelling the words from the original Year 1 and Year 2 lists (Appendix 1). Initially, however, all words were presented in random order. The words used in the original analogy tests at Times 2 and 3 in Experiments 1 and 2 were then presented again to all three year-groups, but this time in the same orthographically analogous categories employed for the clue word paradigm in Experiments 1 and 2 (see 3.3.2.2. and 3.3.4. for details of materials and procedure).

6.3.3. Design

The experiment employed a mixed design with repeated measures, comparing the correct spelling performance of three year-groups (Years 1, 2 and 3) when presented with the original words from the Year 1 and Year 2 wordlists (employed for Experiments 1 and 2) in two conditions: random list order and analogous categories. Testing in the analogous categories condition was designed to replicate the procedure employed for Experiments 1 and 2, using a clue word paradigm and four analogous test words, each sharing the same onset+peak, peak, rime or coda as the clue word. Comparison of analogies made at the four unit levels could therefore be made between the three different year-groups.

There were therefore three main effects: presentation condition (R vs. A); wordlist (WL1 vs. WL2) in both presentation conditions; and unit (onset+peak, peak, rime and coda). The dependent variable in each case was the number of correct spellings.

6.3.4. Procedure

6.3.4.1. Testing Procedure

Tests were held approximately twice a week over a two-month period in one of the classrooms during the lunch hour. All the children were tested in their respective year-groups. Throughout all the tests, both when words were presented in random order and in analogous categories, the researcher presented each word first in isolation and then in context. This was particularly important for words that shared their pronunciation with a homophone (e.g. '*sail*'). Initial presentation of tests for all three year-groups was in the random order condition (R), with subsequent presentation in the analogous categories condition (A). This was so as to ensure that any learning that might have resulted from presenting the words in analogous categories did not carry over into performance on the random list condition. One week of no testing was left clear between testing in the two conditions.

The random order tests comprised all the words used in Experiments 1 and 2 at Times 1, 2 and 3 from both the original Year 1 and Year 2 wordlists, randomly interspersed. There were thus 142 words in total: 71 from the original Year 1 wordlist, and 71 from the Year 2 wordlist. Tests were spread over five sessions of between 28 and 30 words per session. Testing in the random condition also allowed year-group performance comparisons to be made between Years 1, 2 and 3 in their spelling of the words from the original Year 1 and Year 2 wordlists.

The analogous categories tests comprised all the words used in Experiments 1 and 2 at Times 2 and 3 only, since the clue word paradigm was not originally applied till Time 2. Each of the analogous categories tests comprised 30 words, with a clue word presented first for each group of analogous words, in exactly the same manner as for Experiments 1 and 2 (see 3.3.4.1 and 4.3.4.1). Altogether there were four analogous categories tests, giving a total of 120 words in the analogous categories condition. The words from the original Time 1 test, which did not employ the clue word paradigm, clearly could not be included in the analogous categories tests in the present investigation. These words were therefore excluded from the analyses comparing the children's spelling performance in random versus analogous presentation conditions. Thus the same number of words was included in both conditions.

6.3.4.2. Scoring Procedure

Spelling performance was scored in the random order presentation condition on the basis of correct spelling only. In the analogous categories condition, spelling performance was scored first on the basis of correct spelling and, second, on the basis of analogy with the respective clue words. Analogy scores were awarded and broken down according to the unit (onset+peak, peak, rime or coda) used in analogy, exactly as for Experiments 1 and 2 (e.g. '*sail*': '*saint*', '*paid*', '*trail*', '*nil*'). In the present investigation, however, analogy scores were only awarded if the overall spelling of the word was correct, since the purpose was to investigate which unit/s predominated in their contribution to correct spelling and whether the different year-groups showed similar or different patterns of analogy use in their spelling. Homophones were marked as incorrect in both presentation conditions, since the researcher had presented each word in context, as well in isolation.

6.4. RESULTS

Results were collated in spreadsheet format. The maximum score for correct spelling in the random or analogous categories presentation conditions (R vs. A) was 120 in each, while the maximum score for correct spelling of the two wordlists was 71 in the random condition (R.WL1 vs. R.WL2) and 60 in the analogous condition (A.WL1 vs. A.WL2). Since total scores for the two wordlist conditions were not equal, all scores were calculated as percentages correct. Correct scores in the analogous condition were further broken down by unit (onset+peak, peak, rime and coda), giving a maximum score of 12 for each unit on each wordlist (WL1 and WL2).

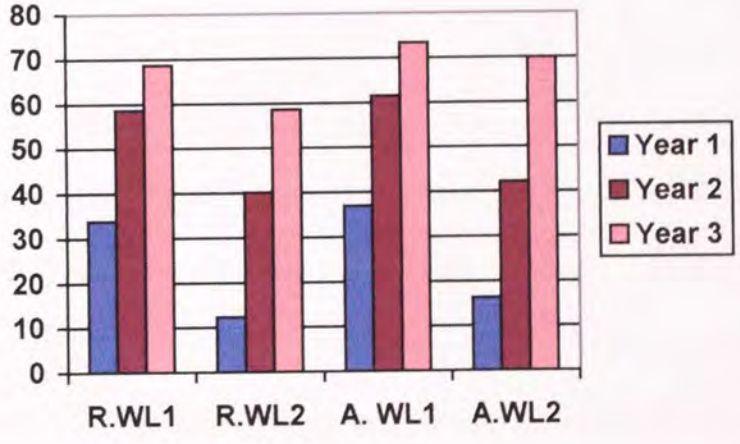
6.4.1. Random versus Analogous Presentation of Wordlists to Years 1, 2 and 3

Based on the findings of Experiments 1 – 3 and on those of both Goswami (1988) and Nation & Hulme (1996), the prediction in relation to spelling performance in the two presentation conditions was that more correct spellings would be produced by all participants in the analogous categories condition than in the random presentation condition. In relation to spelling performance on the two wordlists (originally used for Years 1 and 2 in Experiments 1 and 2), the prediction in Experiment 4 was that the Year 1 children would be able to spell more of the words from the Year 1 wordlist (WL1) than from the Year 2 wordlist (WL2), while the Year 2 children would be able to spell more words from both wordlists than the Year 1 children, but specifically more from the Year 2 wordlist. Additionally, it was predicted that the Year 3 children would also spell more words correctly from both wordlists (WL1 and WL2) than either of the younger year-groups. Table 6.1 presents the mean correct scores for each of the year-groups in spelling both wordlists (WL1 and WL2) in the two presentation conditions (Random versus Analogous). Figure 6.1 illustrates these results in a chart.

Table 6.1: Mean correct scores (calculated as percentages correct) for Years 1, 2 and 3 on wordlists 1 and 2 (WL1 & WL2) in both the random and analogous presentation conditions

	Random Presentation			Analogous Presentation		
	WL1	WL2	Total	WL1	WL2	Total
	Mean (*SD*)	Mean (*SD*)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Yr1 (*n*11)	33.80 (1.44)	12.29 (8.82)	23.05 (11.62)	36.97 (17.24)	16.36 (12.75)	26.67 (14.22)
Yr2 (*n*14)	58.55(15.96)	40.14(21.38)	49.35 (17.42)	61.55 (20.64)	42.14 (23.26)	51.85 (21.08)
Yr3 (*n*14)	68.61(13.74)	58.55(15.56)	63.58 (14.20)	73.33 (17.39)	70.00 (16.12)	71.67 (15.91)
Total(*n*39)	55.18(20.43)	38.89 24.85)	47.04 (21.86)	58.85 (23.37)	44.87 (28.06)	51.86 (24.9)

Figure 6.1: Chart illustrating mean correct scores for Years 1, 2, and 3 on both wordlists in both presentation conditions: random (R.WL1 & R.WL2) and analogous (A.WL1 & A.WL2)



Results were analysed using a repeated-measures three-way analysis of variance (ANOVA), so as to establish the statistical significance of any performance differences by the three year-groups (Years 1, 2 and 3) in the two conditions (R vs. A) in spelling the words from each list (WL1 vs. WL2). As anticipated from the means presented in Table 6.1, the main effect of presentation was statistically significant (F (1,36) = 24.799, $p < .0001$), as was the main effect of list (F (1,36) = 90.126, $p < .0001$), as was also the between-subjects effect of year (F (2,36 = 22.117, $p < .0001$). The interaction of year with list was also significant (F (2,36) = 7.654, p = .002), as was the interaction of presentation with year (F (2,36) = 3.456, p = .042) but no further interactions were statistically significant (presentation x list: F (1,36) = 2.246, p = .143; presentation x list x year: F (2,36) = 2.668, p = .083).

The total mean for each of the two presentation conditions was close to the median in each condition (45.77 for the random order presentation and 47.50 for the analogous categories condition). This, together with the kurtosis being close to 1 (-.899 for the former and –1.067 for the latter) and a skewness of .109 and -.081 for the two presentation conditions respectively, suggests a normal distribution with very little deviation from the mean.

6.4.2. Unit by Unit Comparisons of Analogy Use

Comparison of the means for correct analogy use at the four critical unit levels (onset+peak, peak, rime and coda) is shown in Table 6.2. Remarkably similar patterns of analogy use were observed for the three respective year-groups (Years 1, 2 and 3), although all three year-groups displayed contrasting patterns of analogy use for spelling the different wordlists (WL1 vs. WL2).

Thus all three year-groups predominated in using rime analogies over other unit analogies for the Year 1 wordlist (WL1), but relied on onset+peak and peak analogies for the Year 2 wordlist (WL2 - Table 6.2). It would therefore appear that the differences in analogy use observed in the Year 1 and Year 2 children in Experiments 1 and 2 were due to the different wordlists used to test the two year-groups, rather than due to developmental differences in analogy use.

Table 6.2: Comparison of the mean correct analogy use scores for Years 1, 2 and 3 on the (1) Year 1 and (2) Year 2 wordlists at the levels of onset+peak, peak, rime and coda

(1) Year 1 wordlist (WL1):

	Onset+peak		Peak		Rime		Coda	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Year 1 (*n* 11)	4.00	(2.28)	2.36	(1.80)	4.27	(2.68)	3.00	(2.82)
Year 2 (*n* 14)	6.50	(2.77)	6.00	(2.29)	7.50	(3.21)	6.36	(2.68)
Year 3 (*n* 14)	8.29	(2.52)	7.29	(3.24)	9.00	(2.48)	8.36	(2.47)
Total (*n* 39)	6.44	(3.02)	5.44	(3.22)	7.13	(3.35)	6.13	(3.35)

(2) Year 2 wordlist (WL2):

	Onset+peak		Peak		Rime		Coda	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Year 1 (*n* 11)	2.82	(1.60)	1.82	(1.08)	0.73	(0.91)	1.00	(1.48)
Year 2 (*n* 14)	5.79	(2.23)	5.64	(2.59)	3.79	(4.08)	3.71	(2.76)
Year 3 (*n* 14)	8.00	(2.22)	8.21	(2.12)	7.79	(2.33)	7.79	(2.67)
Total (*n* 39)	5.74	(2.90)	5.49	(3.28)	4.36	(4.00)	4.41	(3.65)

A three-way repeated-measures ANOVA was used to ascertain the statistical significance of these differences. The factors were wordlist (WL1 vs. WL2), unit (onset+peak, peak, rime and coda) and year (Years 1, 2 and 3). The main effect of wordlist was statistically significant ($F(1,36) = 44.471, p < .0001$), confirming performance differences on the two wordlists (WL1 and WL2) to be significant. The main effect of unit was also statistically significant ($F(3,108) = 6.087, p = .001$), as was that of year ($F(2,36) = 20.415, p < .0001$). The interactions of wordlist with year and wordlist with unit were also statistically significant ($F(2,36) = 7.186, p = .002$ and $F(3,108) = 19.048, p < .0001$ respectively), as was that of unit with year ($F(6,108) = 2.013, p = .070$).

However, since a single ANOVA was of little benefit in assessing the comparative contributions of the different individual units to correct spelling of the two individual wordlists, a series of two-way ANOVAs was performed to explore the significant effects in 12 possible pairings: WL1 onset+peak vs. WL1 rime; WL1 onset+peak vs. WL1 peak; WL1 onset+peak vs. WL1 coda; WL1 peak vs. WL1 rime; WL1 peak vs. coda; WL1 rime vs. WL1 coda; WL2 onset+peak vs. WL2 rime; WL2 onset+peak vs. WL2 peak; WL2 onset+peak vs. WL2 coda; WL2 peak vs. WL2 rime; WL2 peak vs. coda; WL2 rime vs. WL2 coda. In each case, the 0.05 significance level was adjusted to account for one-twelfth of the alpha level ($p = < .004$), according to the Bonferroni method. These confirmed analogy at the level of the rime on the Year 1 wordlist (WL1) to be statistically more significant than at the level of either peak ($F(1,36) = 39.918, p < .0001$) or coda ($F(1,36) = 11.333, p = .002$), and to be fractionally short of significance in comparison with analogy at the onset+peak level ($F(1,36) = 36.00, p = .006$). Analogy at the level of onset+peak was also shown to be significantly greater than at the level of the peak ($F(1,36) = 15.451, p < .0001$). No other unit comparisons were significant. Most importantly, however, although the between-subjects effect of year

was statistically significant on all six of the Year 1 wordlist analyses (*p*s <.0001 in all cases, except WL1 onset+peak vs. WL1 rime when $p = .001$), the interaction of year with unit was not significant in any of these analyses. This confirmed the view that there was no significant difference in the patterns of analogy shown for the three year-groups in spelling the words from WL1.

On the Year 2 wordlist (WL2), a completely different pattern of analogy use emerged with analogy at the level of both the onset+peak and peak being statistically more significant in their contribution to correct spelling than either the rime ($F(1,36) = 17.483, p < .0001$ and $F(1,36) = 17.205, p < .0001$) or coda ($F(1,36) = 20.118, p < .0001$ and $F(1,36) = 13.386, p = .001$). No statistical difference was found between the onset+peak and the peak in their respective contributions to analogy use on the Year 2 wordlist ($F(1,36) = 1.442, p = .238$), nor was any statistical difference found between the rime and coda ($F(1,36) = .044, p = .835$). Most importantly, however, although the between-subjects effect of year was statistically significant in all six analyses (*p*s <.0001 in all cases), the interaction of year with unit was again not significant in any of these analyses. This again confirmed the view that there was no significant difference in the patterns of analogy shown for the three year-groups on either of the wordlists, although significant differences were found in patterns of analogy use in spelling the two sets of words (WL1 and WL2). Thus the contrasting patterns of analogy use for the different year-groups observed in Experiments 2 and 3 were not attributable to developmental differences in analogy use, but rather to different strategies of analogy use being required for spelling different words.

6.5. DISCUSSION

The purpose of Experiment 4 was to investigate children's use of analogy in spelling, without intervention, by comparing their correct spelling scores on randomly presented lists of words with their correct spelling scores on words presented in analogous categories. The hypothesis was that, if children could use analogy in their spelling even without the benefit of intervention, their correct spelling performance would be superior when words were presented in analogous groups, as opposed to in random order. The results show this hypothesis to have been upheld, since all three year-groups produced substantially superior spelling scores in the analogous categories presentation over the random order presentation.

Nation and Hume (1996) also concluded that children were able to use analogy in their spelling since in their study, which investigated children's use of analogy with priming (real) words in order to spell a series of non-words with similar phonological features, the primed condition produced more spellings using the critical spelling patterns present in the real words than the un-primed condition. However, their study did not find any significant differences in the types of prime used, whether at the level of onset+peak, peak or rime.

In the present thesis, Experiment 1 found no major differences in analogy use at the different unit levels, while Experiments 2 and 3 both found an overall preference for analogy use at the level of the rime. The latter two experiments also found differences in patterns of analogy use between different year-groups (Years 1 and 2). However, since the two year-groups had been tested in their use of analogy using different wordlists, the conclusion was that any differences in analogy use observed in the two year-groups might have been because different

spelling patterns require different strategies in analogy use, rather than because of a developmental shift in using analogy at different unit levels.

By comparing three different year-groups (Years 1, 2 and 3) in their use of analogy in spelling the *same* words, the present study sought to establish whether the different year-groups would use contrasting patterns of analogy, or whether all three year-groups would employ similar strategies of analogy use but differing patterns of analogy to spell different words. The results clearly indicate the latter, since the same pattern of analogy use was observed in all three year-groups, but contrasting patterns of analogy use were observed for spelling the two wordlists. These findings do not therefore support Nation and Hulme's finding of 1996 that there were no significant differences in analogy use at the different unit levels. In spelling the Year 1 wordlist (WL1), all three year-groups used analogy at the level of the rime considerably more than at any other unit level, and the onset+peak were also found to contribute more to correct spelling than the peak. Whereas, in the case of the Year 2 wordlist (WL2), all three year-groups showed an entirely different pattern of analogy use, in which analogy at the levels of both the onset+peak and the peak was found to contribute considerably more to correct spelling than either the rime or coda. Goswami (1993) suggested that children might show a developmental shift in their use of analogy, at least with regard to reading, moving away from an initial preference to use analogy at the level of the rime towards an increasing ability to use analogy at the smaller unit level. However, the present results do not support Goswami's developmental framework, but rather indicate children to be more flexible in their analogy use, at least with regard to spelling, in that they appear to be able to use analogy at whichever unit level is most salient for the relevant spelling pattern.

This interpretation would be closer to the 'flexible-unit-size model' proposed by Brown and Deavers (1999), in which they suggest that arguments favouring a 'large-unit' or 'small-unit' model may be misplaced, since "even younger children will focus on, and try to make use of, whatever orthographic and phonological units are highlighted and made relevant by the nature of the specific task [or specific words] confronting them" (*ibid*, p. 210 - see also Brown & Ellis, 1994). If this argument is applied to spelling, the implication in the present experiment would be that children are able to use analogy more flexibly than either Nation and Hulme (1996) or Goswami (1988, 1993) have suggested and that this more flexible approach to analogy use in spelling might mean that children will use whatever unit level of analogy is most appropriate, depending on the words to be spelled or on the nature of the spelling task before them.

A secondary purpose of the present study was to compare the correct spelling performance of the respective year-groups (Years 1, 2 and 3) on the Year 1 and Year 2 wordlists originally used in Experiments 1 and 2 (WL1 and WL2), so as to ensure that these had been adequately targeted to the correct age-groups. The prediction was that, if the two wordlists had been correctly targeted to their respective year-groups' spelling ability, then the Year 1 children in the present study would be able to spell more of the words from the Year 1 wordlist (WL1) than from the Year 2 list (WL2), and the Year 2 children would be able both to spell more of the Year 2 words correctly than the Year 1 children. Furthermore, if the Year 1 wordlist (WL1) was indeed easier to spell than the Year 2 list (WL2), the Year 2 children would also be able to spell more words correctly from the former list than from the latter, as well as correctly spelling more words overall than the younger year-group. The prediction with regard to Year 3 was that these children would produce higher correct spelling scores on both wordlists than either of the younger year-groups. The results show that all these predictions

were upheld, both when the words were presented in random order and when presented in analogous categories, as at Times 2 and 3 in Experiments 1 and 2. These results therefore indicate that the two wordlists were correctly targeted to the two year-groups (Years 1 and 2) in Experiments 1 and 2.

