
Children’s spelling of base, inflected, and derived words: Links with morphological awareness

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Abstract

Two studies examined whether young children use their knowledge of the spelling of base words to spell inflected and derived forms. In Study 1, 5- to 9-year-olds wrote the correct letter (s or z) more often to represent the medial /z/ sound of words derived from base forms (e.g., noisy, from noise) than to represent the medial /z/ sound of one-morpheme control words (e.g., busy). In Study 2, 7- to 9-year-olds preserved the spelling of /z/ in pseudoword base forms when writing ostensibly related inflected and derived forms (e.g., kaise-kaisy). In both studies, the children’s tendency to preserve the spelling of /z/ between base and inflected/derived words was related to their performance on analogy tasks of morphological awareness. These findings add to the growing body of evidence that children recognise and represent links of meaning between words from relatively early in their writing experience, and that morphological awareness facilitates the spelling of morphologically complex words.

Keywords: Children, derived words, inflected words, morphological awareness, spelling.
The English spelling system is basically alphabetic, but children must learn about more than just letter-to-sound correspondences. There are correspondences at other levels as well, such as at the level of morphology. For example, despite variations in its pronunciation, the spelling of the inflection -ed is maintained across regular past verbs (e.g., walked, warned, waited). Similarly, the spelling of many base words is maintained in their inflected and derived forms, whether or not their pronunciation changes (e.g., lose/loser, equal/equality).

According to many stage-based models of English spelling development, children start off writing on the basis of sound alone, and take a year or more before they even begin to represent morphological patterns (e.g., Ehri, 1986; Gentry, 1982; Henderson & Templeton, 1986; Marsh, Friedman, Welch, & Desberg, 1980). These models hold that children acquire inflectional endings first, but they do not describe the development of an understanding that base spellings need to be maintained in inflected forms (e.g., kiss/kissed). Children are seen to begin learning to maintain the spelling of base words in derived forms only later, by middle to late primary school (ages 9 to 12). However, the models’ examples of base-derived relations seem to focus on relatively opaque pairs such as critical/criticise (Marsh et al., 1980) or sign/signal (Henderson & Templeton, 1986). They may therefore underestimate young children’s ability to represent morphological links in their writing.

Other authors focus on the role of phonology and word-specific learning in the development of literacy, but minimise the importance of knowledge of any further spelling patterns, including those of morphology. For example, Share (1995; 1999) suggests that a word’s orthographic representation is acquired initially through phonological recoding, but strengthened through repeated encounters with that word in print. The ease with which a child can write a word is thus seen to depend on item-based factors (frequency of exposure, nature and success of identification), rather than stage-based factors (the strategy “stage” at which a child is operating).
There is indeed evidence that knowledge of the frequency with which letters co-occur plays an important role in children’s spelling decisions (Pacton, Perruchet, Fayol, & Cleeremans, 2001), even when using a morphological rule instead would result in more accurate spelling (Kemp & Bryant, 2003). For example, *trees* could also plausibly be spelled *treeze* or *treese* from an orthographic point of view, but the morphology-based ‘plural rule’ determines that regular plurals must end in -s. Similarly, morphology determines that regular past-tense verbs require a final -ed even if the sound is /t/, as in kissed. Thus, the importance of the role of morphology in early spelling remains in question.

Some experimental evidence does point to the middle primary school years as important in the normal acquisition of morphological spelling conventions. From a study of written narratives of nearly 250 children in grades 3 and 4, Green et al. (2003) concluded that although inflectional morphology is largely mastered by age 9 or 10, skills in derivational morphology continue to develop into middle childhood. Carlisle (1988) found that children as young as 10 years (in grade 4) preserved the spelling of base forms in transparent derived words (e.g., *warm/warmth*). However, although spelling improved with age, even children aged 12 and 14 years (in grades 6 and 8) had problems preserving the base forms of relatively opaque derived words (e.g., *equal/equality*).

Children’s spelling of transparent base/derived pairs, however, must be interpreted with caution. If a child writes *warm* and *warmth* consistently, she might just recognise their shared sounds, rather than their shared meaning. One way to avoid this problem of interpretation is to examine children’s spelling of words in which an ambiguity in the spelling of the inflected or derived form can be resolved only by making use of the base form (e.g., the vowel reduced to a schwa in *inflame/inflammation*). Zutell (1980) found that children in grades 1 and 2 often left out whole blocks of letters in such base/derived pairs, but that 12% of children in grade 3 and 40% in grade 4 consistently used the same vowel sound for both words in a pair. (Unfortunately, no check was made of whether the participants knew the meaning of the base or derived words.)
In contrast, other studies, using simpler words, suggest that even children as young as 5 to 8 years (in kindergarten to grade 2) make some use of their morphological knowledge to spell. Treiman, Cassar, and Zukowski (1994) asked American children from kindergarten to grade 4 to spell one- and two-morpheme words with a medial \( t \) or \( d \), which they pronounced as a medial ‘flap’, /\( t \theta \)/. Children of all grade levels more often chose the correct letter, \( t \) or \( d \), to spell the medial flap of the two-morpheme words (e.g., \( \text{dirty} \)) than of the one-morpheme words (e.g., \( \text{city} \)). Similarly, children from kindergarten to grade 1 (Rubin, 1988) and kindergarten to grade 3 (Treiman & Cassar, 1996) were more likely to represent the penultimate consonant in two-morpheme (e.g., /\( m \)/ in \( \text{hummed} \)) than in one-morpheme words (e.g., /\( n \)/ in \( \text{wind} \)). If children had relied only on phonemic information, there should have been no difference between one- and two-morpheme words. In contrast to the conclusions of other studies, these results suggest that even beginning spellers can use their knowledge of the final consonant sounds of the base words to spell inflected and derived forms.

Nevertheless, it is clear that as their spelling improves, children shift from relying on predominantly sound-based strategies, to morphological strategies as well. There is growing evidence that this shift is related to morphological awareness. Researchers have used a range of tasks to measure morphological awareness. Some test a relatively implicit level of awareness, such as oral tasks that require children to apply morphological rules to nonsense base words (e.g., Here is a man who knows how to bod. He is bodding. He did the same thing yesterday. What did he do yesterday? Yesterday he _____ . ) (e.g., Berko, 1958; Hauerwas & Walker, 2003; Rubin, 1988). Other tasks tap a more explicit level of awareness, such as tasks in which children complete spoken sentences with the appropriate derived or base form of a given word (e.g., Warm. He chose the jacket for its _____ . ) (e.g., Carlisle, 1988; Fowler & Liberman, 1995; Leong, 2000). Other tasks use a word or sentence analogy format, in which the child is required to reason by analogy to supply the missing morphological form (e.g., Tom helps Mary \( \rightarrow \) Tom
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helped Mary. Tom sees Mary \( \rightarrow \) _______. ) (Nunes, Bryant, & Bindman, 1997a, b). Finally, some tasks require a very explicit level of morphological awareness, and ask participants specifically about the morphological structure of a word (e.g., Is there a smaller word in kissed that means something like kissed?) (e.g., Derwing, Smith, & Wiebe, 1995; Rubin, 1988.)

Some studies have shown that increasing morphological awareness enhances the ability to read and spell morphologically complex words or pseudowords (e.g., Carlisle, 1995; Nunes et al., 1997a, b), and others have shown that morphological spelling knowledge can in turn affect oral morphological judgements (e.g., Derwing et al., 1995; Hauerwas & Walker, 2003). Further research has concluded that causality flows in both directions (e.g., Bryant, Nunes, & Bindman, 1998; Levin, Ravid, & Rapaport, 1999). Despite the variation in tasks used, morphological awareness seems to play a strong role in learning to spell morphological patterns.

The present studies examined children’s spelling of real and novel base words and their derived and inflected forms, and investigated the relationship of spelling consistency to explicit morphological awareness. The design of Study 1 followed Treiman et al. (1994), and compared children’s spelling of the sound /z/ in base words (e.g., noise, breeze), in their derived/inflected forms (e.g., noisy, breezy), and in control words (e.g., daisy, crazy). In Treiman et al.’s studies, the spelling of the medial ‘flap’ could be determined from the base form’s final sound or spelling (e.g., dirty-dirt, rider-ride). In contrast, the sound /z/ is orthographically ambiguous (s or z) in both word-final and word-medial position (e.g., noisy-noise, breezy-breeze). The present studies were thus designed to reveal whether children make use of the base forms’ spelling, not just their sound. Study 2 used a cloze task to extend the investigation to pseudowords.

These studies also aimed to investigate the relationship between children’s tendency to preserve the spelling of /z/ between base and inflected/derived words, and their morphological awareness. Two tasks of explicit morphological awareness were used, one involving analogies (based on Nunes et al., 1997a, b), and one requiring the extraction of base words from derived forms (based on Rubin, 1988). If consistency of spelling between base and inflected/derived
forms does reflect children’s awareness of morphological relations, then such consistency should be correlated with their scores on the two oral measures of morphological awareness.

Study 1: Children’s use of Base words to Spell Derived Words

Method

Participants

The participants were 74 children in years 1 to 4 at a school in a middle-class area of the south of England. There were 39 boys and 35 girls, ranging in age from 5;09 to 9;10, mean age 7;07 years (SD = 12.4 months). Thirteen were in year 1, 23 were in year 2, 21 were in year 3, and 17 were in year 4. Because spelling ability varied widely across age groups, children were divided into two Spelling Groups on the basis of spelling age (rather than chronological age), as measured on the spelling sub-test of the Wechsler Objective Reading Dimensions (WORD) (Rust, Golombok, & Trickey, 1993). The mean spelling age was 8;03 years (SD = 22.6 months). Those whose spelling age was below the median of 7;07 were allocated to the Poorer spelling group; those at or above the median were allocated to the Better spelling group. The Poorer spellers’ mean chronological age was 7;06 years (SD = 13.8 months), and mean spelling age was 6;10 years (SD = 5.3 months). The Better spellers’ mean chronological age was 7;10 years (SD = 10.5 months), and mean spelling age was 9;08 years (SD = 20.6 months).

Stimuli

The stimuli were 12 Base words, 12 Derived words, and 12 Control words (see appendix). The Base words were one-morpheme, one-syllable words, ending in a /z/ sound, 6 spelled with se (e.g., noise), and 6 with ze or zz (e.g., breeze). The Derived words were two-morpheme, two-syllable words with a medial /z/ sound, derived from the Base words, 6 spelled with s (e.g., noisy), and 6 with z or zz (e.g., breezy). The Control words were one-morpheme, two-syllable words matched closely to the Derived words for phonetic complexity, length and frequency (Carroll, Davies, & Richman, 1971), 6 spelled with s (e.g., daisy), and 6 with z or zz (e.g., crazy).
An analysis of the experimental words’ phonological and orthographic structure confirmed that overall, the spellings of /z/ could not be reliably predicted from their preceding (or following) vowel sounds (e.g., daisy could plausibly be spelled with s or with z).