In conclusion, the findings of Experiment 4 support those of Experiments 2 and 3 in demonstrating children's ability to use analogy in spelling, even in the absence of teaching intervention in analogy use. Furthermore, Experiment 4 supports the conclusion of these previous experiments that using analogy in spelling improves spelling performance, since all three year-groups in the current investigation produced superior mean spelling scores in the analogous condition, compared with the random presentation condition. By comparing all three year-groups' patterns of analogy use in spelling the same wordlists, Experiment 4 also showed that the contrasting patterns of analogy use observed in the two year-groups in Experiments 2 and 3 could not safely be interpreted as a consequence of a developmental shift away from large unit towards smaller unit analogy use, but was more likely to be a consequence of the different words being spelled, since all three year-groups in the present study showed similar patterns of analogy use but employed contrasting patterns of analogy for spelling the two wordlists. This finding directly challenges the view that analogy patterns change with development (Goswami, 1993), at least with regard to spelling. (It should be noted that Goswami used different words in all three of the experiments in her 1993 study). Finally, Experiment 4 confirmed that the two wordlists employed in Experiments 1 and 2 had been appropriately gauged to the two different year-groups' spelling abilities.

7. CHAPTER 7: EXPERIMENT 5

7.1. INTRODUCTION

The debate referred to in Chapter 2 (Section 2.4) in relation to the comparative contributions of analogy and phonology to literacy acquisition has tended to position the argument chiefly in terms of whether awareness of sub-syllabic units (e.g. onset and rime) or smaller (phonemic) units are more predictive of variance in literacy attainment (Bowey, 2002; Bradley & Bryant, 1983; Bryant, 1998, 2002; Bryant *et al.*, 1990; Goswami, 2002; Goswami & Bryant, 1990; Hulme, 2002; Hulme *et al.*, 2002; Hulme, Muter & Snowling, 1998; Muter *et al.*, 1997), but also in terms of the order in which larger-unit and phoneme-based strategies develop (Duncan, Seymour & Hill, 1997; Ehri & Robbins, 1992; Frith, 1985; Goswami, 1986; 1988; 1993; Marsh *et al.*, 1980). Experiments 1 – 3 of the present thesis addressed the former question, and Experiment 2 – 4 the latter. The results in the latter case did not resolve the question of whether larger or smaller units develop first in spelling, but they did indicate that children use analogy more flexibly, at least in relation to spelling, than previous developmental frameworks (Goswami, 1993) might have suggested, and this was the case for all age groups under consideration (primary Years 1, 2 and 3). As to the former question, the findings of Experiments 1 - 3 suggest that both phoneme-based strategies and higher unit level analogy-based strategies are highly predictive of correct spelling. Additionally, although intervention in analogy use appeared to have benefited the intervention group in Experiments 1 and 2 in improving their spelling performance relative to that of controls, Experiment 4 also showed that analogy use was effective in improving correct spelling performance, even without analogy intervention. The interpretation offered was that the 'clue word' paradigm employed in Experiments 1 - 3, and originally used by Goswami (1988) and subsequently by

Nation and Hulme (1996), enabled children to use analogy to benefit their correct spelling performance, but that children who had previously received coaching in analogy use were more able to use analogy strategically to improve their spelling. The analogy effect shown for the intervention group in Experiment 2 was therefore considered to be a combined effect, both of analogy intervention and of the 'clue word' paradigm.

Throughout the thesis thus far, analogy use has therefore been shown to play a highly influential role in spelling: but this does not mean that phoneme-based strategies do not also play a very important role. Indeed Goswami (2002) has suggested that it may be misleading to frame the debate referred to above in such dichotomous terms, since "whether children use small or large units in reading depends on the nature of the reading task, the type of words being read, the methods of reading tuition that they are experiencing, and the orthography under investigation" (*ibid*, 2002, p.47). Thus, for example, Brown and Deavers (1999) have demonstrated that even children of around 5 years of age show considerable flexibility in making use of both phoneme-based and analogical strategies, depending on the demands of the task. The results of Experiment 4 supported this view, since children in all year-groups used contrasting patterns of analogy to spell different words. Furthermore, research has shown that children's phonological and orthographic representations do not develop independently, but interactively and in parallel (Snowling, 1994; Treiman, 1994). Thus growing awareness of orthographic spelling patterns is likely to feed back into how phoneme-level information is perceived, so that children restructure their phonological representations to take account of their growing orthographic knowledge. Hence, they may learn to detect 'extra' phonemes in words like '*pitch*' and '*badge*', marking the /t/ in /tch/ and the /d/ in /dge/ as separate sounds (Ehri & Wilce, 1980) and this phonological restructuring will in turn strengthen their orthographic representations.

In the case of spelling, particularly in an irregular orthography like English, children also need to learn to combine a number of (in some cases conflicting) considerations so as to generate correct spellings. Phonological and lexical information needs to be combined, together with a consideration of morphological, contextual and semantic cues, so as to achieve correct spellings. It is therefore likely that consideration of rules about phoneme-to-grapheme mappings, sensitivity to phonemic context and the relation of one phoneme to another in the context of the syllable (Bernstein & Treiman, 2001; Kessler & Treiman, 2001), as well as the ability to make use of rhyming spelling patterns to generalize from known to new words are all forms of phonological awareness, which children need to be able to make use of in order to learn how to spell correctly in English. However, phonology alone is not enough to achieve correct spelling in an inconsistent orthography. Phonological awareness needs to be combined with orthographic awareness. Phonology is, therefore, an important aspect of analogy use in spelling, whether at the level of onset, rime, or phoneme, in that sensitivity to the shared sounds in words needs to work in combination with sensitivity to shared orthographic patterns. It may be, therefore, that analogy is in fact more influential in spelling than phonology overall. It would be interesting to establish, however, whether it is chiefly the phonological or orthographic similarity between words which drives analogy, or whether it is the *combination* of orthographic AND phonological correspondence that is influential over and above the influence of either of these factors on their own (as was indeed suggested by Hatcher et al's 1994 'phonological linkage hypothesis').

In the context of the present thesis, the aim thus far has been to explore the relationship between phonological and analogical processes in spelling. When this thesis was first conceived, however, the intention had been to explore this relationship in relation to reading

as well as spelling. Furthermore, application of the 'clue word' paradigm might usefully be extended to explore the relationship between phonological and orthographic strategies in relation to both reading and spelling. However, it was envisaged that applying the clue word task to ask children to make similarity-dissimilarity judgments on the basis of orthographic and phonological correspondence, phonological but not orthographic correspondence, or orthographic but not phonological correspondence might tax memory processes and attention, as well as tapping into phonological-orthographic awareness.

Previous research has indicated that there may be a developmental association between memory processes and literacy attainment. Shankweiler, Liberman and colleagues conducted a series of experiments in the late 70s and early 80s investigating the comparative phonological memory processes of skilled and less skilled readers of the same chronological age, which showed the performance of the less skilled readers on tasks designed to tap phonological memory to be consistently below that of children with superior reading skills (Liberman, Mann, Shankweiler & Werfelman, 1982; Mann, Liberman & Shankweiler, 1980; Shankweiler, Liberman, Mark, Fowler & Fischer, 1979, cited in Gathercole & Baddeley, 1993). However, although a link has consistently been found between reading ability and phonological short-term memory both on serial recall (Mann *et al.*, 1980; Shankweiler *et al.*, 1979) and recognition (Liberman *et al.*, 1982) and on non-word repetition (Brady, Shankweiler & Mann, 1983; Snowling, 1981; Snowling, Goulandris, Bowlby & Howell, 1986), more recently others have questioned the importance of short-term memory capacity and suggested that it is the efficiency and speed with which underlying phonological representations in long-term memory are accessed and processed (as well as the quality of those underlying representations) which are critical to the development of good literacy skills (McDougall, Hulme, Ellis & Monk, 1994). However, this clearly also implicates development

in central executive, as well as phonological, functioning (c.f. Baddeley & Hitch, 1974 for an explanation of the central executive as the central component of the working memory model). As central functioning efficiency improves, additional processing resources become available for storage, manipulation and retrieval of new material. Most of the research on the association between memory processes and literacy has related to reading, rather than spelling. The present investigation therefore sought to include an investigation of working memory (and specifically the central component of working memory) and long-term memory in relation to both reading and spelling, as well as in relation to phonological, analogical or visual processes and representations.

The relationship between reading development and attention has been investigated by measuring the effect of Stroop-like (c.f. Stroop, 1935) interference tasks in readers aged from 6 to 12 years (Everatt, McCorquodale, Smith, Culverwell, Wilks, Evans, Kay & Baker, 1999). The latter concluded that there is a modest relationship between reduced interference on Stroop-like tasks and increased reading ability (Everatt *et al.*, 1999, p.17). However, evidence from studies investigating the effects of resource limitations in reading, as gauged by dual task paradigms, suggest that attentional demands also reduce with experience. Horn and Manis (1987) found, for example, that while children in their first year of school showed considerably delayed reaction times on a dual-task exercise, there was a greatly reduced delay for children with two years' formal schooling, which was not dramatically different from the delay effect shown by adults. The implication is that, while there is an important role for attention in children who are beginning to read, there is a greatly diminished role for attention in readers with at least one to two years' reading experience, and an even smaller, though still discernable role for attention in adult readers. This pattern is mirrored by that shown for interference in the incongruent condition of the traditional Stroop task. Interference reaches an

optimum level at around the age of 7 years, and then drops off until the late teens or early adulthood, increasing again from about 60 to 70 years (Comalli, Wapner & Werner, 1962, cited in Everatt *et al.*, 1999). It would seem, then, that interference from the Stroop effect reduces as attentional processes improve and as reading ability progresses from being dependent on attentional mechanisms. The rationale for including a Stroop task in the present experiment was therefore as a measure of attention, which might bear a relationship with reading ability. Although the young age of the participants in this study meant that it was not practicable to include a greater number of trials in the three conditions, it was expected that a shortened Stroop task, which allowed comparison between two age-groups, would nevertheless produce a slightly greater incongruity effect, accompanied by slightly longer reaction times, in the younger children. This would be in line with previous research investigating attention in relation to reading in children (Comalli, *et al.*, 1962; Horn & Manis, 1987), and would be useful in giving an indication of what a focused developmental Stroop study might achieve.

7.2. AIMS OF EXPERIMENT 5

The aim of the present investigation was therefore to examine how performance in relation to each of the factors discussed above might be associated with reading and spelling performance. Additionally, Experiment 5 sought to establish whether the improvement in spelling performance observed in the intervention groups in Experiments 1 and 2 was attributable simply to analogy intervention, or whether analogy is in fact a more influential factor than phoneme-based strategies in spelling overall. The present study extended the scope of the thesis so far, to incorporate an investigation of analogical, phonological and orthographic strategies in relation to children's reading and spelling performance, via a series

of tasks designed to measure sensitivity to sound-spelling similarities and differences (orthographic *and* phonological similarity; phonological similarity but orthographic incongruity; and orthographic similarity but phonological incongruity). Additionally, since these tasks might also tax working memory and/or attention, the investigation was extended to include consideration of memory processes and attention in relation to literacy attainment.

7.3. METHOD

7.3.1. Participants

The sample comprised 49 children (25 boys and 24 girls) between the ages of 6.35 (6 years and 4 months) and 8.26 (8 years and 3 months), with a mean age of 7.37 (*SD* 0.55). Twenty of the children were in Year 2, with a mean age of 6.82 (*SD* 0.32); the other 29 were in Year 3, with a mean age of 7.75 (*SD* 0.31). All the participants were pupils from two mainstream primary schools within the local education authority. Both schools were in the same rural schools cluster, shared the same classroom structure, and were similar in size, environmental setting and pupil background. All the children had English as their first language.

7.3.2. Materials

Materials were a lap-top computer and an additional keyboard. All tests were administered using a computerised Super Lab programme.

7.3.3. Design

A three-part design was adopted. This was so as to be able to discontinue the WORD (Wechsler Objective Reading Dimensions) Basic Reading and Spelling tests after the misreading or misspelling of six consecutive words. Some adjustment needed to be designed

into the administration procedure of the standardised tests, so as to make them compatible with Super Lab (see Procedure: 7.3.4). All three sections were administered consecutively to each child individually.

7.3.3.1. Section 1

The first section comprised the presentation of seven pictures on screen, which constituted both the initial items (1 – 7) of the WORD Basic Reading test and, subsequently, also acted as the stimuli for a long-term memory task (repeated at the end of section three); a numerical working memory task; the first ten items of the analogical, phonological or orthographic similarity task; and remaining items of the Basic Reading test (items 8 - 55), administered as the final part of this section, so that testing could be discontinued after the child had misread six consecutive items.

7.3.3.2. Section 2

The second section comprised a further ten items of the analogical, phonological, or orthographic similarity judgment task, followed by the WORD Spelling test. This was adapted for use with Super Lab, so the procedure adopted was necessarily a modification of the standard procedure. Thus, for example, where the standard procedure requires a child to write a specified letter or word, the procedure adopted for use with Super Lab required the child to point to the specified letter on screen, and to spell the specified word out loud. Additionally, the standard procedure for administering the spelling test requires the examiner to say the letter, sound or word (which the child is to spell) in isolation, then say the sentence containing that letter, sound or word, and finally to complete the sequence by saying the letter, sound or word again in isolation. This procedure was modified for use with Super Lab, however. Since each item was timed to the nearest millisecond, it was considered more

accurate to time a child's performance on the task without naming the word in isolation first, but to start the procedure with the word in context first, and then to repeat the word in isolation. Finally, as was the case with reading, the spelling test was discontinued after a child had misspelled six consecutive items.

7.3.3.3. Section 3

The third section comprised the Stroop task (five neutral items as in '*car*', where the word meaning is unrelated to the colour of the print; six congruent items as in '*blue*', where the word meaning is the same as the colour of the print; and six incongruent items as in '*blue*', where the word meaning conflicts with the colour of the print), followed by the final ten items of the analogical, phonological, or orthographic similarity judgment task, and lastly repetition of the long-term memory task (see section 1).

7.3.4. Procedure

7.3.4.1. Testing Procedure

All tests were administered to children individually in a quiet part of the school using the Super Lab computerised programme. The tests administered were as follows:

7.3.4.1(a). Wechsler Objective Reading Dimensions (WORD): Basic Reading

First, the screen was placed in front of the child and visibility confirmed. The test was then administered to each child in two sections. Items one to seven were administered using following procedure:

Item 1: the child was asked to look at a picture on screen (e.g. of a sun) and, selecting from a choice of four words written below the picture ('*fun*', '*ask*', '*sit*', '*girl*'), 'point to the word which starts with the same sound as the picture'.

Items 2 – 4: the child was asked to look at a picture on screen (e.g. of a fish), select from a choice of four words written below the picture (e.g. '*stop*', '*push*', '*box*', '*walk*') and 'point to the word which ends with the same sound as the picture'.

Items 5 – 7: the child was asked to look at a picture on screen (e.g. of a cow), select from a choice of four words written below the picture (e.g. '*call*', '*cow*', '*could*', '*come*') and 'point to the word which says what the picture is'.

It should be noted that, for items one to four, the experimenter asked the children to point to the word (one of four written below), which either began or ended with the same sound as the picture, without actually saying what the picture represented. The rationale here was that it was necessary to use the same wording for all seven items, since alternative wording for the different items might have introduced unnecessary variables into the procedure for the incidental learning task which was subsequently used to gauge recall of those items. The experimenter indicated the choice selected by the child by entering the appropriate number (1, 2, 3 or 4) on the keypad, followed by 0 (zero) to move on to the next item.

Following the numerical working memory task (see below), items eight onwards were administered using the standard WORD Basic Reading procedure, with the words being presented individually on screen. Correct pronunciation (or acceptable regional variations in correct pronunciation) of a word were indicated as being correct by the experimenter entering

the number 6; incorrect pronunciation was indicated as such by entering the number 4 on the key pad. Again 0 (zero) moved the programme on to the next item. If the child either said, or confirmed when questioned, that he or she was unable to make an attempt at reading an item, the experimenter simply indicated this item as an error and moved on to the next item. Administration of the reading test was discontinued after the child had made six consecutive mistakes.

7.3.4.1(b). Working Memory Task

A numerical working memory task was administered following the first seven items of the reading test. The screen was placed before the experimenter, who ensured that the test items on screen were not visible to the child. The first two items were practice runs, to ensure the child understood the procedure. Each item comprised a sequence of three, four or five random numbers: items 1 – 4 comprised three numbers; items 5 – 8 four numbers; and items 9 – 12 five numbers. In each case, the experimenter presented the items verbally to the child and then said either 'biggest' or 'smallest' following the presentation of each number sequence. The task for the child was: to remember each sequence of numbers, select which number was either the greatest or smallest, depending on the instruction, and then verbally identify either the greatest or smallest number, as appropriate. Correct answers were indicated with a 6 by the experimenter; incorrect answers with a 4. Again 0 (zero) moved the programme on to the next item.

7.3.4.1(c). Long-term Memory Task

Memory of the pictures presented on screen in the first section of the WORD Basic Reading test (items 1 – 7) was tested initially following the working memory task in section one and again at the end of section three. On both occasions children were asked how many of the

seven picture items they could recall from their presentation at the start of testing. The overall score on this task was therefore an aggregate of initial and final recall.

7.3.4.1(d). Analogical, Phonological or Orthographic Similarity Task

Ten groups of words were compiled using some of the test words from Experiments 1 and 2 (Appendix 3). Each group comprised a 'clue' word and five other words, three of which were selected on the basis of the analogical, phonological or orthographic similarity with the 'clue' word, plus two additional distracters. Analogical similarity was defined in terms of both orthographic and phonological correspondence (O+P), as in '*moon - spoon*', '*pitch - ditch*', and '*light - night*'; phonological similarity was defined in terms phonological correspondence, but orthographic incongruence (P-O), as in '*moon - June*', '*pitch - rich*', and '*light - white*'; and orthographic similarity was defined in terms of orthographic correspondence but phonological incongruence (O-P), as in '*moon - moor*', '*pitch - pile*', and '*light - eight*'.

Three questions were devised, with which to gauge children's sensitivity to analogical, phonological and orthographic similarities between the corresponding words. The 'analogy' question was: 'Which word is spelt the same as the clue word AND sounds the same?' The 'phonology' question was: 'Which word SOUNDS like the clue word but is NOT spelt the same?' And the 'orthography' question was: 'Which word LOOKS like the clue word but does NOT sound the same?' Before taking part in the first trial, the task was explained to each child in a practice run. Once the experimenter had ensured that the child understood the task, one of the above three questions was presented on screen, with the child facing the screen and the experimenter reading the question out loud to the child. Five words then appeared on screen, with the clue word written in red and the five test words written in blue and presented in random order below, thus:

Pitch

Pile

Rich

Style

Ditch

Cheat

The child was then asked to select one of the five test words on the basis of analogical, phonological or orthographic similarity with the clue word written above, depending on which question they had been presented with. The question remained in view on screen with the clue word (in red) and test words (in blue) presented below. Each of the three questions was asked in relation to each of the ten word groups, thus forming 30 items in total, with ten items in each of the three sections. The questions were presented in random order, and the presentation order of the test words was also randomised. When the child had made a selection, the relevant number (1 – 5) was entered into the programme. If the child changed his or her mind about which word to select, and if the experimenter had not yet moved on to the next item, then the child was allowed to make an alternative selection. Marks were allocated on the child's final choice.

7.3.4.1(e). Wechsler Objective Reading Dimensions (WORD): Spelling

For the spelling test, the screen was placed in front of the experimenter, rather than in front of the child, except in the case of items one to six, when the child was asked to point to a specified letter on screen, or point to a letter which made a specified sound. Items one to six were administered using the following procedure:

Items 1 – 4: the child was asked to show the experimenter a specified letter out of a choice four letters presented on screen. For example, the experimenter asked the child: 'show me X', using that letter's alphabetical name, and the child pointed to one of the letters presented on screen: K; X; V; W.