The difficulty of finding sufficient words with the ideal phonological and frequency characteristics meant that the written mean frequency of the z words (Standard Frequency Index, SFI = 45.4) was less than that of the s words (SFI = 52.3). (A word with a SFI of 40 would be expected to occur once in every one million printed tokens.) Also, 3 words (nosy, sneezy and fizzy) did not feature in the Carroll et al. (1971) list. However, the first 15 of the Year 1 and 2 children tested could use the words correctly in a spoken sentence. Thus, these words were retained.

Procedure

Each child participated in two testing sessions of between 15 and 25 minutes, conducted about a week apart in a quiet school room. In Session 1, the experimenter administered the experimental spelling task to groups of 3 or 4 children. In Session 2, she saw the children individually, and administered the spelling sub-test of the WORD, the two morphological awareness tasks, and the spelling task for the Base words.

Experimental spelling task. The experimenter read out each of the 24 Derived and Control words; once alone, once in a sentence, and once alone again, and asked the children to write them down. The words were presented in a different order for each group of children.

Base-extraction task of morphological awareness. This task tested the children’s ability to identify the Base words within the Derived words spelled in Session 1. It was explained that some words have ‘a smaller word hidden inside them’ that ‘means something like them’ (e.g., mud in muddy) and that some words do not (e.g., ugly, pretty). Special attention was drawn to words which do not have a true base word, because the ‘hidden’ word is not related to the longer word (e.g., win in window). Three practice items (with feedback) were given, and then the 12 Derived and 12 Control words. The words were intermixed and presented in one of 10 orders.
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Spelling the Base words. Every time a child identified a Base word in the Base-extraction task (whether correctly, e.g., *froze* in *frozen*, or incorrectly, e.g., ‘*does*’ in *dozen*), the experimenter asked him or her to write it down. At the end, the experimenter asked the child to write down (to dictation) any remaining Base words. The children did not appear to notice that these were words that they should have identified in the preceding task.

Sentence Analogy test of morphological awareness. This test used sentence analogies to assess the children’s ability to transform base words into derived forms. These transformations required an understanding of the words’ meaning, rather than just their morphological form. The experimenter introduced two hand-puppets, and explained that every time one puppet said something, the other puppet copied him, but ‘changed it a little bit’. For each item, the first puppet said a pair of sentences, using a base word (noun, adjective or verb), and a derived form of this word (e.g., ‘John likes to *cycle* in the park. He’s a keen *cyclist*.’). The second puppet responded with a sentence similar to the first sentence but containing a different base word, and the beginning of a sentence similar to the second sentence (e.g., ‘Jack likes to *run* in the park. He’s a keen _____.’). The child was asked to provide the missing derived form. Three practice trials (with feedback) were given, and then the eight test items (see Appendix), in a systematically varied order for each child. For all but the first practice analogy, the two base forms required different endings, to ensure that the children were not just copying the ending (as in *run*-runner and *teach*-teacher).

Results and Discussion

Appropriate Spelling of /z/ in the Experimental Words

The children’s representations of the sound /z/ were coded as ‘s’ spellings (if they included *s, ss, se, sse*) or as ‘z’ spellings (if they included *z, zz, ze, zze*). Any ‘s’ (‘z’) spelling produced for a word which required an ‘s’ (‘z’) spelling was considered *appropriate*, even if the attempt was not conventionally correct (e.g., *noissy* for *noisy*). Errors nearly always involved the ‘alternative’
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letter (‘s’ for ‘z’, or vice versa). Non-English representations of /z/ such as sz, zs, and c were not included in the analyses. The proportion of times that the children used ‘s’ and ‘z’ spellings to represent the /z/ sound appropriately in each word was computed, and is presented in Table 1.

** Table 1 about here **

The table shows that overall, the children’s representation of /z/ in the Base words, although not at ceiling, was better overall than on the Control words. This means that there was scope to transfer their knowledge of the spelling of the Base words to the Derived forms. (Control words were seen as a ‘baseline’ for the spelling of /z/ in two-syllable words. Since Base words were spelled better than Control words, participants had, in theory at least, the opportunity to transfer their Base knowledge to improve their Derived spelling beyond that of the Control words.) It appears that at least some transfer occurred: overall, the children wrote /z/ appropriately a little more often in Derived than in Control words. However, this transfer appears incomplete: the number of appropriate spellings is less in Derived words than in Base words. This pattern of results holds for the words requiring an ‘s’ spelling, but not for those requiring ‘z’. The children wrote /z/ appropriately for the ‘z’ Base words only slightly more often than for the ‘z’ Control words. This means that there was little opportunity for them to use their knowledge of the Base words to improve their spelling of the Derived words above the level that they had already attained for the Control words. In all cases, the Better spellers outperformed the Poorer spellers. Their pattern of results seems similar for ‘s’ words, but divergent for ‘z’ words. The items on the spelling task had adequate internal reliability (Cronbach’s alpha = .76).

The mean proportions of appropriate representations of /z/ were analysed in a repeated-measures analysis of variance, for which the data met the usual statistical assumptions. Occasional violations of the assumption of sphericity were corrected by the Greenhouse-Geisser correction factor. The ANOVA had one between-subjects variable, Spelling Group, and two
within-subjects variables, Word Type (Base, Derived or Control), and Letter (the spelling required for /z/; ‘s’ or ‘z’). There was a significant effect of Spelling Group, $F(1, 72) = 95.4, p < .001$. The Better spellers wrote /z/ appropriately significantly more often ($M = .82$) than the Poorer spellers ($M = .54$). There was also a main effect of Word Type, $F(2, 144) = 22.9, p < .001$. Newman-Keuls post-hoc tests confirmed that the number of appropriate spellings was significantly higher in Base words than in Derived words, and significantly greater in Derived words than in Control words ($p < .01$ in all cases). It seems that participants transferred their knowledge of the spelling of the Base words to the Derived words to at least some extent. There was no significant main effect of Letter, but there was a significant interaction between Word Type and Letter, $F(2, 144) = 8.35, p = .001$. Post-hoc Newman Keuls tests revealed that for the words which required an ‘s’ spelling, the number of appropriate representations of /z/ written for Base words was significantly higher than for both Derived and Control words ($p < .01$), but the difference between Derived and Control words did not reach significance. For the words which required a ‘z’ spelling, however, the difference across Word Types no longer quite reached significance.

The division of participants according to spelling age necessarily conflated age with spelling ability. To clarify the role of chronological age, these analyses were repeated, with participants divided into a Younger and an Older group. The pattern of significant main effects and interactions proved to be the same as that in the analyses on the basis of spelling age.

Spelling Consistency

The previous analyses were not designed to specify the children’s consistency in representing /z/ within individual Base-Derived pairs. This Spelling Consistency was determined by calculating the proportion of times that appropriate (‘s’ for ‘s’, ‘z’ for ‘z’) and inappropriate (‘s’ for ‘z’, ‘z’ for ‘s’) spellings of /z/ in the Base forms were followed by that same representation of /z/ in their Derived forms. The Better and Poorer spellers’ responses were combined, since the
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previous analyses had revealed that Spelling Group did not interact significantly with any other factor. Table 2 shows the results.

** Table 2 about here **

The table confirms that the children’s transfer of knowledge of the Base words’ spelling to the Derived words was never entirely complete. However, it seems that if children spelled a Base word appropriately, they were more likely to use that same appropriate spelling in the word’s Derived form as well, than if they had spelled it inappropriately. This may relate to participants’ confidence in their spelling of /z/ in the Base words.

*Base-extraction Task*

When the experimenter asked if each word in this task contained a related Base word, the correct response to the Control words was ‘no’. However, to achieve a correct response to the Derived words, the child had to answer ‘yes’, and also provide the right Base word. Thus, indiscriminate ‘no’ responses would result in a higher score than indiscriminate ‘yes’ responses. To counter this, Rubin’s (1988) ‘two-pronged’ scoring system was used. Each Derived word was paired with its most similar Control word (e.g., chosen-raisin, fizzy-dizzy). To score one point, a child had to reply ‘yes’ and provide the correct Base form to the Derived word, and reply ‘no’ to the matched Control word. (Children did score a point if they identified please, ease, craze or raze as Base forms of pleasant, easy, crazy or razor – but only if they had not also incorrectly identified a Base word in at least half the remaining Control words, e.g., ‘does’ in dozen. This left only 3 children considered to have correctly identified ease or craze, and seems to support the labelling of these as ‘Control’ words for this study.) The overall mean proportion of correct scores on this 12-item task was .56 (SD = .25). A one-way ANOVA showed that the Better spellers’ mean proportion correct of .64 (SD = .22) was significantly higher than the Poorer spellers’ mean of .47 (SD = .26), $F(1, 73) = 9.69, p = .003$. When the participants were divided
according to chronological age, however, the difference between Older ($M = .61$) and Younger ($M = .40$) children did not reach significance, $F (1, 73) = 3.58, p = .06$.

**Sentence Analogy Task**

The number of times (out of 8) that each child successfully transformed the target word in the sentence analogy task was computed. The mean proportion correct was .79 overall (SD = .25), and Better spellers gained a significantly higher mean of .90 (SD = .11) than Poorer spellers, with a mean of .69 (SD = .27), $F (1, 73) = 15.3, p < .01$). Scores for these items were internally consistent (Cronbach’s alpha = .72). Comparing chronological age groups, the difference between the Older ($M = .85$) and Younger ($M = .40$) children remained significant, but less so, $F (1, 73) = 5.17, p = .03$.

**Correlations and Regression Analyses**

Pearson correlations, shown in Table 3, were calculated to examine how strongly the children’s chronological and spelling ages and morphological awareness scores were related to their consistency in representing /z/ between Base and Derived words.