Items 5 – 6: the child was again asked to show the experimenter a specified letter out of a choice of four letters presented on screen, but for these items the experimenter asked the child to, for example: 'show me 'b' for boy', sounding out the phoneme, rather than saying the letter's alphabetical name.

As with the reading test, the experimenter indicated the letter selected by the child by entering the appropriate number on the keypad (1, 2, 3 or 4 for K; X; V or W, for example), followed by 0 (zero) to move on to the next item.

For items seven onwards, each item was presented to the child first in context (e.g. '*Ann's cat had kittens*') and then in isolation ('*cat*') and the child was asked to spell each item out loud. The rationale for using this procedure is explained in Section 2 (7.3.3.2). Correct spelling of a word was indicated as being correct by the experimenter entering the number 6 on the keypad; incorrect spelling was indicated as such by entering the number 4. Zero was pressed to move the programme on to the next item. If the child either said, or confirmed when questioned, that he or she was unable to make an attempt at spelling an item, the experimenter simply indicated this item as an error and moved on to the next item. As was the case with reading, the spelling test was discontinued after a child had misspelled six consecutive items.

7.3.4.1(f). Stroop

A Stroop task was presented on screen, timed to the nearest millisecond. Initially the children were presented with individual coloured squares in either red, blue or green and asked to name the colour. They were then presented with the words 'blue', 'green' or 'red' and asked to read these. The Stroop task was introduced with the instruction that children were to name, as quickly as possible, the colour of the print that the word was written in, rather than read out the word itself. Five neutral items (as in '*car*', where the word meaning is unrelated to the colour of the print), six congruent items (as in '*blue*', where the word meaning is the same as the colour of the print) and six incongruent items as in '*blue*' (where the word meaning conflicts with the colour of the print) were then presented to each child individually on screen in random order. Immediately on the child naming the colour that each word was written in, the experimenter entered either the number 6 for correct or 4 for incorrect. Although this procedure meant that the experimenter's, as well as the child's reaction times were necessarily included in the overall times recorded, this was an unavoidable consequence of using Super Lab and should not, furthermore, have affected the overall measures, since it applied across all three conditions. It was anticipated that including seventeen trials across three conditions might not be enough to obtain a significant incongruity effect. (Wright & Wanley, 2003 used nearly 600 trials to obtain an eight-millisecond difference between children and adults). However, Stroop tasks are quite demanding for children of even 10 or 12 years of age, so it was not practicable with children as young as seven to include a large number of trials.

7.3.4.2. Scoring Procedure

A score of one was allocated for each correct answer, and zero for incorrect answers. The WORD Basic Reading score was therefore out of a possible total of 55; the WORD Spelling score out of possible total of 50; the working memory score out of a possible total of 12; the

analogical, phonological and visual similarity judgement scores each out of a possible total of 10; the Stroop score out of a possible total of five for the neutral items, a total of six for the congruent items and a total of six for the incongruent items; and the aggregate LTM score out of a possible total of 14.

Raw scores were used for the WORD Basic reading and spelling tasks, rather than standard score equivalents, since standard scores are already corrected for age in four-month bands and the intension was to investigate any possible effects of age in relation to all study measures. Results and analyses using the standard scores for reading and spelling have been included in Appendix 4, however.

7.4. RESULTS

Responses to all tests were recorded for each child by the computerised Super Lab programme. Results for each child were then collated in spreadsheet format. Descriptive statistics using the raw scores for each of the year-groups on all the study measures are shown in Table 7.1.

7.4.1. Year-Group Comparisons

Not surprisingly, results show the older year-group to be ahead of the younger on all study measures, apart from on working memory and the Stroop task, on which year-group scores were either equal (congruent condition) or showed the younger year-group producing fractionally more errors (in the incongruent condition) and slightly longer reaction times than the older year-group, as predicted (Table 7.1). Figure 7.1 illustrates the results on all measures for each year-group, expressed as percentages.

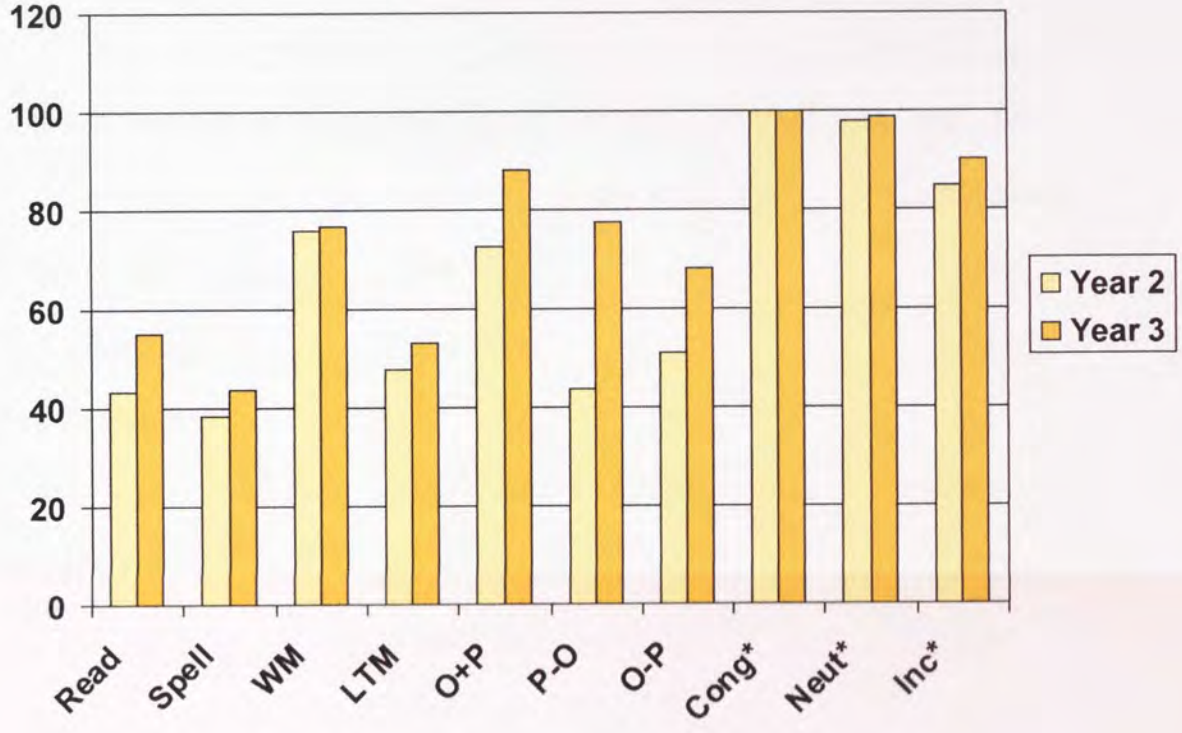
Table 7.1: Descriptive statistics broken down by year-group for all study measures

	YEAR 2	YEAR 3	TOTAL
	MEANS (*SD*)	MEANS (*SD*)	MEANS (*SD*)
	(*n* = 20)	(*n* = 29)	(*n* =49)
WORD Basic Reading	23.70 (8.83)	30.24 (8.11)	27.57 (8.93)
WORD Spelling	19.10 (4.27)	21.93 (4.33)	20.78 (4.48)
Working memory	9.10 (1.77)	9.21 (2.09)	9.16 (1.95)
LTM	6.70 (0.80)	7.45 (1.53)	7.14 (1.32)
Analogy (O+P)	7.25 (3.01)	8.83 (2.11)	8.18 (2.60)
Phonology (P-O)	4.35 (3.05)	7.76 (2.50)	6.37 (3.19)
Orthographic similarity (O-P)	5.10 (2.59)	6.83 (2.05)	6.12 (2.42)
Stroop (incongruent)	5.10 (0.72)	5.41 (0.78)	5.29 (0.76)
Error (incongruent)	0.90 (0.72)	0.59 (0.78)	0.71 (0.76)
Stroop (neutral)	4.90 (0.31)	4.93 (0.26)	4.92 (0.28)
Error (neutral)	0.10 (0.31)	0.07 (0.26)	0.80 (0.28)
Stroop (congruent)*	6.00 (0.00)	6.00 (0.00)	6.00 (0.00)
Stroop error (total)**	1.00 (0.73)	0.66 (0.90)	0.80 (0.84)
Stroop RT (ms)**	2042 (407.4)	1877 (315.7)	1944 (361.4)

*Note: there were no errors on the congruent Stroop task for either year-group.

**Averaged across all three Stroop conditions.

Figure 7.1: Chart illustrating means for all study measures by year-group, expressed as percentages



*Note: Congruous, Neutral and Incongruous Conditions on Stroop task.

Results on all the study measures for the two year-groups were subjected to statistical analysis using an Independent-Samples T-Test so as to establish any significant performance differences. The criteria for using parametric statistical analyses were largely met, although there was evidence of a slight skew on the analogical similarity measure. Accordingly, since Levene's Test for Equality of Variances could not be assumed on analogy and LTM (analogy: $p = .008$; LTM: $p = .011$), details for 'equal variances not assumed' have been used for these two measures. 'Equal variances assumed' have been used for all other variables. A summary

is shown in Table 7.2. This reveals year-group differences to be statistically significant on the scores for WORD Basic Reading, WORD Spelling, LTM, and on the phonological (P-O) and orthographic (O-P) similarity judgement tasks, with year-group differences on the analogy (O+P) judgement task bordering on statistical significance ($p = .051$).

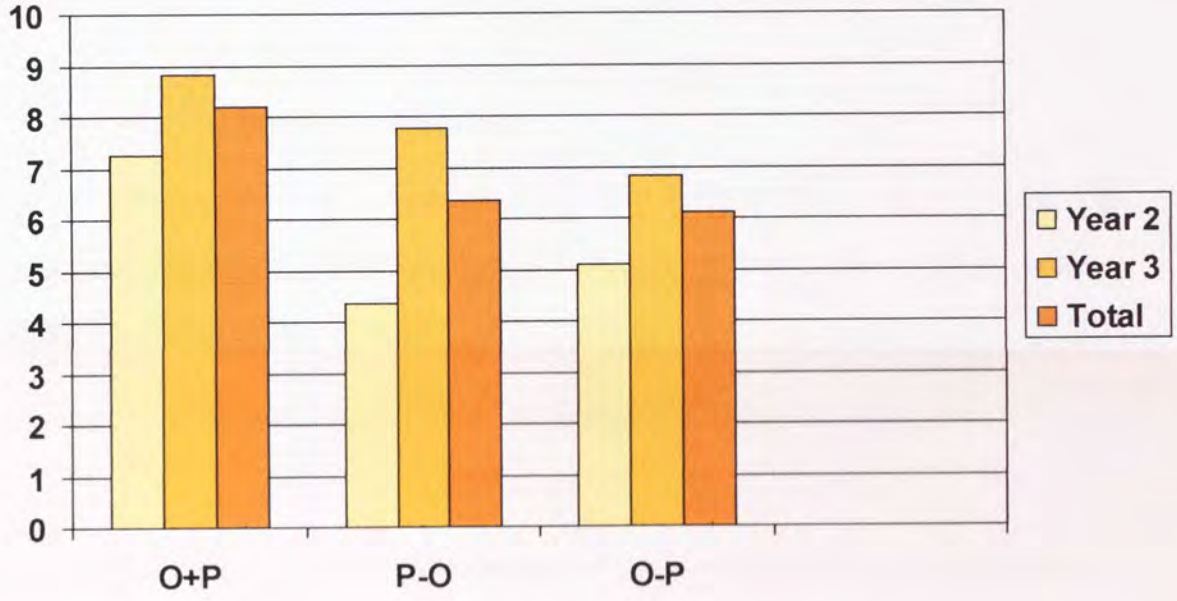
Table 7.2: Summary of Independent-Samples T-Test on all Study Measures

	t	df	Sig. (2-tailed)	Mean Differences
WORD Basic Reading	-2.676	47	.010	-6.54
WORD Spelling	-2.264	47	.028	-2.83
Working memory	-.187	47	.853	-0.11
LTM*	-2.232	44.41	.031	-0.75
Analogy (O+P)*	-2.028	31.58	.051	-1.58
Phonology (P-O)	-4.286	47	<.0001	-3.41
Orthographic similarity (O-P)	-2.598	47	.012	-1.73
Stroop (neutral)	-.383	47	.704	-0.03
Stroop (incongruent)	-1.429	47	1.60	-0.31
Stroop error	1.426	47	.161	0.34
Stroop RT (ms)	1.602	47	.116	165.60

Note: *t* could not be computed for Stroop congruent because the standard deviations for both year-group scores were zero. *Equal variances not assumed. For all other variables equal variances assumed have been used.

Figure 7.2 allows direct task performance comparison between the scores for the analogical similarity judgment task (O+P) and those for the phonological (P-O) and orthographic (O-P) similarity judgement tasks, since scores for all three were out of a maximum total of ten.

Figure 7.2: Chart illustrating mean score comparisons on the analogical (O+P), phonological (P-O) and orthographic (O-P) similarity judgement tasks by year-group



A repeated-measures two-way analysis of variance (ANOVA) was used to assess the statistical significance of the interaction between task and year-group. The factors were 'year' which had two levels, and 'task' which had three (O+P, P-O and O-P). As anticipated from Figure 7.2, the main effect of 'task' was statistically significant (F (1,47) = 14.638, p <.0001), as was the main effect of 'year' (F (1,47) = 21.086, p <.0001), but the interaction of 'task' with 'year' was not statistically significant (F (1,47) = .019, p = .891).

A paired-samples T-Test was carried out on the analogical, phonological and orthographic similarity judgement tasks, so as to establish whether the overall effect of task was driven by all three factors, or predominantly by one or two factors. These revealed statistically significant differences in performance on the analogical (P+O) and phonological (P-O) similarity judgement tasks (F (1,48) = 5.428, p <.0001), as well as on the analogical (P+O) and orthographic (O-P) similarity judgement tasks (F (1,48) = 3.906, p <.0001), but no significant performance difference was found on the phonological (P-O) and orthographic (O-P) similarity judgement tasks (F (1,48) = .467, p = .643).

7.4.2. Predictors of Reading and Spelling

To test whether the children's performance on either of the memory tasks or on any of the orthographic/ phonological similarity tasks (O+P, P-O, O-P) was related to reading or spelling, the raw scores for WORD reading and spelling were correlated with all study measures, as well as with age. Correlations are shown in Table 7.3.

Age correlated significantly with all measures except working memory and long-term memory. Working memory correlated significantly with both reading and spelling, as well as with performance on the analogical (O+P) and phonological (P-O) judgement tasks. Long-term memory correlated significantly only with the phonological similarity (P-O) task. Spelling and reading correlated highly (ps < .0001) both with each other and with the analogical (O+P) and phonological (P-O) similarity tasks; performance measures on these latter tasks also correlated highly with each other. Performance on the orthographic similarity (O-P) task correlated significantly with reading, but not with spelling.

Table 7.3: Pearson correlations between all study measures for the whole sample.

	AGE	LTM	WM	READ	SPELL	O+P	P-O	O-P
LTM	.188							
WM	.042	.007						
READ	.428**	.123	**.491****					
SPELL	.444**	.065	.323*	**.767****				
O+P	.302*	.168	**.576****	**.744****	**.621****			
P-O	.427**	.352*	.378**	**.667****	**.627****	**.691****		
O-P	.399**	.059	-.048	.251	.177	-.080	.167	
RT	-.409**	-.048	-.088	.034	-.083	.019	-.040	-.139

LTM: long-term memory; WM: working memory; READ: WORD Basic Reading; SPELL: WORD Basic Spelling; O+P: Orthographic & phonological (analogical) similarity task; P-O: Phonological similarity task; O-P: Orthographic similarity task; RT: reaction times (Stroop).

Note: * Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level or (where shown in **bold**) <.0001 (2-tailed).

Relationships between the different variables in terms of their predictive significance for variance in spelling and reading performance were further explored for the sample as a whole, using hierarchical regression analyses. Since age was shown to correlate significantly with most measures, this was always entered as the first step of the regressions for both reading and spelling. Since performance on both the combined phonological and orthographic (O+P) and phonological only (P-O) similarity tasks had been found to correlate highly with both the WORD basic spelling and reading measures, the former variables were entered as predictors for spelling and reading respectively, as was also working memory (WM), which had been

found to be significantly correlated with both reading and spelling, as well as with performance on the analogical (O+P) and phonological (P-O) judgement tasks. The order in which these variables were entered into the model was varied so as to establish which of these significantly contributed to either spelling or reading when entered as the last step in either analysis. Tables 7.4 and 7.5 summarise the analyses for spelling and for reading respectively.

Table 7.4: Summary of the models in which age, working memory (WM), phonological similarity (P-O) and analogy (O+P) were entered in fixed order as predictors of spelling. Criterion variable: Spelling; Predictor variables: Age; WM; P-O; O+P.

Order/ Variables	Adj.R^2	R^2Change	F Change	Sig. F Change	F(Anova)	Sig.
1. Age	.180	.197	11.57	.001	11.57	.001
2. Age, WM	.260	.093	6.03	.018	9.42	<.0001
3. Age, WM, P-O	.410	.156	12.69	.001	12.11	<.0001
4. Age, WM, P-O, O+P	.452	.051	4.51	.039	10.91	<.0001
3. Age, WM, O+P	.422	.168	13.95	.001	12.69	<.0001
4. Age, WM, O+P, P-O	.452	.040	3.48	*ns*	10.91	<.0001
2. Age, P-O	.407	.234	18.96	<.0001	17.47	<.0001
3. Age, P-O, O+P	.465	.066	5.95	.019	14.88	<.0001
4. Age, P-O, O+P, WM	.452	.000	.00	*ns*	10.91	<.0001
2. Age, O+P	.435	.261	22.16	<.0001	19.47	<.0001
3. Age, O+P, P-O	.465	.040	3.56	*ns*	14.88	<.0001
4. Age, P-O, O+P, WM	.452	.000	.00	*ns*	10.91	<.0001

Table 7.5: Summary of the model in which age, working memory (WM), phonological similarity (P-O) and analogy (O+P) were entered in fixed order as predictors of reading. Criterion variable: Reading; Predictor variables: Age; WM; P-O; O+P.

Order/ Variables	Adj.R^2	R^2Change	F Change	Sig. F Change	F(Anova)	Sig.
1. Age	.166	.183	10.55	.002	10.55	.002
2. Age, WM	.381	.224	17.35	<.0001	15.78	<.0001
3. Age, WM, P-O	.520	.143	14.36	<.0001	18.37	<.0001
4. Age, WM, P-O, O+P	.601	.084	10.14	.003	19.11	<.0001
3. Age, WM, O+P	.586	.205	23.81	<.0001	23.68	<.0001
4 Age, WM, O+P, P-O	.601	.022	2.71	*ns*	19.11	<.0001
2. Age, P-O	.447	.287	24.94	<.0001	20.43	<.0001
3. Age, P-O, O+P	.597	.152	18.13	<.0001	24.74	<.0001
4. Age, P-O, O+P, WM	.601	.012	1.5	*ns*	19.11	<.0001
2. Age, O+P	.582	.416	47.77	<.0001	34.41	<.0001
3. Age, O+P, P-O	.597	.023	2.76	*ns*	24.74	<.0001
4. Age, O+P, P-O, WM	.601	.012	1.5	*ns*	19.11	<.0001

7.5. DISCUSSION

The main aim of this investigation was to establish how performance in relation to each of the study measures might be associated with reading and spelling performance and how performance in relation to each of these measures changes from mean age 6.82 to mean age 7.75 (primary school Years 2 and 3). Additionally, Experiment 5 sought to establish whether

the improvement in spelling performance observed in Experiments 1 and 2 was attributable simply to the intervention in analogy use, or whether analogy is in fact a more influential factor than phonology overall and, if so, which aspect of analogy (phonological or orthographic similarity between words) is more influential, or whether it is the *combination* of orthographic and phonological correspondence that is influential over and above the influence of either of these factors on their own.

Comparison of the means for Years 2 and 3 on all study measures (Table 7.1) and subsequent analysis (Table 7.2) revealed considerable differences between the two year-groups on both the WORD Basic Reading and Spelling tasks, long-term memory and analogical, phonological and visual similarity. These results therefore indicate a marked improvement in these areas from Year 2 to Year 3, although caution needs to be applied to year-group performance comparison on the analogical similarity task, since ceiling effects were apparent on this measure. Only slight year-group differences were observed on working memory, error rates in the neutral and incongruent Stroop conditions and on reaction time. Year-group differences on reaction time and Stroop error rates, although not pronounced, were nevertheless in the predicted direction, with the Year 2 sample showing marginally higher error rates and longer reaction times than the Year 3 sample. As has already been mentioned, a greater number of trials than was practicable on this occasion would need to have been incorporated into the experiment to show a marked interference effect (see Wright and Wanley, 2003). However, the slight effect observed is in line with previous findings (Comalli *et al.*, 1962; Everatt, *et al.*, 1999; Horn & Manis, 1987).

Table 7.3 illustrates the correlations between each of the study measures. Not surprisingly, spelling correlated highly with reading, as did analogical judgement (O+P) with phonological

judgement (P-O). Analogy taps phonological awareness as well as orthographic awareness. Rather more surprising, however, was the finding that performance on the orthographic similarity task (O-P) was not highly correlated with performance on either the analogical or phonological similarity task. A possible explanation might be that, although the analogy and phonology tasks both required children to read the words in question so as to establish that they sounded the same, the visual task may have encouraged some children to rely entirely on the visual properties of the words, without actually pronouncing them to confirm their different sounds (e.g. '*pitch – pile*', in which the '*i*' is pronounced differently, although the onset-peak units look the same).

Age correlated highly with reading, spelling, analogy and both phonological and orthographic similarity, implying that children's performance on all of these tasks improved with age, as did their reaction times (RT) on the Stroop task. Superior performance on the analogy, phonology and orthographic similarity tasks may have improved with age partly because children were able to read the clue and target words more easily as they got older. If this interpretation is correct, then the high correlation of orthographic (i.e. visual) similarity with age is particularly interesting, since it implies that visual strategies are not limited to an initial logographic stage of reading (Frith, 1985).

Not surprisingly, working memory correlated both with reading and with spelling. This finding replicates many studies that have specifically considered the relationship between working memory and literacy acquisition (e.g. McDougall *et al.*, 1994). Nor is it surprising that working memory correlated with performance on the analogical and phonological similarity tasks (although not with the orthographic similarity task). Not only did the children have to hold the question relating to the task in memory, they also had to sift through all five

test words to judge which word provided the best 'match' with the clue word in terms of the specifications of the question. Additionally the task required them to process the material phonologically as well as visually, and to integrate this information, before making their decision. What is perhaps rather more surprising is that working memory did not correlate highly with reaction time. However, the working memory measure related to accuracy, rather than processing speed. Had the latter been taken into consideration on this task, a more positive interrelationship might have been seen on these two measures.

It is also of interest that long-term memory correlated with phonological judgement, implying that the phonological judgement task did tap into phonological representations held in long-term memory. Although the test items for the long-term memory task were presented visually, the names for these items must have been processed phonologically and held in long-term memory. The initial picture presentation of these items required phonological encoding, since children were asked to choose which of a number of words either began with or ended with the same sound as the picture (e.g. of a sun or fish).

Subsequent analysis of the contributions of age, working memory, analogy and phonology both to spelling (Table 7.4) and to reading performance (Table 7.5) revealed differing degrees of influence for these factors on spelling and reading respectively. In the case of the former, phonology (O-P) and analogy (O+P) accounted for roughly the same proportion of variance in spelling. Additionally most of the variance accounted for by performance on these two tasks was shared variance, with only a small additional amount of variance left over for either when entered as the fourth step in the model, although analogy still accounted for significant additional variance, even at this final step. In the case of reading, however, performance on the analogy task (O+P) appeared to be more strongly predictive of variance in reading than

performance on the phonology task (P-O), with analogy accounting for 41.6% additional variance after age had been entered at the first step, compared with 28.7% additional variance for phonology after age. Additionally, analogy still accounted for over 10% of additional variance, even when entered last in the model after age, working memory and phonology, whereas phonology only accounted for an additional 2.7% at this final step. As to the contribution of working memory to variance in spelling and reading performance, analyses revealed working memory to be more influential in reading than in spelling, accounting for an additional 22.4% of variance in reading when entered at the second step after age, compared with an additional 9.3% of variance in spelling. However, when entered at the final step (after age, phonology and analogy), working memory no longer accounted for any additional variance to the model for spelling, nor did it account for much more than 1% additional variance to the model for reading. This suggests that most of the variance accounted for by working memory was shared with variance in performance on the analogy and phonological similarity tasks.

These findings therefore suggest that, while working memory is influential in reading, it is the *combination* of orthographic *and* phonological information (O+P) that is most influential in reading (Hatcher *et al*, 1994; Ehri, 1986, 1992), while both phonology and analogy appear to be equally influential in spelling. These results do not mean, however, that phonology does not also play an important role in reading. They indicate, rather, that phonological and orthographic strategies need to be seen as complementary (Bowey, 2002; Bowey, Vaughan & Hansen, 1998; Bryant, 2002; Goswami, 2002; Roberts & McDougall, 2003). However, these findings do imply that phonological similarity alone does not contribute significantly to variation in reading or spelling performance. This supports the view, outlined earlier, that sound-based strategies alone are not enough for children to master the complexities of an

irregular orthography like English. Furthermore, these findings, related to reading and spelling together, give strong support to the view that analogy plays an influential role in literacy acquisition in English (Bryant, 1998; Bryant *et al.*, 1990; Goswami, 1986, 1988, 1991, 1993; Goswami & Mead, 1992; Goswami *et al.*, 1998).

That is not to say, however, that children necessarily favour analogy use at the level of the rime over analogy at other unit levels. The issue of whether there is any evidence that children rely primarily on either larger unit (e.g. rime) analogies or small unit (phoneme) analogies was not the concern of this study. It should, however, be noted that the analogical, phonological and orthographic similarity tasks in the present study required children to make judgements based on the similarity or dissimilarity of both the initial and latter parts of the words. Thus, for example, in answer to the question 'Which word looks like the clue word but does not sound the same?' some trials included visually similar, but phonologically incongruous word-beginnings ('*cold-cost*'), whereas others included visually similar, but phonologically incongruous word-endings ('*light-eight*'). Thus the present study offers no support in favour of either a large-unit or a small-unit bias in children's analogy use. However, as has been suggested before, arguments in favour of either may be misplaced, since children can (and indeed need to) show considerable flexibility in the strategies they employ, depending on the task before them (Brown & Deavers, 1999). The findings of Experiment 4 in relation to this issue also supported the view that children apply flexibility in the way they use analogy, demonstrating differing patterns of analogy use for spelling different words.

In summary, this investigation contributes to research on spelling and reading in a number of ways. First, it lends support to the view that analogy plays an influential role in literacy

attainment in the English language. Second, it does not contradict the view that phonology is also an important factor in literacy attainment, but it does undermine the view that phoneme-based strategies take a leading role independent of orthographic strategies in English literacy attainment. Thirdly, it suggests that working memory (at least as measured in the present task) may be less influential in literacy attainment than the combined influences of phonology and orthography. Finally, the slightly greater interference effect combined with the slightly longer reaction times of the younger age-group compared with the older children on the Stroop task is in line with previous findings on attention in relation to reading development. A more focused developmental Stroop study would be needed to clarify this finding.

8. CHAPTER 8: OVERALL DISCUSSION

8.1. INTRODUCTION

The theoretical framework of this thesis, set out in Chapter 2, was that the structure and characteristics of spoken language must form the basis for research in written language. Thus the hierarchical structure of words informs the way, in which they can be analysed: at the level of the syllable; at the sub-syllabic level of onset and rime, with the rime in turn comprising the units of peak and coda; and at the level of individual phonemes. Due to the tendency in English to maintain morphemic consistency at the expense of phonological consistency (e.g. '*health*', '*heal*'), and due to the way in which some word families have changed in pronunciation but not in their spelling (e.g. '*light*', '*night*', '*eight*'), English orthography is typically seen as 'irregular' or inconsistent. However, research has shown that consideration of the way in which certain sub-syllabic units relate to others in many English words can add consistency to English spelling. Thus, for example, Kessler and Treiman's (2001) analyses of both adults' and children's vocabulary, and the degree to which knowledge of one unit affects the pronunciation and spelling of others, showed that the majority of vowels are spelled considerably more accurately if the coda is taken into account (see also Walton, 1995). Furthermore, children from early on in their schooling have been shown to be sensitive to these kinds of sub-syllabic relations (Treiman *et al.*, 1995) and to make use of them in their reading (Bowey & Hansen, 1994; Goswami, 1986, 1991, 1993; Goswami & Mead, 1992; Treiman, Goswami & Bruck, 1990) and in their spelling (Goswami, 1988; Nation & Hulme, 1996). It was therefore suggested that children might benefit from spelling instruction, which drew explicit attention to phonemic-orthographic connections, both at

higher sub-syllabic unit levels (onset+peak and rime) and at lower phonemic unit levels (peak and coda).

8.2. SUMMARY OF MAIN FINDINGS

8.2.1. Experiment 1

The finding in Experiment 1 (Chapter 3) that children who received spelling intervention providing explicit instruction in analogy use at four unit levels (onset+peak, peak, rime and coda) considerably improved in their spelling performance relative to controls, who received no analogy training, was interpreted as providing evidence that the analogy intervention had indeed been effective in improving spelling performance. The finding that analogy use was also strongly predictive of the intervention group's correct spelling performance, whereas phonological plausibility (PP) was more strongly predictive of spelling for the controls, was interpreted as providing evidence that these two groups were using different strategies in their spelling, the former being guided primarily by analogy use across both higher and lower unit levels, the latter primarily by phonological-orthographic correspondence at the phonemic level. This was in turn interpreted as providing support for the effectiveness specifically of the tuition in analogy use in improving spelling performance, rather than the effectiveness of intervention *per se*.

However, the results for Experiment 1 were not entirely conclusive. First, the superior spelling performance of the intervention group, relative to that of controls, was shown as a trend only in the follow-up test (at Time 3). Secondly, no group differences were found in the degree to which children used analogy in their spelling, which is difficult to reconcile with the conclusion that it was the *analogy* intervention that had a beneficial effect on the correct

spelling performance of the intervention group, relative to that of controls who received no analogy intervention. Finally, in terms of which unit contributed most to analogy use and correct spelling by all three groups, there was no marked difference in the overall contributions of onset+peak, peak, rime or coda. This finding was regarded as ambivalent in the context of the debate as to whether children make better use of smaller (phoneme-level) or larger (sub-syllabic) units in their spelling. However, it was suggested, in the light of previous research by Goswami (1993) and Nation and Hulme (1996), that consideration of possible developmental changes in the use of analogy at differing unit levels might shed further light on these findings. Furthermore, it was considered that a replication of this study with a larger sample of children might achieve more robust results in relation to the effectiveness of analogy spelling intervention.

8.2.2. Experiment 2

Experiment 2 was therefore carried out (Chapter 4) to replicate Experiment 1, again investigating the effect on correct spelling performance of intervention in analogy use by comparing the spelling performance of an intervention and a non-intervention group at pre-intervention (Time 1), post-intervention (Time 2) and at follow-up five weeks later (Time 3), but with the addition of more pupils from another school, so as to double the sample size for the experimental and control groups.

The findings of Experiment 2 both supported and extended those of Experiment 1. Not only did the intervention group improve considerably in correct spelling performance relative to the performance of controls from Time 1 to Time 2, but the former also remained convincingly ahead of the latter at Time 3, indicating the effect of the analogy intervention to have been lasting. Furthermore, although both groups showed very similar scores for

phonologically plausible (PP) spelling at each time point, they differed considerably in their analogy use scores following intervention/ non-intervention. This was interpreted as providing support for the effectiveness of analogy coaching in improving spelling performance. This interpretation was further supported by the finding that analogy use was even more predictive of correct spelling for the intervention group, whereas PP was even more predictive of correct spelling for the controls. However the finding, that both analogy and PP were significant predictors of spelling for both groups, was interpreted as support for the suggestion that using the 'clue word' paradigm in itself encouraged analogy use, whereas using the 'clue word' paradigm *in combination with* intervention in analogy use not only encouraged analogy use, but also appeared to encourage strategic use of analogy to improve spelling performance.

The finding that the rime contributed to analogy use and correct spelling over and above any of the other units under consideration provided support for the earlier work of Goswami (1988), but contrasted with the results of Experiment 1, in which no overall difference was found between the contributions of any of the units, as well as contradicting those of Nation and Hulme (1996). However, it was concluded that no decisive resolution could be reached on this issue due to the methodological differences between the previous studies of Goswami (1988, Exp.1) and Nation & Hulme (1996, Exp. 1), which had both employed the original written 'clue word' paradigm in which clue words remained in view during testing, and Experiments 1 and 2 of the present thesis, in which no written clue words were provided. One pattern that did emerge in Experiment 2, however, was that the younger (Year 1) and older (Year 2) children displayed differing patterns of analogy use in their spelling, with the former favouring rime analogies more than the older year-group, but the latter favouring onset-peak and peak analogies more than the younger year-group. Again, however, no decisive

conclusion could be formed, since it was not clear whether these results reflected contrasting patterns of analogy use for spelling different word-lists (employed for the two year-groups) or whether they reflected a developmental shift away from rime-analogy towards analogy at the levels of onset+peak and peak.

8.2.3. Experiment 3

Experiment 3 (Chapter 5) compared performance in analogy use and spelling in two conditions: spoken clue word (as in Experiments 1 and 2) and spoken-plus-written clue word (as in Goswami, 1988, Exp.1 and Nation & Hulme, 1996, Exp. 1).

Interestingly the presence of the written clue word did not substantially increase the degree to which either the intervention or non-intervention group used analogy in their spelling, although noticeable group differences did remain. However, the presence of the written clue word did benefit all children, and the younger year-group particularly, in improving both phonologically plausible and correct spelling (in line with Muter *et al.*, 1994). Age, along with analogy use and phonological plausibility, was found to be strongly predictive of spelling ability, but only when the clue word remained present and only for the non-intervention group. The negative effect shown for age suggested the presence of the clue word to have been more beneficial for the younger year-group than for the older. Conversely, all the children who had previously been coached in analogy use in spelling appeared to be less dependent on the visual presence of the clue word than the non-intervention group.

An important finding in Experiment 3 was that the rime was unequivocally more influential in relation to analogy use in spelling than any of the other units under consideration. This was interpreted as providing support both for Experiment 2 and for the earlier work of Goswami

(1988, Exp. 1), while challenging the findings of Nation and Hulme (1996, Exp.1). Furthermore, although there were noticeable differences in the patterns of analogy use in the two clue-word presentation conditions shown by the two year-groups (Years 1 and 2), both year-groups showed evidence of using rime-analogies in preference to other unit analogies when the clue-word remained present. This was also the pattern shown for both the intervention and non-intervention groups when the clue-word remained present. It was therefore concluded that any differences apparent in the contrasting patterns of analogy use shown by the two year-groups were likely to be a consequence of differences between the two word-lists used for the two year-groups, rather than due to any developmental shift away from rime-analogy.

8.2.4. Experiment 4

Experiment 4 (Chapter 6) compared the patterns in analogy use of three age cohorts of English primary school children (Years 1, 2 and 3) in spelling the same word-lists and, additionally, compared children's performance in spelling words presented either in random order or in analogous orthographic categories.

The main finding in relation to the former aspect of the investigation was that all three year-groups in this study showed the same patterns of analogy use in their spelling, but all three year-groups showed contrasting patterns of analogy use for spelling the two different word-lists. This provided further support for the interpretation put forward in Experiment 3, that any contrasting patterns of analogy use shown by the two year-groups in the earlier studies were likely to be a consequence of the different words used by the two year-groups, rather than due to a developmental shift in the way the two year-groups used analogy in their spelling. This finding poses a direct challenge to previous research, which has posited a developmental

framework for children's changing patterns of analogy use (e.g. Goswami, 1993), suggesting instead that children use analogy more flexible depending on the task before them (Brown & Deavers, 1999) or on the words to be spelled.

The main finding in relation to children's performance in spelling words presented in random order and in analogous categories was that all three year-groups achieved substantially superior spelling scores when words were presented in analogous categories, compared with when the same words were presented in random lists. This supports the suggestion put forward in Experiment 2 in relation to the finding that both analogy and PP were significant predictors of spelling for both the intervention and non-intervention groups, that using the 'clue word' paradigm in itself encouraged analogy use by both groups, but that using the 'clue word' paradigm *in combination with* intervention in analogy use in spelling not only encouraged a greater degree of analogy use on the part of the intervention group, but also encouraged more *strategic* application of analogy to improve their correct spelling performance relative to the controls.

8.2.5. Experiment 5

Experiment 5 lead on from the previous experiments in further exploring any possible changes between primary school Years 2 and 3 in relation to not only analogical and phonological strategies, but also visual strategies in both spelling and reading, as well as the relationship of other non-language-specific variables, such as working memory, long-term memory and attention in relation to spelling and reading. Additionally Experiment 5 sought to establish whether the spelling improvement observed in Experiments 1 and 2 was attributable simply to intervention in analogy use, or whether analogy is in fact more influential than phonology overall, and if so, which aspects of analogy (phonological similarity or

orthographic similarity) are most influential, or if it is in fact the *combination* of both factors which is influential over and above either of these factors independently. The investigation therefore sought to observe phonological strategies in the absence of orthographic correspondence and visual strategies in the absence of phonological correspondence, as well as a combination of orthographic and phonological factors in analogy.

The main findings in this final experiment were that, while analogy and phonology were both shown to be fairly equally influential spelling, analogy was shown to be more influential than phonology in reading, although phonology was still influential. This finding therefore supports the view that reading and spelling do require slightly different strategies, as suggested by Goswami and Bryant (1990), but that analogy use is predictive of both. Since analogy was the only variable, in which orthographic-phonological links were maintained *between the test and* 'clue' words, the highly predictive value of analogy for both spelling and reading also offers support for Ehri's model of reading and spelling (Ehri, 1986, 1992), in which phonological-orthographic 'amalgamations' have to be formed for accurate reading and spelling to take place. While not contradicting the general view that phonological strategies are important in literacy attainment, these results were interpreted as suggesting that phoneme-level strategies are of limited influence unless combined with orthographic strategies. It was therefore suggested that this lends support to the view that analogy plays an influential role in literacy attainment.