**Table 3 about here**

Table 3 shows that chronological age correlated significantly with spelling age and spelling consistency, but spelling age correlated significantly with all other variables. (This supports the decision to divide children by spelling ability, rather than by age or school year.) Spelling age was strongly linked with spelling consistency and with scores on both tasks of morphological awareness. Consistency in representing /z/ in Base-Derived pairs correlated significantly with performance on the Sentence Analogy task, which in turn was significantly correlated with performance on the Base-extraction task. However, the correlation between Spelling Consistency and Base-extraction performance did not reach significance, even though these two tasks involved the same pairs of words.
The pattern of correlations between Spelling Consistency, Spelling Analogy score and Base-Extraction score (see Table 3) could stem from differences in the level of explicitness of morphological awareness required to succeed on the three measures. Children who are consistent in their spelling of /z/ in Base-Derived pairs may know at some level that because the words have similar meanings, the common sound sequence should be spelled with a common letter sequence. In contrast, the ability to identify base words in Derived forms requires a more explicit understanding of the relationship between Base and Derived words, and of the Base word as a unit of sound, spelling, and meaning. Even the Better spellers found the Base-extraction test difficult, and it may be some time before these spellers gain a sufficiently explicit understanding of these base-derived relations for correlations to be observed.

In terms of explicitness, the Sentence Analogy task probably taps a level of morphological awareness somewhere between the measures of Spelling Consistency and Base-extraction. Sentence Analogy score did correlate significantly with Spelling Consistency, possibly because the required level of understanding could be reached more easily by more of the children, and they really were using this kind of knowledge to help their spelling, and vice versa. To determine to what extent this relationship could be attributed to chronological and spelling age, two regression analyses were conducted, with Spelling Consistency as the outcome variable (Table 4). In the first analysis, chronological and spelling age were entered before Sentence Analogy score. However, although consistent spelling was taken to indicate the children’s understanding of the link of meaning between Base and Derived words, it is also closely tied to spelling ability, regardless of level of morphological awareness.

Table 4 shows that chronological age and spelling age account for a significant amount of the variance in Spelling Consistency. Sentence Analogy score also accounts for a significant amount
of variance, provided that it is entered after spelling age. Thus, children’s ability to manipulate base and derived forms in an oral task predicts their ability to preserve spellings between related words, over and above changes in chronological age.

One limitation of the Sentence Analogy task of morphological awareness used here is that the sentence context inevitably constrains the child’s choice of missing word. One way to avoid such a semantic confound is to use word analogy or sentence analogy tasks in which context provides no help with the grammatical transformation required (see Nunes et al., 1997a, b). Further, conclusions drawn from the spelling of read words are always limited by uncertainty about how much rote spelling knowledge children bring to the task. The second study therefore extended the investigation into children’s spelling of base pseudowords and their ostensibly related forms, both inflected and derived. To achieve a cleaner measure of morphological awareness, analogy tasks were chosen or developed for their lack of semantic confounds.

Study 2: Children’s Use of Base Pseudowords to Spell Inflected and Derived Pseudowords

Method

Participants

The participants were 75 children in school years 3 and 4, at two schools in a middle-class area of the English Midlands. The pseudoword spelling task was initially administered to children in school years 1 and 2, but they found the pseudowords too difficult to spell. Further, their reading skills were not advanced enough for them to read the surrounding sentence contexts spontaneously. We therefore tested older children. There were 33 girls and 42 boys, aged from 7;10 to 9;10, with a mean age of 9;00 years (SD = 5.8 months). Twenty of these children were in year 3, and 55 were in year 4. As in Study 1, spelling age was determined by performance on the Spelling Subtest of the WORD. The mean overall spelling age was 9;11 years (SD = 27.9 months). The children whose spelling age was less than the median of 9;00 were placed in the Poorer spelling group; those at or above the median were allocated to the Better spelling group.
The Poorer spellers’ mean chronological age was 8;11 years (SD = 6.3 months), and mean spelling age was 8;01 years (SD = 7.9 months). The Better spellers’ mean chronological age was 9;02 years (SD = 4.8 months), and mean spelling age was 11;07 years (SD = 24.4 months).

Stimuli

The experimental stimuli were 48 pseudowords, formed from monosyllabic ‘Base’ pseudowords with a long medial vowel and a final /z/ sound which could plausibly be spelled with either a final -se or -ze (e.g., mease/meaze). These Base forms were transformed into the experimental pseudowords by adding one of four suffixes, either inflectional (12 with -s, e.g., meases; 12 with -ed, e.g., chized) or derivational (12 with -y, e.g., nisy; 12 with -er, e.g., pazer). As in Study 1, it was confirmed that the spelling of the /z/ sounds in the pseudowords could not be reliably predicted from their phonological contexts.

The 48 pseudowords were presented in one of 3 types of sentence context. There were 16 sentences of each type. Children were provided with worksheets showing these sentences, each with one word missing. The experimenter read out the sentences, including the missing pseudoword, and the children wrote down this word. In the **Base provided** sentences, the missing pseudoword’s Base form was included in the sentence (e.g., ‘Mum’s going to buy a mease for tea. I love _______ (meases, /miz3/)!’). This tested the ability to use the spelling of the ambiguous /z/ sound in the base form (s or z) to spell the /z/ sound in the inflected or derived pseudoword. In the **Copy word** sentences, the missing pseudoword was presented in the sentence (e.g., ‘I wish you’d neazed yours as well as Jane _______ (neazed, /nizd/) hers!’). This checked whether the children could use spelling clues available in the sentence. Finally, the **Pseudoclue** sentences contained a ‘pseudoclue’: a real word with the same suffix and similar phonetic structure (consonant (cluster) + vowel + /z/ + ending) as the missing pseudoword, which contained a /z/ sound spelled either with s or with z (e.g., ‘He sneezed so loudly that the cat _______ (fozed, /fəʊzd/) out of the room.’). A real word was used because the inclusion of two
different pseudowords in one sentence might have been too confusing for the children. These sentences tested whether the participants preserved the spelling of /z/ that they saw in the ‘clue’ word because they recognised its apparent link of meaning to the missing pseudoword, or whether they just used the most recent representation of /z/ that they had seen, without being aware of the role of meaning at all.