8.3.1. The Basis of the Research

Three main points were made in Chapter 2 regarding the theoretical framework of this study. The first (Section 2.2) concerned the need for research in the development of written language to be founded on the nature and characteristics of spoken language; the second (Section 2.3) related to the hierarchical structure of spoken English and children's sensitivity to this structure; and the third (Section 2.4) concerned the theoretical and practical implications of this in relation to literacy research on the one hand, and literacy education on the other. The argument put forward was that, if the structure of spoken English is hierarchical in nature and if children bring their awareness of the nature of spoken English to the process of learning to read and write, then theoretical models of literacy acquisition in English should also take the hierarchical nature of language into consideration and the practical benefits of drawing children's attention to and building on the structural characteristics of English should also be explored in relation to literacy education. The theoretical position of this thesis was therefore that conceptualisations of the English writing system, which view the spelling and reading process simply at the phonemic level, rather than incorporating a phonemic level within the context of higher sub-syllabic levels, are incomplete. Thus, the practical implications were that bringing explicit attention to the relationship between spoken and written language at both higher sub-syllabic levels (e.g. rime and onset-peak) and at lower phonemic levels (e.g. peak and coda) might benefit beginner-spellers and readers.

8.3.2. Intervention in Analogy Use in Spelling

Experiments 1, 2, 3 and 4 were therefore designed to investigate what happens to children's spelling performance, when they are encouraged to use analogy with clue words at both the

higher sub-syllabic levels of onset-peak and rime and at the lower levels of peak and coda, in order to help them to spell new words. Experiments 1 and 2 both showed that children who had explicitly been coached in analogy use in spelling prior to being tested for analogy use (using a 'clue word' paradigm similar to that used by Goswami, 1988 and Nation & Hulme, 1996) improved in their spelling performance relative to controls, who had not received any analogy coaching, and this effect was maintained, in Experiment 2, even five weeks after the end of the five-week long intervention programme. Furthermore, those children who had originally received analogy coaching still maintained their superior spelling position, with regard to both analogy use and correct spelling, relative to the controls in a further analogy test, in which the clue words remained visible during testing (Experiment 3), although both the intervention and non-intervention groups benefited from the visual presence of the clue words, particularly the younger children in the intervention group.

Additionally, Experiment 2 (Group B) and Experiment 4 both showed that, even in the absence of specific coaching in analogy use in spelling, children can spontaneously make use of analogy with clue words to help them work out the spellings of other words. The implications of this are that analogy use is indeed an effective strategy for producing new spellings, as suggested by Ehri (1997) and Goswami (1988), and that, in English at least, it may be more effective than using sound-based rules, unless these are combined with orthographic information. Support for this claim comes from the finding, consistently shown in both Experiments 1 and 2, that analogy was even more strongly predictive of correct spelling than phonological plausibility.

8.3.3. The Relationship between Analogical and Phonological Strategies in Literacy

In Experiment 5, in which phonological and visual strategies were observed both independently (e.g. '*moon-June*', '*pitch-rich*', '*light-white*'; '*light-eight*', '*pitch-pile*', '*race-rack*') and in combination ('*moon-spoon*', '*pitch-ditch*', '*light-night*'), analogy was shown to be even more influential than phonology in reading, while both were shown to be fairly equally influential in spelling.

This does not deny that phonology is important in both spelling and reading. Indeed, it was notable in the present thesis (Experiments 1 and 2) that a requirement for accurate spelling in English appeared to be the ability to combine both analogical and phonological strategies (see discussion of Group A's and Group B's respective correct spelling performances in Experiment 2, Section 4.5). Children who failed to combine both strategies either produced spellings like '*payed*' for '*paid*', because they had failed to use analogy at the level of the peak with the clue word '*rain*', or conversely produced spellings like '*boak*' for '*beak*' (having previously crossed out '*bee...*') or '*wylold*' for '*wild*' because they were trying to use analogy with the clue words '*soak*' and '*old*' respectively, but did so at the expense of phonological plausibility, conserving the entire rime, rather than just the coda in both cases.

Rather, the suggestion being made is that analogy is perhaps particularly influential in an inconsistent orthography like English, in which similar-sounding words often have very different spellings, as in the case of '*moon-June*', '*pitch-rich*' and '*light-white*' in Experiment 5. When this is taken into consideration, it is not surprising that analogy (which by definition conserves orthographic-phonological correspondence) is at least as influential as phonology (which does not necessarily do so) in spelling, and may be even more influential in reading (Experiment 5). It should be noted, however, that analogy incorporates both orthographic and

phonological similarity, and there is therefore a 'phonological' element present in analogy (hence the high correlation between the analogy and phonological similarity tasks in Experiment 5 – see Table 7.3).

The suggestion that analogy may be particularly influential in English has been made many times before. For example, Goswami *et al.* (1998) demonstrated that there was a considerably greater orthographic+phonological ('*loffee – coffee*') than phonological ('*loffi – coffee*') neighbourhood effect in English, than was shown in either French or Spanish (see Section 1.4.1.). Furthermore, Goulandris (1994) has pointed out that, although the application of analogy does not always result in correct spelling, it is at least as likely to result in correct spelling as the application of simple phoneme-grapheme correspondences (Section 1.4.4.), which are frequently unreliable in English.

8.3.4. The Role of 'Larger' and 'Smaller' Units in Analogy Use in Spelling

Much of the debate in relation to children's use of analogy in spelling and reading has centred on the 'small units first' versus 'large units first' debate (see Section 2.4). The dispute has not been so much about the existence of larger unit (e.g. rime and onset-peak) analogies, as well as phoneme-level strategies, but more about the relative importance of each of these strategies and the order in which they develop in relation to literacy acquisition. The view taken throughout this thesis has been that children's use of phonological and orthographic knowledge is much more *interactive* (Goswami, 1993; Snowling, 1994) than either a 'small-units-first' or 'large-units-first' model might suggest. However, the finding in Experiment 4 that children use contrasting patterns of analogy for spelling different words challenges previous models of analogy use that have suggested a developmental framework (Goswami, 1993), in which children's patterns of analogy were viewed as dependent on development,

rather than on the words to be spelled. Thus, consistent with Brown and his colleagues, the debate as to which of these strategies develops first "may be misplaced, and the evidence that is found in favour of the earlier development of either high- of low-level correspondences may depend on the nature of the task used to investigate the issue" (Brown & Ellis, 1994, p.12; see also Brown & Deavers, 1999 in relation to their 'flexible-unit-size hypothesis'). Moreover, it is conceivable that different children may rely on different strategies to differing degrees (Bryant & Impey, 1986). Thus, children may choose to draw on different strategies in their analyses of different words, depending on whether it is more appropriate to use analogy (e.g. with '*head*' to spell '*bread*') or phoneme-grapheme correspondence (e.g. to spell '*bed*'). An analogy strategy may be more useful in some situations, whereas phoneme-grapheme correspondence may be preferable in others, and children are likely to be able to draw on either in parallel. Additionally, rime or coda analogies may be more salient in relation to some spelling patterns, whereas onset-peak or peak analogies may be more pertinent for others. Indeed, this was the conclusion of Experiment 4, since all three age-cohorts tended to use onset-peak or peak analogies for spelling some words, but rime analogy for spelling others.

However, this is not to say that the rime might not play a special role in written English overall (Treiman *et al.*, 1995). Indeed, although no difference was found in the contributions of the different units under consideration in Experiment 1, the rime was found to be more influential than any other unit in both Experiments 2 and 3. It should be pointed out that the analogy intervention procedure and materials did not focus on rime analogy specifically, but were designed to draw children's attention to the orthographic and phonological similarities between words at the levels of onset-peak, peak and coda, as well as at the level of the rime. It is noteworthy, therefore, that (in two out of three experiments) children generally favoured rime analogies over other unit analogies in their spelling. There was also considerable

anecdotal evidence to suggest that children found rime analogies particularly useful, with children making comments like: "*I know it rhymes with Jack and I know how to spell that*" (in relation to '*black*'); or "*I know how to spell old, so I can spell cold*"; and "*You just think of ball and then gall*". The greater influence of the rime compared with other units under consideration provides support for the earlier work of Goswami (1988), while challenging the findings of Nation and Hulme (1996), since the latter had found no difference in the contributions to analogy use at the levels of the rime, onset-peak or peak. Moreover, in Experiment 3, which more closely mirrored the methodology used by both Goswami (1988, Exp.1) and Nation and Hulme (1996, Exp. 1), both year-groups showed evidence of using rime-analogies in preference to other unit analogies, when the clue-word remained present, and this was also the pattern shown for both the intervention and non-intervention groups.

These findings in favour of the influence of rime-analogies are consistent with the views of both Goswami (1991), that "children's ability to learn about letter sequences... should be enhanced when shared spelling units in words reflect the linguistic structure of the syllable" (ibid, pp.1115-1116), and of Treiman and colleagues, that rimes play a 'special role' in the 'description, use and acquisition of English orthography' (Treiman *et al.*, 1995), since rime units play a 'special role' in adding consistency to English spelling (Kessler & Treiman, 2001).

8.3.5. Practical Implications for Teaching Spelling in English

It therefore seems reasonable to suggest that teaching in relation to English spelling should also be more flexible, and should take into consideration the linguistic structure of the syllable, rather than emphasising 'phonics' at the expense of exploring 'consistent' rime spelling patterns (see Gentry & Henderson, 1980; Henderson, 1980). As Treiman *et al.* (1995)

have also suggested, "just because the English writing system can be described, used and learned as an alphabet, it does not necessarily follow that it must be described, used and learned only at the level of graphemes and phonemes" (*ibid*, p.107). This does not mean ignoring analysis at the phonemic level, but rather exploring phonemic relations in the wider context of higher sub-syllabic relations. Research in literacy acquisition in other orthographies has shown that consistency in itself plays a role in determining how quickly and easily children learn to read and spell, and that they are more likely to cope with common spelling problems, such as those posed by consonant clusters for example, in a more transparent orthography (Caravolas & Bruck, 1993; Wimmer & Landerl, 1997, Exp. 2). It therefore follows, that exploration of common rime spelling patterns, which have been shown to lend consistency to English spelling (Kessler & Treiman, 2001; Treiman *et al*, 1995), may well benefit beginner-spellers and readers in acquiring written English.

However, care should be taken not to over-emphasise one strategy at the expense of others. Not only do different children rely on different strategies to differing degrees (Bryant & Impey, 1986), but additionally, children may need to be shown how and when to apply different strategies in different situations, when to draw on phoneme-grapheme correspondence in some situations, or to use an analogy strategy in others. Additionally, Experiment 4 showed that different unit analogies might be more salient for spelling different words. Either way, a combination of strategies may need to be applied. For example, Berninger *et al.* (1998) looked at a number of ways of modelling sound-spelling connections so as to improve the spelling performance of a group of second-grade poor spellers and compared different approaches at the levels of the whole word, onset-rime or phoneme, or using a combination of different levels. They found the treatment, which combined whole-word and onset-rime methods, to be most effective and the one that achieved significantly

better transfer to untrained words, compared with the control treatment which focused on training only at the smaller unit level. However, *all* methods combining training in phonological-orthographic connections at more than one level (e.g. combining onset-rime with phoneme-level or whole-word with phoneme-level work) improved spelling performance relative to controls. Berninger *et al.* therefore concluded that "there may be more than one way to learn to spell words, but teaching multiple connections between spoken and written words at the whole-word and sub-word level may facilitate transfer of the alphabetic principle across word contexts, and training in both explicit phonological and orthographic awareness and explicit phonological-orthographic connections should be taught to achieve transfer to untrained words."

8.3.6. Theoretical Implications: the Relationship between Spelling and Reading

Experiment 5, in line with many previous studies (see Ehri, 1997, p.257), showed reading and spelling to be highly correlated (Table 5.3). Reading and spelling also correlated highly with age, as did performance on all three phonological/orthographic similarity tasks. However, Experiment 5 also revealed differing degrees of influence for analogy and phonology in relation to reading and spelling. These findings imply two things: first, since analogy was found to be more influential in reading than phonology, whereas both factors were shown to contribute fairly equally to spelling, orthographic strategies may be more important in reading than in spelling; and second, visual strategies are not limited to the initial stages of reading, but appear to improve with age.

The theoretical implications of this are that visual strategies are not limited to the so-called 'logographic' stage of reading acquisition, as implied in Frith's (1985) stage models of literacy acquisition, but continue to be influential in reading, if not in spelling. Although

Ehri's (1987, 1992, 1997) account of literacy development also includes a 'logographic' stage in pre-alphabetic reading, her account places continued emphasis on visual cues which, initially in the 'partial alphabetic' or 'semi-phonetic' stage of development, allow beginner-readers to attend to the most salient visual cues, (such as first and last letters), in order to read but which, later on in development, become increasingly well defined and increasingly 'paved with phonological information' (Ehri, 1992, p.114). In Ehri's account, then, visual and phonological information becomes increasingly 'amalgamated', such that a spelling and its pronunciation can be directly accessed in memory.

The findings of the present thesis fit well within this general developmental framework, since analogy (which by definition conserves orthographic-phonological correspondence) was found to be highly predictive of both reading (Experiment 5) and of spelling (Experiments 1, 2, 3 and 5). However, while analogy was shown to be more influential than phonology in reading, this was not the case for spelling. This therefore implies that learning to read and learning to spell are not quite the same (as was implied by Ehri, 1997), but that orthographic processes may be rather more influential in reading than in spelling.

8.4. METHODOLOGICAL CONSIDERATIONS

8.4.1. Intervention Studies

Experiments 1 and 2 in the present thesis sought to investigate whether intervention in analogy use would improve children's correct spelling performance. So as to investigate this, comparison was made between the spelling performance of a group of children who received coaching in analogy use, and another group of children who did not receive analogy coaching. Since the aim of the investigation was to establish that it was the analogy coaching, rather

than just intervention *per se* that made the difference to the former group's spelling performance, the latter group of children was also seen once a week during the intervention period for joint reading practice with the experimenter. This basic research design was based on previous oft-cited training studies which compared the effects of different types of phonological awareness instruction either in isolation (Byrne & Fielding-Barnsley, 1991) or in combination with other forms of literacy instruction, such as letter knowledge (Ball & Blachman, 1991; Bradley & Bryant, 1983) or reading (Cunningham, 1990; Hatcher, *et al.*, 1994).

The research design of Experiments 1 and 2 might have been improved on by investigating the effect of an alternative form of spelling intervention (e.g. phoneme-based instruction), as well as that of analogy intervention, so as to compare the effects of alternative forms of instruction on children's spelling performance. Unfortunately time restrictions did not allow this in the case of the current thesis. However, if a further intervention study were to be undertaken, a research design which incorporated a comparison of the effects of two alternative forms of instruction would clearly be preferable. That is not to say that many oft-cited training studies exist in the literature that did not incorporate such a design. For example, Lundberg *et al.* (1988) compared the reading and spelling development of a group of children who received phonological awareness training prior to literacy instruction, with a control group who received no phonological awareness training but who simply attended their regular pre-school programme. However, studies which lack a control group that receives some form of intervention have been criticised as simply comparing instruction with no instruction (Macmillan, 2002; Troia, 1999). The children in the 'seen' control group in Experiment 1 in the present thesis undertook reading practice with the researcher during the intervention period, but had a comparison of two forms of alternative *instruction* been

incorporated into the design, any advantages shown for analogy instruction, as compared with an alternative form of spelling instruction, would clearly have made an even stronger case for teaching children to use analogy in spelling.

Were a further study of this kind to be undertaken in future, care would need to be taken to match the alternative instruction groups and the controls, so as to ensure that any perceived differences were due to the different forms of instruction, rather than to differences already inherent in the children. The different experimental groups in Experiments 1 and 2 were matched for age, and children from the different schools taking part were divided equally among the groups so as to control for any possible differences in teaching methods (Savage & Stuart, 1998). Additionally the children from the additional school that took part in Experiment 2 were matched with the children from the previous sample (Experiment 1) in terms of their age, and post-hoc analyses were undertaken to ensure that there were no major differences between their and the previous sample's correct and phonologically plausible spelling performance at the start of the study. In a future study, however, it would also be advisable to include base line measures of reading and spelling ability, such as the Schonell Graded Word Reading and Spelling Tests (Schonell & Goodacre, 1971), and a more general test of verbal ability, such as the British Picture Vocabulary Scales (Dunn, Dunn & Whetton, 1982), both to ensure that the various groups were matched with each other and to ensure that their performance on these measures was in line with the population average.

8.4.2. Disparate Phonology Measures

As has been pointed out by Yopp (1988), different measures of phonological awareness not only tap different degrees of difficulty, but also different processes and consequently may often obtain different results. In the present thesis, two slightly different phonology measures

were used in the initial investigations (Experiments 1-3) and in the final experiment (Experiment 5). Phonological plausibility was the measure used in the initial experiments, since this criterion allowed consideration of children's progress in terms of their ability to represent the sounds present in a word with plausible spellings, even though these may not have been correct. Treiman, among others, has suggested that children's invented spellings "can shed light on the knowledge that children bring with them to the spelling task and the way in which they apply this knowledge" (Treiman, 1994, p.75) and they are, as such, useful indicators of children's phonological awareness. In Experiment 5, however, the phonology measure used was the phonological similarity judgement task, in which children had to match words on the basis of whether they sounded the same (i.e. rhymed), although they were spelled differently (e.g. '*moon-June*', '*pitch-rich*' and '*light-white*'). The purpose of this latter measure was to investigate children's use of orthographic analogy ('*pitch-ditch*'), compared with their ability to make a judgement based purely on phonological ('*pitch-rich*') or visual ('*pitch-pile*') similarity in the absence of either orthographic similarity in the first instance, or phonological similarity in the second.

The task requirements for the phonology measures in Experiments 1 – 3 and Experiment 5 therefore differed considerably, since the former required the production of phonologically plausible spellings, while the latter required judgement in terms of sound similarity or dissimilarity. Given these task differences, it is therefore not surprising that, whereas the first (in Experiments 1 - 3) was, along with analogy, highly predictive of variance in spelling performance, the second (in Experiment 5) was not. Moreover, since a different phonology measure was used in Experiment 5, one cannot directly compare this finding with those of Experiments 1 - 3. Nor should one conclude from Experiment 5 that phonology is not influential in spelling: indeed the evidence that supports the opposite view is overwhelming.

Rather, what is of interest here is the finding (in Experiments 1, 2, 3 and 5) that analogy was highly predictive of variance in spelling performance. The implication is that, in English spelling at least, analogy is influential because it incorporates both orthographic and phonological information.

8.4.3. Real-Word versus Non-Word Stimuli

Previous research in analogy use has used both real-word stimuli (Bruck & Treiman, 1992; Goswami, 1986, 1988, 1991, 1993; Goswami & Mead, 1992; Greaney, Tunmer & Chapman; Nation & Hulme, 1996; Savage & Stuart, 1998) and nonsense words (Brown & Deavers, 1991; Ehri & Robbins, 1992; Marsh *et al.*, 1980; Treiman, Goswami & Bruck, 1990). The theoretical framework of the present thesis hinged on the close relationship between spoken and written language and children's sensitivity to the structural characteristics of spoken language (Chapter 2). Although a non-word like '*dalk*' can be spelled by analogy with '*talk*', children do not by definition have phonological representations of words like '*dalk*' from their experience of spoken language. It was therefore considered preferable to use real-word stimuli. Spelling intervention using real-word stimuli was also the preference of the schools taking part in the study.

A consequence of using real-word stimuli in analogy studies, however, is that it is difficult to be sure that the participants are in fact using analogy with the clue word to spell the test words, rather than just spelling test words that they already know how to spell. For this reason, considerable care was taken in establishing the current spelling knowledge of the children involved in the study, prior to the start of the investigation. This entailed direct observation of the children's work, analysis of vocabulary in school reading texts and discussion with staff to establish the children's expected spelling knowledge in relation to the

National Literacy Strategy. As a result of this detailed preparation, two separate word-lists were drawn up for testing the two year-groups involved in the study (Appendix 1), so as to gauge both the intervention and the spelling tests appropriately to the current spelling knowledge of both groups of participants.

It was also considered theoretically important to establish that the majority of children were familiar with the spelling of the clue words, since they would not otherwise be able to use analogy with the clue words to spell the test words. A pilot study was therefore undertaken with children from a school not taking part in the intervention study, so as to establish that the clue words, rather than test words, were within the spelling vocabulary of similarly-aged children. However, one consequence of using separate word-lists for the two year-groups was that any observed differences in the patterns of analogy used in spelling the two word-lists could either be attributable to the different words being spelled or to children of different ages using contrasting strategies. However, this question was fully investigated in Experiment 4 (Section 6.4.3). Experiment 4 also established that the different word-lists used for the two year-groups were appropriately gauged to the spelling abilities of the age-groups in question (Section 6.4.2).

A further consequence of using real-word stimuli, however, was that it was not always easy to find real words that were analogous to the clue words at each of the unit levels under consideration (onset-peak, peak, rime and coda). As a result, a small number of test words (specifically '*olm*' and '*smalt*') would not have been within the spoken vocabulary of the participating children. This was clearly regrettable, given the theoretic framework of the thesis, but it was considered that the majority of words were within the children's spoken vocabulary, particularly when presented in context. Additionally, the spelling of all of the

words, including those that were not familiar to the children, could be worked out by analogy with the clue words.

8.4.4. The Interface of Research and Education

A limitation of experimental psychology generally is that it is sometimes necessary to isolate specific components in order to investigate them. Morris (1980) makes the point that one difficulty with an experimental approach is that it can be "characterised by artificial, task-specific methodologies that afford little or no generalizability to the teaching enterprise" (*ibid*, p. 110). Although the focus of the present thesis has been on one specific aspect of spelling, namely the use of analogy in spelling, an attempt has been made to set the research context firmly within the realm of the classroom. Not only has analogy been shown to be a useful strategy, which can be applied to the benefit of children's spelling performance, but the methodology used to investigate children's use of analogy (in Experiments 1 and 2) can easily be transferred from the research context to the classroom environment. Indeed the intervention was designed specifically to be applicable to a teaching context. The hope is therefore that this research will bridge the gap between research and education and that it is therefore 'generalizable to the teaching enterprise'.

8.5. DIRECTIONS FOR FURTHER RESEARCH

Several lines of enquiry for future research have been suggested in relation to a number of findings. Comment has already been made that it was not possible to include enough trials to demonstrate a marked interference effect in the Stroop task in Experiment 5. Although in line with previous findings on attention in relation to reading (Comalli *et al.*, 1962; Everatt *et al*,

1999; Horn & Manis, 1987), a more focused Stroop study might be useful to investigate attentional factors more thoroughly in relation to children's reading development.

It might also be useful, following on from the finding in Experiment 4 that children use contrasting patterns of analogy for spelling different words, to carry out a further investigation into children's use of analogy in relation to different kinds of spelling pattern and, indeed, to extend this line of enquiry to older age-groups.

Finally, in collating the evidence for this investigation, a considerable number of children's spellings have been collected. Time constraints have not allowed a detailed examination of these, although some attempt was made to categorise the most common mistakes (see Appendix 5). However, a more detailed analysis of the misspellings produced by the children in this study might be useful to establish whether they are in line with those previously observed by Read (1986) and Treiman (1993). Continued analysis of children's 'invented spellings' is essential in order to gain further insight into the processes used by children as their literacy skills develop.

8.6. CONCLUSIONS

The aim of this thesis was to carry out a detailed investigation into children's use of analogy in relation to literacy acquisition in English. The focus has primarily been on spelling development, but consideration has also been given to reading and the relationship between spelling and reading. Five separate experiments have consistently found that analogy is highly influential in spelling development and Experiment 5 also found analogy to be highly influential in relation to children's reading. Phonology was also found (in Experiments 1 – 3

and 5) to be predictive of variance in spelling performance. However, Experiment 5 suggested that phonology, in the absence of orthographic correspondence, is not a primary influence in spelling or reading. Although the findings of Experiment 5 cannot be directly compared with those of Experiments 1 – 3, since different measures of phonology were used (Yopp, 1988), nevertheless two different kinds of methodology (the former focusing on intervention, the latter on correlations) have provided evidence that analogy is highly influential in spelling, and Experiment 5 also suggests that analogy may be even more influential than phonology in reading.

That analogy has so consistently been found to be influential in children's literacy attainment throughout this thesis is in line with Ehri's overall account of literacy development (Ehri 1987, 1992, 1997), in which the integration of visual and phonological factors is essential for the acquisition of skilled spelling and reading.

The important implications of this research for education are that analogy provides a useful strategy in spelling, since knowledge of how certain units relate to others in the context of common spelling 'families' can add consistency to an otherwise inconsistent orthography (Kessler & Treiman, 2001). Moreover, analogy provides a link between the structure of written language and the phonological characteristics of spoken language and children have been shown to be able to build on their awareness of this structure in their dealings with written language (Treiman *et al.*, 1995). This does not mean ignoring analysis at the phonemic level, but rather consideration of phonemic relations in the context of sub-lexical relations. It does, however, suggest that if children are to advance in spelling acquisition in English, they need to progress beyond "simply matching letters to sounds" (Henderson, 1980, p.141) and using analogy provides them with one way of doing so.

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10. APPENDICES

10.1. APPENDIX 1: WORDLISTS FOR EXPERIMENTS 1 AND 2

Time 1 – Year 1	Time 1 – Year 2	Time 2 – Year 1	Time 2 – Year 2	Time 3 – Year 1	Time 3–Year 2
Pet	Boy	Clue: Room	Clue: Light	Clue: Soon	Clue: Night
Of	Made	**Roof**	**Lime**	**Soot**	**Nine**
Stop	**Pitch**	**Shoot**	**Sigh**	**Loose**	**High**
Soon	Then	**Loom**	**Flight**	**Goon**	**Slight**
Back	**Light**	**Swim**	**Sheet**	**Chin**	**Greet**
Bell	**Face**				
Get	Do	Clue: Black	Clue: Pitch	Clue: Back	Clue: Hutch
Dog	**Muddle**	**Bland**	**Pink**	**Band**	**Hunt**
Old	**Walk**	**Cram**	**Drill**	**Pram**	**Drum**
Sail	How	**Stack**	**Switch**	**Smack**	**Clutch**
Black	Name	**Chuck**	**Fetch**	**Flock**	**Patch**
Tell	**Race**				
And	So	Clue: Rain	Clue: Face	Clue: Sail	Clue: Race
Like	When	**Raid**	**Fake**	**Saint**	**Rake**
Boat	**Small**	**Waist**	**Baby**	**Paid**	**Lady**
My	**Night**	**Chain**	**Place**	**Trail**	**Space**
Went	**Coat**	**Spin**	**Trice**	**Nil**	**Price**
Room	Saw				
Oak	**Hutch**	Clue: Cold	Clue: Boat	Clue: Old	Clue: Coat
Go	**Middle**	**Cone**	**Boast**	**Olm**	**Coast**
Cold	Out	**Pole**	**Road**	**Mole**	**Moan**
Rain	**Boat**	**Wold**	**Moat**	**Scold**	**Stoat**
		Child	**Cheat**	**Wild**	**Neat**
		Clue: Bell	Clue: Middle	Clue: Tell	Clue:Muddle
		Best	**Misty**	**Test**	**Munch**
		Help	**Think**	**Shelf**	**Lungs**
		Smell	**Griddle**	**Dell**	**Huddle**
		Chill	**Wobble**	**Spill**	**Nibble**
		Clue: Moon	Clue: Walk	Clue: Good	Clue: Small
		Moose	**Walrus**	**Goose**	**Small**
		Droop	**Gall**	**Spook**	**Halter**
		Spoon	**Stalk**	**Hood**	**Pall**
		Thin	**Folk**	**Proud**	**Frill**

Note: Only words printed in bold used in analyses.

10.2. APPENDIX 2: WORDLISTS FOR EXPERIMENT 3

SPOKEN ONLY

Year 1	Year 2
Clue: Soon	Clue: Night
Soot	Nine
Loose	High
Goon	Slight
Chin	Greet
Clue: Back	Clue: Hutch
Band	Hunt
Pram	Drum
Smack	Clutch
Flock	Patch
Clue: Sail	Clue: Race
Saint	Rake
Paid	Lady
Trail	Space
Nil	Price
Clue: Old	Clue: Coat
Olm	Coast
Mole	Moan
Scold	Stoat
Wild	Neat
Clue: Tell	Clue: Muddle
Test	Munch
Shelf	Lungs
Dell	Huddle
Spill	Nibble
Clue: Good	Clue: Small
Goose	Small
Spook	Halter
Hood	Pall
Proud	Frill

SPOKEN + WRITTEN

Year 1	Year 2
Clue: Spoon	Clue: Fight
Spool	Fine
Hoof	Nigh
Noon	Bright
Town	Sleet
Clue: Snack	Clue: Batch
Snap	Bank
Flag	Drag
Crack	Snatch
Chick	Hitch
Clue: Wait	Clue: Lace
Wail	Lake
Train	Gravy
Bait	Pace
Seat	Slice
Clue: Bold	Clue: Soak
Bone	Soap
Hole	Poach
Told	Croak
Mild	Beak
Clue: Well	Clue: Saddle
Went	Sacking
Held	Flashy
Shell	Paddle
Still	Dribble
Clue: Goose	Clue: Fall
Goofy	Falter
Tooth	Bald
Noose	Stall
Chase	Grill

Note: Clue words not used in analyses.

10.3. APPENDIX 3: STIMULI FOR EXPERIMENT 5

(ANALOGICAL, PHONOLOGICAL AND ORTHOGRAPHIC SIMILARITY JUDGEMENT TASKS)

Clue: Moon	Clue: Light
June	White
Moor	Eight
Spoon	Night
Pour	Late
Stone	Sing
Clue: Cold	Clue: Race
Mould	Chase
Cost	Rack
Hold	Space
Frost	Stack
Door	Bean
Clue: Sail	Clue: Boat
Tale	Wrote
Said	Board
Nail	Moat
Head	Cord
Lion	Shout
Clue: Good	Clue: Walk
Would	Fork
Food	Wales
Hood	Stalk
Chewed	Tails
Done	Low
Clue: Black	Clue: Pitch
Yak	Rich
Blaze	Pile
Track	Ditch
Rays	Style
Climb	Cheat

10.4. APPENDIX 4: Table 10.1: Descriptive statistics using standard scores for year-group comparison on the Word Basic Reading and Spelling tests (Experiment 5)

	YEAR 2	YEAR 3	TOTAL
	MEANS (*SD*)	MEANS (*SD*)	MEANS (*SD*)
	(*n* = 20)	(*n* = 29)	(*n* = 49)
WORD Basic Reading	105.95 (14.68)	105.52 (13.52)	105.69 (13.86)
WORD Basic Spelling	109.10 (12.02)	101.34 (9.17)	104.51 (11.00)

A repeated measures two-way analysis of variance (ANOVA) to assess the statistical significance of the interaction between the two main effects ('task' and 'year') showed no statistical significance of either task (F (1,47) = .108, p = .744) or year effects (F (1,47) =1.606, p = .211), but a statistically significant interaction between task and year (F (1,47) = 5.525, p = .023).

Consideration of the standard score means, which are corrected for age, reveals the performance of the two groups to be equal on the WORD Basic Reading test, but the older group to be marginally behind the younger in performance on the Spelling test.

10.5. APPENDIX 5: SCORING CRITERIA

CRITERIA FOR CORRECT SPELLINGS

A score of one point was awarded for each correct spelling. In the case of homophones, a correct score was only given for the intended meaning according to the context given.

CRITERIA FOR PHONOLOGICALLY PLAUSIBLE (PP) SPELLINGS

A score of one point was awarded for all spellings deemed to be phonologically plausible representations of the intended word, although not necessarily correct. In the case of correct spellings, these were clearly also phonologically plausible and were therefore awarded a point in both cases. Phonologically plausible spellings were broken down into the following categories:

Homophones

'Poll' for 'pole' – accepted as PP, but not correct since a child in Year One is unlikely to be familiar with the meaning of the word 'poll', plus the given context of 'pole - as in telegraph pole' makes it clear which type of meaning is intended.

Consonants – Alternative Spellings

'c' for 'ck' in 'bac' for 'back', 'chuc' for 'chuck', 'stac' for 'stack', 'smac' for 'smack' and 'floc' for 'flock' – 'c', 'ck' and 'k' are all phonetically accurate representations of the /c/ sound.
'c' for 'k' as in 'spooc' for 'spook' and 'oc' / 'oce' for 'oak' – again 'c' and 'k' are both phonetically accurate representations of the /c/ sound.
'cc' for 'k' as in 'occ' for 'oak' – although rare 'cc' is found in English as in 'soccer' and 'cc' is phonetically as acceptable as 'ck'.
'c' for 's' as in 'Luc' for 'loose' – 'c' is pronounced 's' in words like 'ice', 'juice' etc. But in this instance the child was actually making an analogy with the abbreviation (Luc) of the name 'Lucy' and actually commented: "I know how to spell that coz it's the name of my nursery teacher."
*'choot' for 'shoot' – as in 'Champagne' or Michelle.
'ch' for 'ck' as in 'spooch' for 'spook' – as in Christmas or Christopher.
'ck' for 'k' in 'ock' and 'oack' for 'oak' and 'spoock' for 'spook' - as in final 'ck' in 'black'.
'd' for 't' in 'tesd' for 'test' – phonetically the same rime as 'dressed'.
'de' for 'd' in 'prowde' for 'proud' – as in the 'de' in 'made', which is phonetically indistinguishable from the 'd' in 'proud'.
'ed' for 'd' in 'wioled' or 'wiled' for 'wild' – substitution of final 'd' with past tense 'ed' ending.
'ed' for 'd' in 'payed' for 'paid' – completely logical use of 'ed' past tense to the verb 'pay'.
'l' for 'll' in 'tell', 'bell', 'dell', 'spill', 'smell' and 'chill' – as in single final 'l' in 'nil'.
'j' for 'd' in 'jroop' for 'droop' – the 'j' at the start of 'judge' actually starts with a /d/ sound and is phonetically indistinguishable from the 'dg' at the end, so to represent 'dr' with 'jr' seems reasonable.
'k' for 'ck' in 'flok' for 'flock', 'chuk' for 'chuck' and 'stak' for 'stack'– as in final 'k' in 'look'.
'k' for 'ck' in 'kold' for 'cold', as in koala, Kate, kite, etc .
'kc' for 'ck' in 'blakc' for 'black' – although there is clearly confusion about the letter order here, it is still classed as PP rather than incorrect, because the phoneme remains the same in terms of pronunciation, although the letter combination 'kc' does not exist in English.
* 's' for 'sh' in 'soot' for 'shoot' or 'sellf' or 'self' for 'shelf' – 's' is pronounced as 'sh' in 'sugar' and 'Sioban', as is 'ss' in 'mission'.
's' instead of 'se' in 'loos' for 'loose', 'goos' for 'goose' and 'moos' for 'moose'– phonetically accurate, although a final /s/ sound on single nouns is usually represented with 'se' or 'ce'.
'sb' for 'sp' in 'sbin' for 'spin', 'sbill' for 'spill' and 'sbock' for 'spook'– phonetically accurate since 'p' becomes more like 'b' after 's' (Treiman 1993).
'sk' for 'sc' in 'skold' for 'scold' – as in 'ski'.
'sg' for 'sc' in 'sgold' for 'scold' – phonetically accurate representation of the 'c' which actually sounds more like 'g' after 's', as in 'school' (Treiman 1993).

*Although all these examples might be marked as incorrect under the heading Memory Lapses or Mix-ups (see below), I have given the children the benefit of the doubt in both these cases and scored them as PP because both 'ch' and 's' can be pronounced as /sh/ in English, as can 'ch' be pronounced as /c/.

Vowels – Alternative Spellings

'a' for 'ai' in 'ran', 'rad', 'chan', 'tral', 'pad', 'wast', 'sal'/ sall' or 'sant' for 'rain', 'raid', 'chain', 'trail', 'paid', 'waist', 'sail' and 'saint' – /a/ sound represented with the letter 'a' without a final 'e'. Note that the letter sound /a/ is the same as the letter name 'A'.

'a' followed by final 'e' in 'rane' for 'rain', 'chane' for 'chain' and 'rade' for 'raid' and 'pade' for 'paid' - as in 'mane' or 'made'.

'ae' for 'a' as in 'raed' for 'rade' – as in Ellie Mae, or as in prayed, replacing the 'd' with 'ed'.

'ay' for 'ai' in 'sayl' for 'sail', 'trayl' for 'trail', 'rayn' for 'rain', 'chayn' for 'chain', wayst' for 'waist' and 'payd' or 'payed' for 'paid' – as in 'say', 'tray', 'ray', 'way', 'pay' etc.

Silent 'e' in 'olme' for 'olm' – silent 'e' is phonetically plausible here because the 'o' in 'olm' is long.

'e' for 'ai' in 'ren'/ 'renn' for 'rain', 'sent' for 'saint', and 'west' for 'waist' – as in grey.

'ea' for 'a' as in 'reann' for 'rain'. Although 'ea' is more frequently pronounced like a long /ee/, it can be pronounced as /a/, as in 'great'.

'ee' for 'e' – see Doubling below.

'ei' for 'ai' in 'rein' or 'peid' for 'rain' and 'paid'– as in 'rein', 'deign', 'neigh' plus '/e/ + /i/' is a logical representation of the sound in 'ai'.

'ey' for 'ai' in 'peyd' for 'paid', 'seyl for 'sail' and 'treyl' for 'trail' – as in 'grey'.

'o' for 'oo' in 'los' or 'lose' for 'loose', 'mose' for 'moose', 'gose' or 'gos' for 'goose', 'gon' or 'gonn' for 'goon', 'hod' for 'hood', 'shot' for 'shoot', 'sot' or 'sott' for 'soot', 'spok' or 'sbock' for 'spook', 'drop' for 'droop' and 'rof' for 'roof– as in 'lose', 'move' or 'shoe'.

'o' for 'oa' in 'ock' / 'oc' for 'oak' – as in the 'o' in 'joke' but with the final 'ck' as in 'black'.

'o' for 'oa' in 'bot' for 'boat' – as in 'go' plus a final 't'.

'o' followed by silent 'e' at end of word in 'oce' for 'oak' – as in 'spoke'.

'o' without the final silent 'e' in 'con' for 'cone', 'pol' for 'pole' and 'mol'/ 'moll' for 'mole'– as in 'o' in 'go' or 'poll' (see Homophones above).

'oo' for 'o' or 'oa' – see Doubling below.

'ou' for 'o' in 'could' for 'cold', 'would' for 'wold', 'coun' for 'cone' and 'poul' for 'pole' – accepted as PP because, although 'could' and 'would' might possibly be misrepresentations of 'cold' and 'wold', 'ou' for the /o/ sound does exist in English – as in 'mould', 'boulder', 'shoulder', etc.

'ou' for 'oa' as in 'ouk' for 'oak' – although it is possible that the child in this instance had partial recall of the spelling pattern 'oa' in 'oak', but confused it with 'ou', nevertheless the 'ou' in 'mould' and the 'oa' in 'foal' are phonetically indistinguishable, so 'ouk' this was marked as PP.

'ow' and 'oow' for 'oa' in 'owc' for 'oak' and 'boowt' for 'boat' – 'o' and 'ow' are phonetically indistinguishable from 'oa' in 'go', 'slow' and 'spoke' (see also 'oo' in Doubling below).