**Procedure**

Each child participated in two testing sessions of 20-25 minutes each, conducted about 3 days apart, in a small private area within the school. In Session 1, the experimenter saw the children in groups of 4 to 6, and administered the experimental spelling task. In Session 2 she saw the children individually, and administered the Spelling sub-test of the WORD between the two parts of the analogy-based task of morphological awareness (described below).

*Experimental spelling task.* The children received worksheets showing the 48 sentences, each with one word missing (represented by a line). The experimenter said each missing pseudoword alone, in the sentence, and then alone again, and the children wrote it on the line provided. The experimenter explained that these missing words were not real words that the children had heard before, but new words that she had made up. The sentences were presented in a different order for each group of participants. All the children heard the same 48 missing pseudowords. However, the ‘clue’ words (Base pseudowords, pseudowords to be copied, and pseudoclues) were systematically varied, as was the spelling of /z/ in the clue words (between s and z).

*Analogy task of morphological awareness.* This task investigated children’s ability to transform words of the grammatical categories to which the pseudowords in the spelling task belonged (see Appendix). Item types included ‘Plurals’ (changing nouns from plural to singular and vice versa), ‘Verbs’ (changing verb tense from past to present/present continuous and vice versa), ‘Nouns’ (changing nouns to related verbs and vice versa), and ‘Adjectives’ (changing nouns to adjectives and vice versa). The task used the same hand-puppets and analogy format as Study 1. The Plurals and Verbs tasks used Sentence Analogies. In order to avoid the potential
Results and Discussion

Spelling of /z/ in the Experimental Pseudowords

The participants’ spelling of each word’s /z/ sound was coded as ‘correct’ or ‘incorrect’. We focused on the ‘correct’ representations: those which preserved the spelling of /z/ in the form of the pseudoword given in the sentence context (e.g., ‘Mum’s going to buy a mease for tea. I love meases!’). Because all the pseudowords (and their base forms) were pronounced with a long vowel, and all the printed Base clues ended in -se or -ze, only s or z (but not ss or zz) were counted as an appropriate spelling of medial /z/. We also labelled as ‘correct’ the preservation of the spelling of /z/ in the pseudoclues when writing apparently unrelated inflected and derived words (e.g., ‘He sneezed so loudly that the cat fozed out of the room’). The term ‘correct’ was used for the purposes of comparison with the other words, rather than to imply a judgement about how these ‘pseudoclued’ pseudowords should have been spelled. The mean proportion of times that the children preserved the spelling of /z/ given, for each sentence type and letter type, is shown in Table 5. Internal consistency was satisfactory (Cronbach’s alpha = .79).

**Table 5 about here**
The table shows that overall, the children were very good indeed at making use of the Base pseudoword clues to decide how to spell the /z/ of their missing inflected and derived forms. Their performance was just as high as when they could simply copy down the missing forms from the sentence. However, the representation of /z/ in the unrelated pseudoclues had no effect on spelling. There is no consistent effect of Word Type, nor of Letter. Finally, the Better spellers consistently preserved the spelling of /z/ in missing pseudowords more often than the Poorer spellers in both Base Provided and Copy Word sentence contexts.

A repeated-measures analysis of variance was conducted on these data. It had one between-subjects factor, Spelling Group (Poorer or Better), and three within-subjects factors; Sentence Type (Base Provided, Copy Word, and Pseudoclue), Word Type (inflected or derived), and Letter (the letter in the clue or pseudoclue, s or z). The dependent variable was the number of times that the children represented /z/ in the same way – ‘correctly’ – as it had been represented in the clue or pseudoclue. The data fitted the usual assumptions for repeated-measures ANOVA, and occasional violations of the assumption of sphericity were subjected to the Greenhouse-Geisser correction factor. There was a significant main effect of Spelling Group, $F(1, 73) = 7.89$, $p = .006$. The Better spellers represented /z/ correctly significantly more often ($M = .74$) than the Poorer spellers ($M = .67$). There was also a significant effect of Sentence Type $F(2, 146) = 167.2$, $p < .001$. Post-hoc Newman-Keuls tests showed that the mean number of correct spellings provided for the pseudowords did not differ significantly between the ‘Base provided’ ($M = .84$) and the ‘Copy word’ sentences ($M = .83$), but that both were significantly greater than in the ‘Pseudoclue’ sentences ($M = .41$), $p < .01$. This demonstrates that the children preserved the spelling of /z/ only for clues that were apparently related to the missing pseudowords.

There was no significant effect of Word Type, which confirms that the children were no more likely to preserve the spelling of inflected than of derived words. Sentence Type interacted significantly with Letter, $F(2, 146) = 3.61$, $p = .038$. Post-hoc tests indicated that there were no
significant differences between correct preservation of s and z in the ‘Base provided’ and ‘Copy word’ sentences. However, both of these were significantly greater than s or z preservation in the ‘Pseudoclue’ sentences, (p < .01 in all cases). Finally, there was a significant interaction between Word Type and Letter, $F(1, 73) = 5.31, p = .024$. Post-hoc tests revealed that in inflected words, s and z were preserved about equally often, but that in derived words, z was preserved significantly more than s, $p < .01$. The letter s was preserved significantly more in inflected than derived words, and the letter z was preserved significantly more often in derived than inflected words, $p < .05$ for both. The reasons for these minor s/z differences in derived and inflected words are not clear.

As in Study 1, when the analyses were re-run, dividing instead by chronological age, the pattern of significant main effects and interactions was the same as when dividing by spelling age. Overall, the results suggest that children were aware of, and able to use, the morphological relations between the base and the inflected/derived pseudowords that they wrote.

**Analogy Tasks of Morphological Awareness**

The number of times that the children successfully transformed the target word in each of the tasks of morphological awareness was counted, and the means are shown in Table 6. Internal consistency was satisfactory for all scales and subscales (Cronbach’s alpha = .68-.73).

The means in Table 6 were analysed in two repeated-measures analyses of variance. They both had one between-subjects factor, Spelling Group (Poorer or Better), and one within-subjects factor, Item Type. The first ANOVA was based on the Sentence Analogy tasks. This analysis confirmed that the Better spellers correctly transformed significantly more words than did the Poorer spellers, $F(1, 73) = 23.9, p < .01$, and that the children performed significantly better on the Plurals than on the Verbs tasks, $F(1, 73) = 24.5, p < .01$. Item Type and Spelling Group
interacted significantly, $F (3, 219) = 7.2, p < .01$. Newman-Keuls post-hoc tests showed that the Better spellers outperformed the Poorer spellers on both the Plurals ($p < .05$) and the Verbs items ($p < .01$). The Better spellers performed equally well on both, but the Poorer spellers did better on the Plurals than on the Verbs items ($p < .01$). The second ANOVA was based on the Word Analogies. Again, the Better spellers correctly transformed significantly more words than the Poorer spellers, $F (1, 73) = 8.4, p < .01$, and the children performed significantly better overall on the Nouns than on the Adjectives items, $F (1, 73) = 21.2, p < .01$. Item Type and Spelling Group interacted significantly, $F (1, 73) = 7.6, p < .01$. Post-hoc tests showed that on the Nouns, the Better spellers outperformed the Poorer spellers ($p < .01$), but that on the Adjectives, the groups did not differ. The Better spellers did significantly better on the Nouns than the Adjectives ($p < .01$), but the Poorer spellers did not differ significantly.

When overall performance on the morphological awareness task was compared between chronological age groups, the difference between Older ($M = 0.71$) and Younger ($M = 0.66$) children did not reach significance, $F (1, 74) = 1.78, p = .19$.

**Correlations and Regression Analyses**

Pearson correlations were calculated between the children’s chronological and spelling ages, their performance on the analogy task of morphological awareness, and their correct spelling of the /z/ sound in inflected and derived pseudowords presented in ‘Base provided and ‘Copy word’ sentences. The correlations of interest are shown in Table 7.

**Table 7 about here**

The table shows that the children’s spelling age correlated significantly with performance on the task of morphological awareness, whereas chronological age did not. Both chronological and spelling age correlated significantly with the correct spelling of inflected and derived pseudowords in many more of the ‘Base provided’ than the ‘Copy word’ sentences. This
confirms that the older and better spellers were more adept at making use of the Base pseudowords to spell their inflected and derived forms than the younger and poorer spellers.

Overall Analogy task performance was significantly correlated with the correct spelling of /z/ for both inflected and derived pseudowords, in both ‘Base provided’ and ‘Copy word’ sentences. Two regression analyses were conducted to determine whether these links would remain once chronological and spelling age were controlled for. Table 8 shows the results.

** Table 8 about here **

The table shows that even after controlling for chronological and spelling age, the children’s Sentence Analogy score (from inflected words) still accounted for a significant amount of variance in the outcome measure: the preservation of the spelling of /z/ from Base to inflected words in the ‘Base provided’ sentences. In the ‘Copy word’ sentences, in contrast, Sentence Analogy score did not account for a significant amount of the variance in their spelling of /z/ after controlling for chronological and spelling age. Similarly, even after controls were made for chronological and spelling age, Word Analogy score (from derived words) accounted for a significant amount of the variance in children’s correct representation of /z/ in derived pseudowords presented in ‘Base provided’ sentences. For the ‘Copy word’ sentences, in contrast, neither chronological age, spelling age, nor Word Analogy score accounted significantly for the variance in outcome measure.

General Discussion

Two studies investigated children’s use of the spelling of base words to write inflected and derived forms. They also examined how the children’s ability to represent such morphological links in their spelling was related to their morphological awareness, measured in oral tasks. The results suggest that children have some idea about morphological relationships, and that children
may sometimes use these relationships to guide their spelling (although they may not yet be doing so consistently or deliberately), earlier than many spelling models and researchers have suggested (e.g., Ehri, 1986; Gentry, 1982; Green et al., 2003; Henderson & Templeton, 1986; Zutell, 1980). Even if children use frequency-based information in preference to morphology-based information in some situations (Kemp & Bryant, 2003), this is clearly not always the case. The current findings add to the small but growing body of evidence that children have at least some ability to represent morphological links in their writing in the first few years of school (e.g., Rubin, 1988; Treiman & Cassar, 1996; Treiman et al., 1994).