'ow' for 'ou' in 'prowde' for 'proud' – phonetically indistinguishable from the 'ow' in 'town'.

'u' for 'oo' in 'shut' for 'shoot', 'sut', 'sute' or 'sutt' for 'soot', 'hud' for 'hood', 'Luc'/'lus' for 'loose', 'mus' for 'moose', 'gus' or 'guss' for 'goose', and 'gun' for 'goon'– as in 'pull', 'suit', 'true' or 'truce'.

'y' for /i/ in 'wyld' for 'wild' – as in 'my' and 'sky'.

Doubling of Vowels or Consonants

Double 'aa' in 'baand' for 'band' and 'staac' for 'stack'– phonetically acceptable because is represents the long /a/ sound, although double 'aa' in English is really only found in words originating from a foreign language, such as 'aardvark' from Afrikaans.

Double 'ee' for 'e' in 'deel' for 'dell' or 'beell' for 'bell' – the 'e' in 'bell' or 'dell' is longer than that at the start of the word 'elastic', so it seems reasonable that a child will try to represent the length of the vowel by doubling it (see double 'oo' below). Alternatively the child could be sounding out the word as 'd–e–L' using the letter name L for the sound /l/ (Treiman 1993).

Double 'ff' for final 'f' as in 'shelff' for 'shelf'. Although the combination 'llf' is not usual in English, 'ff at the end of words is frequently found as in 'bluff', 'cliff', 'off' etc.

Double 'll' for middle 'l' in 'shellf' for 'shell' or 'hallp' for 'help'– as in 'shell' or 'hell' with an additional /f/ sound at the end (see also 'Phonetic Approximations below).

Final 'll' for final 'l' as in 'nill' for 'nil' or 'pooll' for 'pole'– most words ending in /l/ sound in English do take double, rather than single 'l' ending ('hill', 'till', 'bell', 'ball', 'pill', etc.)

Double 'mm' for 'm' in 'swimm' for 'swim' – as in 'swimming' or 'swimmer'.

Double 'oo' for 'o' as in 'boot' / 'boowt' for 'boat', 'coon' for 'cone', 'pooll' for 'pole', 'oock' for 'oak', 'coold' for 'cold' and 'oold' for 'old'– PP because representing a long /o/ sound as in 'brooch', as opposed to the short 'o' in 'on'.

Double 'ss' as in 'besst' for 'best' – phonetically acceptable because, although the letter combination 'sst' is not found in English, 'ss' is frequently found and is often phonetically indistinguishable from single 's', as in 'blessed' compared with 'best'.

Double 'tt' in 'wastt' for 'waist' and 'sutt' for 'soot' – phonetically acceptable because, although the letter combination 'stt' is not found in English, 'tt' is frequently found in the middle of words (e.g. 'letter', 'butter' etc) and is even occasionally found at the ends of words, as in 'mitt', 'nett' and 'watt'.
Double 'uu' in 'luum' for 'loom' – although 'uu' in English would actually represent two phonemes (as in 'vacuum') it is acceptable as a phonetically plausible representation of 'oo' , since 'u' is found in words like 'suit' and 'true', and the child is showing awareness that the sound in 'loom' is longer than that in 'book' or 'pull', for example, by making it a double 'uu'.
Double 'yy' in 'sayyl' for 'sail' – accepted as PP because, although 'yy' does not exist in English spelling, it is a logical representation of the word when pronounced slowly : 'say – yl'.

Triple Letters
Triple 'ooo' in 'hoood' for 'hood' – accepted as PP because, although there are no example of triple letters in English spelling, the child is trying to convey the length of the vowel by making it look longer on paper too.

Phonetic Approximations
'a' for 'e' in 'halp'/ 'hallp' for 'help', 'ball'/ 'bal' for 'bell', 'tal' for 'tell', 'dal' for 'dell', 'smal' for 'smell', and 'shalf' for 'shelf'– 'a' pronounced as 'e' as in 'ate', but also childish pronunciation of /e/ sound as /a/, particularly in combination with the liquid /l/.
'chr' for 'tr' in 'chral' for 'trail' – childish pronunciation but accurate identification of the phonemes.
'f' for 'th' in 'fin' for 'thin' - childish pronunciation of /th/ sound as /f/.
'ts' for 'ch' in 'tsan' for 'chain' – childish pronunciation of the /ch/ sound but demonstrates awareness of the sounds present in /ch/ and tries to represent these on paper.
'wan' for 'rain' – accepted as phonologically plausible, given that some children pronounce 'r' as 'w'. (the same child actually wrote 'rane' for 'rain' a couple of weeks later at t2, but children are not always consistent in their spelling or pronunciation).

Phonetically Oversensitive Representations
'chiyld', 'chiold' or 'chield' for 'child' and 'wiold' or 'wioled' for 'wild' – phonetically accurate esentations of the sounds present in the combination of the vowel /i/ with the liquid /l/.
'loows' for 'loose' / 'goows' for 'goose'– phonetically accurate representation of all the sounds present when words are sounded out slowly for spelling.
'trayol'/ 'trayul' or 'traol' for 'trail' and 'sayole'/ 'sayol' or 'saol' for 'sail' – phonetically accurate representations of the sounds present in the combination of the vowel /a/ with the liquid /l/.

CRITERIA FOR INCORRECT SPELLINGS
Incorrect spellings did NOT receive a point, since they were neither correct, nor phonologically plausible. Incorrectly spelled words were broken down into the following categories:

Memory Lapses or Mix-ups
'aba' (or 'ada') for 'olm' – none of the correct phonemes appear to be present, but possibly the child is confusing similar looking or similar sounding letters and phonemes, such as 'a' and 'o' and 'b' and 'm'(see also 'banl' for 'spill', 'thn' for 'pram', 'tnd' for 'proud', and 'tknc' for 'spook' – all examples of confusions by the same participant).
'aoce' for 'oak' – it appears this child has partial representation of the 'oa' spelling pattern for the /o/ sound, but has remembered the letters in reverse.
'banl' for 'spill' – some of the correct phonemes are represented, but not all. The 'b' is an accurate representation of the second phoneme in the onset, although the 's' is not represented, and the 'l' clearly represents the coda. Possibly there is confusion between the vowel sounds /a/ and /i/, particularly in combination with the liquid 'l'. This participant also possibly has a tendency to confuse 'u' and 'n' (see also 'thn' for 'pram', 'tnd' for 'proud' and 'tknc' for 'spook'), in which case 'ul' would be an accurate representation of the phonemes present in the ending if it is pronounced 'spi – ull'.
'bcamtl' for 'bell' – it is hard to see what is going on here, but since it occurs in the next line after 'camt' for 'cold, possibly the child got confused with the previous spelling, although the beginning and final sounds of 'bell' were represented
'c' for 'ch' in 'cac' for 'chuck', 'cil' for 'chill' or 'child', and 'cield for 'child' – only remembering first half of letter combination 'ch'.
'camt' for 'cold – see above ('bcamt' – same participant). Possibly another processing mix-up. The context given for the word 'cold' was 'Ice-cream is very cold'. Possibly the child started representing 'cold' with 'ca', but then got confused between the final sounds in 'cream' and 'cold', to give 'camt'.
'cll' for 'chill' – forgetting the second half of the 'ch' combination as well as omission of //i/.

'cnoon' for 'cone' and 'pllall' for 'pole' – here the child appears to have represented the first and last sounds, followed by the rime (see also 'rnttf' for 'roof' etc below – same participant.)
'dlo' for 'old' – has all the correct phonemes but has failed to memorise them short term in the correct order. Or has simply written the word backwards? See 'pisil' below (same child at t3).
'dod' for 'old' – child appear to have written down the final sound first and then attempted to write the word again, but forgetting the 'l'.
'donn' for 'old' – appears to be having difficulty with memorising the individual phonemes and getting them in the correct order, thus the first and final sounds ('o' and 'd') are reversed and the middle sound ('l') is replaced with 'nn'.
'delloll' for 'dell' – child appears to be trying to represent the rime section of the word twice (see 'losos' for 'loose' below – same child).
'fnosn' for 'thin' – here the child appears to have attempted to represent the first phoneme ('f' for 'th), followed by the last ('n') which is also represented at he end again, but the 'os' in the middle ears no resemblance to /i/. See also 'cnoon' for 'cone' and 'rnttf' for 'roof' – same participant.
'he/hlp' for 'help' – where the child has initially written 'he', then started again and written 'hlp' beside the original 'he', but this time forgetting the 'e'.
'how' instead of 'old' – here I think the child has got confused by the context given for the word 'old': 'How old are you?', although the word 'old' was repeated twice separately, as well as once in context.
'ia' for 'ai' in 'rian' for 'rain', 'wiast' for 'waist', 'piad' for 'paid' and 'trial' for 'trail' – all examples of the child apparently remembering that 'ai' says /a/, but forgetting the correct order of the letters.
'ken' for 'flock' – only the coda is represented here by the 'k'. The other phonemes are missing, and 'e' and 'n' bear no apparent resemblance to either 'f', 'l' or 'o'. It may be that the child has tried to represent the 'ck' in 'flock' and then lost sight of the rest of the word.
'losos' for 'loose' – child appears to be representing the rime twice (see 'delloll' for 'dell' above – same participant).
'olat' (for 'old') – crossed out, so child probably realised spelling was wrong, but then forgot, or was confused about how, to write another spelling.
'pisil' for 'spill' – again has all the correct phonemes there but has failed to memorise them short term to get them in correct order. See 'dlo' above (same child at t1).
'prod' for 'proud' – forgetting the second half of the letter combination 'ou'.
'rnttf' for 'roof, 'chillm' for 'cram', 'wlnwmt' for 'waist, 'chniinn' for 'chain', 'rlliid' for 'raid' and 'mons' for 'moose' – are all examples from the same participant. In each case she appears to have represented the first and last sounds, but has apparently guessed at the sounds in the middle. And yet she has remembered the 'ch' in 'chain', has written 'loom' correctly and has produced a phonologically plausible spelling for 'droop' ('jroop'). See also 'cnoon' for 'cone above – same child.
'sdst' for 'spook' – child appears to be so preoccupied on analysing the sounds in the onset ('sp') that no further progress is made with the remaining sounds.
'slakc' for 'stack' – it may be that the child has simply forgotten to cross her 't' in which case it would be accepted as PP but her 't's in other spellings are very clearly crossed, so one cannot assume she meant to write 't'.
'slilp' for 'spill' – it appears this child, having identified the sounds correctly, has then got confused with the order of the letters when writing them down.
'stoot' for 'shoot' – apparent confusion as to the combination of letters that represents the /sh/ sound. The child has got the 's' right but combined it with the wrong letter ('st' instead of 'sh').
'sz' for 'soon' – again, possibly child was so preoccupied with getting the initial sound write that got no further with spelling the rest of the word.
'tayn'/ 'chyn' for 'chain' – child wrote both 'tayn and 'chyn', apparently correcting the substituted 't' with 'ch' but then forgetting the 'a' in the /a/ sound, although it was initially present in 'tayn'.
't' for 'th' in 'tin' for 'thin' – only partially remembering the 'th' letter combination.
'th' for 'ch' – child appears habitually to confuse 'th' with 'ch in 'than' for 'chain', 'thin' for 'chin' and 'thid' for 'child' with the 'l' omitted – all from the same participant (see also 'thrraul' for 'trail' below).
'then' for 'chain' – confusion of 'th' and 'ch'.
'thn' for 'pram' – either the child misheard, although the context of 'pushing a baby in its pram' should have conveyed the meaning, or possibly there is confusion between similar sounding phonemes ('n' and 'm') or between letters that are formed in a similar way ('h' and 'r') or that might look similar the other way up ('t' and 'p') – see 'tnd' for 'proud' and 'tknc' for 'spook' (same particiapnt).
'thrraul' for 'trail' – child appears to be pronouncing the word 'trail' as 'chray – ul' but this particular participant habitually gets 'ch' mixed up with 'th' and so ends up representing it as 'thrraul' (see also 'th' for 'ch' above – same child).

'tknc' for 'spook' – again the child seems to have represented the coda (both 'c' and 'k' are present), but possibly got confused between 't' and 'p' and 'u' (for the 'oo') and 'n', perhaps because they look similar the other way up. The 's' of the onset is not represented. See 'thn' for 'pram' and 'tnd' for 'proud' – both by the same participant.
'tnd' for 'proud' – the coda is represented but possibly the child is confusing 't' with 'p' and 'n' with 'u', since they look similar the other way up. The 'r' in the onset is not represented. See also 'thn' for 'pram' and 'tknc' for 'spook' – both by the same participant.
'tryl' for 'trail' – changing the middle vowel sound by forgetting the letter 'a' in the 'ai'/ 'ay' sound.
'tsbe' for 'test' – appears to have identified all or most of the phonemes, depending on whether the 'b' is a reversed 'd', (since the 't' following the 's' in 'test' sounds like 'd'), or meant to be a 'b' which would be mistaken identification of the final part of the coda. But, in representing these sounds on paper, appears to have found it difficult to remember their order.

Reversals
'badn' for 'band' – reversal of 'n' and 'd'.
'balck' for 'black' – reversal of 'a' and 'l'.
'baald' for 'bland' – reversal of 'l' and 'a', as well as omission of 'n'.
'bets' for 'best' – the 't' and 's' are reversed.
'carm' for 'cram' – reversing 'r' and 'a'.
'clod' for 'cold' – reversing the 'c' and 'l'.
'codle' for 'cold' – reversing the 'l' and 'd'.
'hepl' for 'help' – reversing the 'l' and 'p'.
'knch' for 'chin' – reversing 'ch' and 'n', as well as omission of /i/ and addition of 'k'.
'lap' or 'iap' – for 'smell'. Looks like the child may have misheard the word as 'spell' but has reversed the 'p' and 'l', as well as omitting the 's'.
'lie' for 'chill' – reversal of /i/ and 'l', and omission of 'ch'.
'lmo' for 'loom' – reversing the 'o' and 'm'.
'odl' for 'old' – reversal of 'l' and 'd'.
'oml'/ 'omelo' for 'olm' – 'l' and 'm' are reversed (see also Additional Letters below).
'plo' for 'pole' – reversal of the 'o' and 'l'.
'samck' for 'smack' – 'm' and 'a' are reversed.
'sclod' for 'scold' – 'o' and 'l' are reversed.
'sipn' for 'spin' – reversing 'p' and /i/.
'sle' for 'smell' – reversal of 'e' and 'l' and omission of 'm'.
'slood' for 'scold' – the 'o' and 'l' are reversed and the 'c' omitted.
'smi' for 'swim' – reversal of /i/ and 'm' (as well as omission of 'w').
'solef' for 'shelf' – reversing 'l' and 'e', as well as adding an extra 'o'.
'soop' for 'spoon' – the 'p' is placed at the end of the word instead of near the beginning and the 'n' is omitted.
'tets' for 'test' – reversal of 's' and 't'.
'tste' – reversal of 'e' with 'st'.
'tryall' for 'trail' – reversing the 'y' and 'a' to give a phonetically as well as semantically different word.
'wlyod' for 'wild' – reversal of /i/ and 'l' (as in 'wyold'- see Phonetically Oversensitive Representations above).

Omissions
'aack' for 'stack' – omission of onset 'st'.
'baald' for 'bland' – omission of 'n', as well as reversal of 'l' and 'a'.
'ba' for 'bell' – omission of 'll'.
'bac'/ 'bak' for 'black' – omission of 'l'.
'bad' for 'band' – omission of 'n'.
'ban' for 'band' – omission of 'd'.
'ban' for 'bland' – omission of 'l' and 'd'.
'band' for 'bland' – omission of 'l'.
'beil' for 'spill' – omission of 's'.
'bes' for 'best' – omission of 't'.
'bin' for 'spin – omission of 's'.
'bla' for 'black' – omitted the final sound.
'blad' for 'bland' – omission of 'n'.
'blck' for 'black' – omission of 'a'.
'blt' for 'bland' – omission of 'a', as well as substituting 'd' with 't'.
'bnn' for 'back' – omission of 'a' and substitution of 'ck' with 'nn'.

'bou' for 'boat' – omission of 't'.
'cam' or 'camay' for 'cram' – omission of 'r'.
'chck' – omission of 'u' . The child has done all the hard work (remembering that 'c' and 'h' say /ch/ and remembering the final 'ck' for /c/, but forgotten the 'u' in the middle!
'chlf' – omission of 'e' – as above, this child has represented both sounds in the coda, made a good attempt at the onset (although he had commented that he could not remember how to write the sound /sh/), but in the process forgotten the central 'e'.
'chode' for 'child' – omission of 'l'.
'chyd' or 'chyt' for 'child' – omission of 'l'.
'cil' for 'child' – omission of final 'd' and second half of 'ch' combination.
'cin' for 'spin' – omission of 'p'.
'cll' for 'chill' – omission of /i/, as well as forgetting the 'h' in 'ch'.
'coa' or 'cow' for 'cold' – omission of 'ld'.
'cod' for 'cold' – omission of 'l'.
'dll'/ 'dlw' for 'dell' – omission of 'e'.
'dupu' for 'droop' – omission of 'r', as well as addition of 'u' at end (see Additional Letters below). 'eia' (or 'ea' with the central letter crossed out) for 'trail' – possibly this is simply an omission of both the onset 'tr' and the coda 'l', so it is categorised as such.
'fock' for 'flock' – omission of 'l'.
'happ', 'hepp' or 'heb' for 'help' – omission of 'l'.
'hllp' for 'help' – omission of the 'e'.
'hp' for 'droop' – omission of central phonemes 'r' and 'oo', plus substitution of 'd' with 'h' or confusion between these letters (see 'hon' for 'spoon' in Substitutions – same child).
'jdoop' for 'droop' – omission of 'r'.
'jiood' for 'child' – omission of 'l' as well as substitution of 'ch' with 'j'.
'joop' for 'droop' – the 'r' is not represented
'kc' for 'oak' – omission of 'o'.
'ken' for 'flock' – omission of first CCV 'flo', plus additional letters 'en'.
'knch' for 'chin' – omission of /i/, as well as reversal of 'ch' and 'n' and addition of 'k'.
'mll' fpr 'mole' – omission of central vowel 'o'.
'mow' for 'mole' – omission of final sound ('l').
'nu' for 'nil' – omission of 'l' as well as substitution of /i/ with 'u'.
'niy' for 'nil' – omission of 'l'.
'od' /'ode' and 'ood' for 'old' – omission of 'l'.
'oll' for 'old' – omission of 'd'.
'ood' for 'old' – omission of 'l'.
'om' for 'olm' – omission of 'l'.
'oun' for 'olm' – omission of 'l', as well as substituting 'n' for 'm'.
'owd' for 'old' – omission of 'l'.
'ms' for 'moose' – omission of the central phoneme 'oo'.
'pad' for 'proud' – omission of 'r', as well as substitution of 'ou' with 'a'.
'pam' for 'pram' – omission of 'r'.
'pll' for 'pole' – omission of 'o'
'poood' or 'poot' for 'proud' – omission of 'r', as well as substitution of 'ou' with 'oo.
'poon' for 'spoon' – omission of 's'.
'ruw' for 'room' – omission of final 'm'.
'sack', 'sac' /'sak' for 'stack' – omission of 't' in the onset.
'sall' for 'smell' – omission of 'm'.
'sat' or 'sate' for 'saint' – omission of 'n'.
'say' for 'sail' – omission of 'l'.
'sbn' for 'spoon' – omission of 'oo'.
'sclit' for 'scold' – omission of 'o' as well as substitution of 'd' with 't'.
'scol' for 'scold' – omission of 'd'.
'sef' for 'shelf' – omission of 'l'.
'sel' or 'sell' for 'smell' – omission of 'm'.
'sem' for 'swim' – the 'w' is omitted and the /i/ substituted with /e/.
'sey' for 'sail' – omission of 'l'.
'sey' for 'saint' – omission of 'nt'.
'seyt' for 'saint' – omission of 'n'.
'sgol' / 'sgool' for 'scold' – omission of 'd'.

'sil'/ 'sill' for 'spill' – omission of 'p'.
'sin' for 'spin' – omitting the 'p'.
'sim' for 'swim' – omission of 'w'.
'shef' or 'shaf'/'shaff' for 'shelf' – omission of 'l'.
'shel' for 'shelf' – omission of 'f'.
'shlf'/ 'shllf' for 'shelf' – omission of the 'e'. All the hard work is done, but the central vowel is omitted!
'shsab' for 'shelf' – omission of 'l' and 'b' submitted for 'f'.
'sle' for 'smell' – omission of 'm' and reversal of 'e' and 'l'.
'slf' for 'shelf' – omission of 'e'.
'slll' for 'spill' – omission of central part of word 'pi'.
'slood' for 'scold' – omission of 'c', as well as reversal of 'o' and 'l'.
'smi' for 'swim' – omission of 'w' (as well as reversal of 'm' and /i/).
'sml' for 'smell' – omission of 'e'.
'snn' for 'soon' – omission of 'oo'.
'sod' for 'scold' – omission of 'c' and 'l'.
'sold' /'solod' for 'scold' – omission of 'c' as well as addition of an extra 'o' in second instance.
'sooc' or 'soock' for 'spook' – omission of 'p'.
'sood' for 'scold' – omission of 'c' and 'l'.
'soon' for 'spoon' – omitting the 'p'.
'soomm' for 'swim' – omitting 'w', as well as substituting 'oo' for /i/.
'soop' for 'spoon' – the 'n' is omitted and the 'p' is in the wrong place.
'soyd' for 'scold' – omission of 'c' and 'l'.
'snh' for 'soon' – omission of 'oo', as well as additional 'h'.
'stn' for 'spin' – omission of /i/, as well as substitution of 'p' with 't'.
'stn' for 'soot' – omission of 'oo', as well as additional 'n', possibly an analogy with the coda of the clue word 'soon'.
'synt' for 'saint' – omission of the 'a' in combination with the 'y'.
'take' for 'stack' – omission of the initial sound 's'.
'taol' for 'trail' – omission of 'r'.
'tas' or 'tess' for 'test' – omission of 't'.
'tet' for 'test' – omission of 's'.
'tey' for 'test' – omission of 'st'.
'thid' for 'child' – omission of 'l', as well as confusion of 'th' with 'ch (see Memory above)
'tll' for 'tell' – omission of 'e'.
'tly' for 'tell' –omission of 'e' and addition of 'y' at end.
'trul' for 'trail – omission of /a/.
'waat' for 'waist' – omission of 's'.
'was' /'wes' for 'waist – omission of 't'.
'wauyyt' for 'wild' – omission of 'l', as well as substitution of /i/ with /a/.
'wid'/ 'wiyd' and 'wiod'/ 'wiyod' for 'wild – omission of 'l'.
'wld' for 'wild' – omission of /i/.
'wlot' for 'wild' – omission of /i/, as well as substitution of 'd' with 't'.
'wlltll' for 'wold' – omission of 'o' as well as additional 'll' at end.
'wod' / 'wot' for 'wold' – omission of 'l' and substitution of 'd' with 't'.

Substitutions

'alm' for 'olm' – substituting 'o' for 'a'.
'bad' for 'boat' – substituting 'oa' with 'a' and 't' with 'd'. Possibly child misheard, but the context 'We crossed the lake in a boat' should have made the meaning clear.
'bayd' for 'paid' – substituting 'p' with 'b'. Although this is scored as PP when it occurs after 's' (as in 'sboon' for 'spoon') since this is an accurate representation of the 'p' after 's', it is not accurate when the 'p' becomes the first part of the onset.
'bell' for 'dell – substituting 'd' with 'b'. Some children use 'b' for 'd' or vice versa, but this did not appear to be the case with this child. Could simply have misheard but the context of 'We ran down to the bottom of the dell' did not imply 'bell'.
'bim' for 'chin' – substituted 'b' for 'ch' and 'n' for 'm' – possibly misheard, but the context and action of touching my chin should have directed child to right word.
'blt' for 'bland' – substituting 'd' with 't', as well as omission of 'a'.
'bnn' for 'ack – substituting 'ck' with 'nn', as well as omission of 'a'.
'buc' for 'back' – substitution of 'u' for 'a'.

'cac' for 'chuck' – substituting 'u' with 'a', as well as forgetting 'h' in 'ch'.
'check' for 'chuck – although could have been misheard the context of 'Chuck the ball' combined with the throwing action should have directed the child to the correct word.
'chantt' for 'child' – substituting 'a' for /i/, 'n' for 'l', and 't' for 'd'. (With the exception of sustituting 't' for 'd', the 'a' and 'n' for /i/ and 'l' make it appear that the child is almost guessing, yet that same child has remembered the letter combination 'c+h' for 'ch'!)
'chayld' for 'child' – substituting 'ay' for /i/. See 'wayld' below (same child at t3).
'chim' for 'chin' – substituting 'm' for 'n'. Child may have misheard, but the action and context of the experimenter touching her chin should have prevented confusion.
'chptt' for 'shoot' –substituting 'p' for 'oo'.
'chyt' for 'child' – substituting final 'd' with 't' (as well as omission of 'l').
'cod' for 'cone – substituting 'n' with 'd'. Child appears to be using analogy with 'cold' and 'wold', which were both spelled 'cod' and 'wod' (see also 'pod' for 'pole' below – same participant.)
'colt' for 'cold' substituting 'd' with 't'. Although 'd' can sometimes sound more like 't', (such as after 's' in 'stay' or at the end of the word 'dressed' which is phonetically the same in its ending as 'vest), this is not the case in the word 'cold'.

'com' for 'cone' – substituting 'n' with 'm'. Possibly misheard, but the context of an 'Ice-cream cone' should have avoided confusion with 'comb'.
'com' for 'cold' – substituting 'ld' with 'm'. Possibly misheard, but the context: 'Ice-cream is very cold' should have directed child to correct word.
'crab' for 'cram' – substituting 'b' for 'm'. The child may have misheard, but the spelling substituted does not fit with the context given of trying to "cram lots of things into a small space".
'cuosf' for 'goose – substituting 'g' with 'c' and addition of 'f'.
'cun' for 'cone' – substituting 'o' with 'u'. The letter 'o' can be pronounced as /u/ (as in 'shove' or 'glove') but the letter 'u' is not pronounced as /o/ unless written in combination with 'u' (as in 'boulder' and 'shoulder').
'deb' for 'dell' – substituting 'l' with 'b'.
'flaf' for 'flock' – sustituting 'ck' with 'f' – or possibly repetition of initial part of onset and omission of coda.
'flooc' / 'flook' for 'flock' – although doubling of a vowel was accepted as PP where it represented a long vowel, as in 'pooll' for 'pole' (see Doubling above), it was scored as incorrect if used to represent a short vowel, as in the 'o' in 'flock'.
'gin' for 'goon' – substituting 'oo' with /i/.
'gold' for 'cold' – substituting 'c' with 'g'. Could have misheard but the context 'Ice-cream is very cold' should have alerted child to correct word.
'goot' for 'good' – substituting 'd' with 't'.
'hole' or 'hol' for 'pole' – substituting 'p' with 'h'. Possibly child could have misheard but the context 'as in telegraph pole' should have indicated the right word.
'hon' for 'spoon' – substituting 'sp' for 'h'. This may be a confusion of the letters 'p' and 'h' and an omission of 's' (see also 'hp' for 'droop' in Omissions – same child).
'hoot' for 'hood' – substituting 'd' with 't', so making a word with a different meaning.
'home' for 'cone' – substituting the 'h' for 'c' and the 'm' for 'n'. Presumably this child misheard but the context given was 'Cone' as in 'Ice-cream cone', so this is an incorrect substitution.
'hoyt' for 'hood' – substituting 'd' with 't', and 'oo' with 'oy'.
'iuc' or 'juc' for 'chuck' – substituting 'ch' with /i/ or 'j'.
'jiood' for 'child' – substituting 'ch' with 'j' and omission of 'l'.
'jrum' for 'droop' – the 'jr' for 'dr' would be classed as PP under the heading 'Phonetic Approximations' but the substitution of the final 'm' for 'p' makes this incorrect.
'kran' for 'cram' – substituting 'n' for 'm'.
'luock' for 'loose' – substituting 'se' with 'ck' – or possibly the child had intended to write 'ce' for the final /s/ sound, but was confused between 'ck and 'ce'.
'mel' for 'nil' – substituting 'm' for 'n' and /e/ for /i/. Child could have misheard, but the context given of a football score being one: nil should have directed the child to the right word.
'mall' for 'mole' – substituting 'ole for 'all, which are phonetically very similar.
'mill' for 'nil' – substituting 'm' for 'n'. Although 'mill' is an existing word, the context of "nil – as in zero" should have made it clear which word was being asked for.
'moot' for 'boat' – substitution of 'm' for 'b'. Possibly the child misheard the word as 'moat', but the context of 'We crossed the lake in a boat' should have made the meaning clear.
'nayol' for 'nil' – substituting /i/ with 'ayo'. Possibly child misheard and thought the word was 'nail', in which case it would be an accurate representation, but the context of a football score being 'one:nil' should have made the intended word clear.

'ninn' for 'nil' – substituting 'nn' for 'l'.
'noom' for 'loom' – sustituting 'n' for 'l'. Child could possibly have misheard but the context given was 'You weave cloth on a loom'.
'oun' for 'olm' – sustituting 'm' with 'n', as well as omitting 'l'.
'peet' for 'paid' – substituting 'd' with 't'.
'pod' for 'pole' – substituting 'l' with 'd'. Child appears to be using analogy with 'cold and 'wold', which were both spelt 'cod' and 'wod', and 'cone' was also spelt as 'cod' – see above (same participant).
'poot' or 'poood' for 'proud' – substituting 'ou' with 'oo' and omission of the 'r'.
'prad' for 'proud' – substituting 'ou' with 'a'.
'pralld' for 'proud' – substituting 'all' for 'ou'.
'pran' for 'pram' – substituting 'n' for 'm'.
'prauot' for 'proud' – substituting 'd' with 't' and 'ou' with 'auo'.
'prawd' for 'proud' – substituting 'aw' for 'ou'. ('ow' would have been phoentically plausible but 'aw' is not).
'prood' for 'proud' – substituting 'oo' for 'ou'
'red' for 'rain' – substituting 'd' for 'n'.
'reem' for 'room' – substituting 'ee' for 'oo'.
'reng' for 'rain' – substituting 'n' for 'ng'.
'rooth' for 'roof' – although substituting 'f' for 'th' (as in 'fin' for 'thin') is classed as PP under the heading 'Phonetic Approximations', substituting 'th' for 'f' is incorrect because it is unlikely that a child pronounces /f/ as /th/, even though they pronounce /th/ as /f/.
'rul' for 'roof' – substituting 'l' for 'f'.
'san' for 'soon' – substituting 'oo' with 'a'.
'sarl' for 'sail' – substituting 'ai' with 'ar'.
'scllt' for 'scold' – substitution of 'd' with 't', as well as omission of 'o'.
'sem' for 'swim' – substituting /i/ with /e/ as well as omission of the 'w'.
'set' for 'sail' – substituting 'l' with 't'.
'shsab' for 'shelf' – substituting 'f' with 'b' and omission of 'l'.
'sllack' for 'stack' – substituting 't' with 'll'.
'slock' for 'flock' – substituting 'f' with 's'.
'soly' / 'soley' for 'sail' – substituting the 'ai' with 'o', as well as adding 'y' at end.
'soomm' substituting 'oo' for /i/, as well as omitting 'w'.
'spail' for 'spill'– substituting 'ai' for /i/. The combination 'ai' can be found in English representing a long /i/, as in 'aisle', but not a short /i/ as in 'spill'.
'spell' for 'smell' (at t2) – substituting 'p' for 'm'. Although could have been misheard, the action of holding one's nose and giving the context 'What a horrid smell!' should have directed child to right word.
'spell' for 'spill' (at t3) – substituting 'e' for /i/. Although the child could have misheard, the context of "Don't spill your drink!" should have made it clear which word was being asked for.
'spiwi' for 'spill' – substituting 'w' for 'll, and repetition of the central vowel /i/ at end.
'spog' for 'spook' – substituting 'k' with 'g'.
'spum' for 'spoon – substituting 'm' for final 'n'.
'stin' for 'spin' – substituting 't' for 'p'.
'stold' for 'scold' – substituting 'c' with 't'. Child could have misheard, but the context of 'You scold me when I'm naughty' should have alerted the child to the correct word.
'sum' for 'soon' – substituting 'm' with 'n'.
'tan' for 'tell' – substituting 'll' with 'n'.
'tal' for 'dell' – substituting 'd' with 't'.
'taran' for 'trail' – substituting 'l' with 'n'. Possibly the child misheard the word as 'train' and stressed the 't' at the beginning to give 't – uh', which was represented as 'ta' on paper (see 'teso' for 'test' below – different participant). However the context given of a 'trail' being a 'path which you follow' should have directed the child to the correct word.
'teso' for 'test' – substituting final 't' for 'o'. Possibly the child is actually omitting the 't' and emphasising the 's' with a final 'uh' sound, which is represented with an 'o' on paper (see 'taran' above – different participant).
'thn' for 'pram' – appears to be substitution of 't' for 'p' and 'n' for 'm', both closely related sounds, plus possible confusion of the letters 'h' and 'r' which are similar in formation.
'tole' for 'tell' – substituting 'o' for 'e'.
'trarl' for 'trail' – substituting 'ar' for 'ai'.
'troop' for 'droop' – substituting 'd' with 't'. Could have misheard, but the context of a 'The flowers will droop if you don't give them water' should have directed child to correct word.

'ulm' for 'olm' – substituting 'u' for 'o'. This would be accepted as PP in words where the 'o' sounds like 'u', as in 'shove', but the 'o' in 'olm' is analogous with the 'o' in 'old' and therefore substituting 'u' for 'o' as not phonetically plausible here.
'wauyyt' for 'wild' – substitution of /a/ for /i/, as well as omission of 'l'.
'wayld' for 'wild' –substituting 'ay' for /i/. See 'chayld' above (same child at t2).
'went' for 'waist' – substituting 'n' for 's'. It may be that this child was using analogy with the clue word ('rain' - which he spelt 'ren') to get this spelling of 'waist' – or he may simply have misheard, although the context of 'I'm wearing a belt round my waist' should have made the meaning clear.
'wlot' for 'wild' – substitution of 'd' with 't', as well as omission of /i/.

Additional Letters
'bacl' for 'back' – additional 'l' at end.
'bandn' for 'bandn' - additional 'n' - possibly partial repetition of the coda 'nd'.
'blaclc' / 'blaclk' for 'black' – additional 'l'.
'boell' for 'bell' – additional 'o' after the 'b' (see note below).
**'buot' for 'boat' – additional 'u' after 'b'.
**'cheill' for 'chill' – additional 'e' after 'ch'.
**'colod' for 'cold' – additional 'o'.
'cuosf' for 'goose' – additional 'f' at end as well as substitution of 'g' with 'c'.
**'dupu' for droop' – additional 'u' at end, as well as omission of 'r'.
**'fine' for 'thin – 'f' is phonologically plausible representation of 'th' for Year 1 children who pronounce 'th' as 'f', but the additional silent 'e' at the end is unacceptable, because silent 'e' would make the /i/ sound longer, as in 'like' or as in 'police'. Possibly the child is stressing the final 'n' with an additional 'uh' sound after it and representing this as 'e'.
'gunts' for 'goose' – additional 'nt' (or possibly 'ut' since this child appear to reverse 'n' and 'u' sometimes.)
'knch' for 'chin' – addition of 'k', as well as reversal of 'ch' and 'n' and omission of /i/. Or possibly the 'k' is a first attempt at representing 'ch'.
**'molue' for 'mole' – additional 'u'.
'monle' for 'mole' – additional 'n'.
**'ocu' for 'oak' – additional 'u'.
'ocul' for 'oak' – additional 'ul'.
'oldm' for 'olm' – additional 'd', possibly because child is making an analogy with 'old' but forgetting to drop the 'd'.
'oldllm' for 'olm' – additional 'dll' in the middle, again possibly because of analogy with 'old'.
**'olma' – additional 'a' at end.
**'omelo' – as well as reversing the 'l' and 'm' the child has added two extra sounds: 'e' and 'o'.
'omck' for 'oak' – additional 'm'.
'pold' for 'pole' – additional 'd'.
'pranm' for 'pram' – additional 'n'.
'ranck' for 'rain' – additional 'ck'.
**'rofu' for 'roof' – addition of 'u' at end.
'sald' / 'seyld' for 'sail' – addition of 'd' at end of word.
'saly', 'soly' / 'soley' for 'sail' and 'traly' for 'trail' – additional 'y' at end.
'saold' for 'sail' – addition of 'd' at end.
'sbogck' for 'spook' – additional 'g'.
'sclold' for 'scold' – additional 'l'.
** 'sgolod' for scold – additional 'o' squeezed in between the 'l' and 'd' of the coda.
'sllel' for 'sail' – additional 'll' in middle.
'snh' for 'soon' – additional 'h', as well as omission of 'oo'.
'solef' for 'shelf' – additional 'o' as well as reversal of the 'e' and 'l'.
**'solod' for 'scold' – addition 'o' after the 'l' as well as omission of 'c'.
'spilq' for 'spill' – either an additional 'q' at end or, possibly more likely, an additional reversed 'p' at end – repetition of the 'p' in the onset perhaps.
'stn' for 'soot' – additional of 'n', possibly an analogy with the coda of the clue word 'soon', as well as omission of 'oo'.
'tly' for 'tell' – additional 'y' at end as well as omission of 'e'.
**'traller' for 'trail' – addition of 'er' at end.
'uoc' for 'oak' – additional initial 'u'.
'wylold' for 'wild' - additional 'o', possibly because child is making analogy with 'old'. See 'oldm' above (same child).

'woldl' for 'wold' – additional 'l'.
**'wolod' for 'wold' – additional 'o'.
**'wulod' for 'wold' – additional 'u', plus reversal of 'o' and 'l'.

**In these instances, it may be that the children are sounding out the individual phonemes to themselves as they spell and, in emphasising a consonant like 'b', 'm', 'f', 'l' or 'p' or a sound like 'ch', they are adding an additional 'uh' sound, which they then seek to represent on paper. Thus 'bell' becomes 'b – uh – ell' (boell'), 'roof' becomes 'roof – uh' ('rofu'), 'olm' becomes 'olm – uh' ('olma') or even 'om – uh - l – uh' ('omelo') when the 'l' and 'm' are reversed, 'boat' becomes 'b – uh – oat' ('buot'), 'droop' becomes 'droop – uh' ('dupu' with the 'r' omitted), 'chill' becomes 'ch – uh – ill' ('cheill'), 'oak' becomes 'oak – uh' ('ocu'), 'trail' becomes 'trail – uh' ('taller' with the 'r' omitted) and 'wold' and 'scold' become 'wol – uh – d' ('wolod') and 'scol – uh – d' ('solod' with the 'c' omitted).