Study 1 showed that children aged 5 to 9 years correctly wrote the sound /z/ significantly more often in transparent derived words (e.g., noisy, from noise) than in control words (e.g., daisy). However, the spelling of /z/ even in the base words proved to be quite difficult, and so there was limited scope for participants to use this base-word spelling knowledge for the spelling of derived words. Participants’ spelling of derived words was never as good as their spelling of base words, which suggests that the ‘transfer’ of knowledge from base to derived spelling was never complete. However, it did appear that children were more likely to use the same spelling for both base and derived forms when they had got the base form right than when they had got it wrong. Overall, the results do point to a tendency for children in the first years of school to make use of morphological relations in their spelling.

This conclusion was supported in Study 2, which showed that children aged 7 to 9 years recognised and exploited apparent morphological links between base pseudowords (e.g., mease, taise) and their inflected/derived forms (e.g., meased, taiser). Regardless of their spelling ability, participants were as likely to preserve the spelling of /z/ in an inflected/derived form when they were given its base form as when they could simply copy out the inflected/derived form. The challenge of having to read the sentence contexts meant that the participants in Study 2 had to be older than those in Study 1. An easier version of the task will be necessary before the ability of children in the first years of school to use base pseudowords in their spelling can be tested.
In both studies, the Better spellers used the correct spelling of /z/ more often than the Poorer spellers, but the pattern of the two groups’ responses was the same. The differences between the groups remained whether children were divided by chronological or spelling age. In general, spelling ability and age do not correlate perfectly, and this was the case in the present studies, in which the correlations were only about 0.30. However, it is clear that overall, spelling skill increases with age and experience: children generally get better at spelling as they get older. It might be that from the beginnings of writing, most children develop some rudimentary understanding of the need to represent morphological links, but this understanding is limited only to transparently-related pairs. The middle to late primary school years might mark a point at which children typically begin to develop a more general understanding of morphologically complex words. This could be the stage at which children begin to represent derivational relationships in their writing.

In Study 2, participants performed equally well on derived words and on inflected words. This goes against the view of some spelling models that derivational relationships are not understood until several years after inflectional relations (e.g., Gentry, 1982; Henderson & Templeton, 1986; Marsh et al., 1980). It instead supports the contention that derivational links are not intrinsically difficult to understand, provided that we ask children to spell simple, rather than complex, derivational pairs (Treiman & Cassar, 1997).

Both studies showed a strong link between children’s ability to use morphological relationships in spelling, and their oral morphological awareness. Better spellers scored consistently higher than Poorer spellers in all morphological awareness tasks, but the relationships went further than this. In Study 1, children’s consistency in spelling /z/ in related words was correlated with their morphological awareness as measured on the Sentence Analogy task. Sentence Analogy score accounted for a significant amount of variance in the children’s consistency of spelling /z/ in related words, provided it was entered before spelling age (which is closely entwined with spelling consistency). In Study 2, when children could just copy out the
base word, their ability to manipulate morphologically complex words in an oral analogy task did not account for significant amounts of variance in spelling /z/ in morphologically complex words, after controlling for chronological and spelling age. However, when children had to use the base word to spell a morphologically-related word, analogy score did account for significant amounts of variance in spelling /z/ in ostensibly related words, even after these age controls, and for both inflected and derived words. Thus, the children’s ability to transform words orally predicted their preservation of the spelling of /z/ when this preservation (presumably) required the speller to recognise that the base and inflected/derived words were related, and therefore should be spelled similarly. The prediction did not hold when the inflected/derived word could simply be copied out; that is, when the recognition of morphological links was not necessary for correct spelling.

Interestingly, the significance of group differences on the tasks of morphological awareness diminished or even disappeared when scores between older and younger children were compared. Morphological awareness may not simply increase linearly with age. It may depend on the gradual development of spelling skill, but especially on the understanding of morphological spelling patterns, which take more time to learn. (Indeed, in both studies, spelling age correlated much more strongly with morphological awareness scores than did chronological age.) In any case, it does seem that morphological awareness and skill in writing morphological patterns are mutually facilitative (e.g., Carlisle, 1995; Nunes et al., 1997a, b; Hauerwas & Walker, 2003, Levin et al., 1999).

The use of several different tasks of morphological awareness has highlighted the importance of choosing tasks which test an appropriate level of explicitness of awareness. If tasks are too difficult (e.g., Base-extraction), they will not be very useful in predicting children’s spelling of morphological patterns. Children learn to represent many such patterns before they attain the most explicit levels of morphological awareness. Researchers must therefore take care to consider the level of awareness that they are attempting to test. Training in morphological
analysis has been shown to foster the development of vocabulary, reading, and spelling skills (Henry, 1988; Nunes, Bryant, & Olsson, 2003; Wysocki & Jenkins, 1987), even in children with reading difficulties (Arnbak & Elbro, 2000; Lovett, 1999). As children begin to encounter more morphologically complex words (Nagy & Anderson, 1984), a deeper understanding of morphology becomes even more important for reading and spelling accurately in English.
Appendix

Study 1: Experimental Words

Base words, with s: noise, rose, nose, lose, wise, chose; with z: breeze, freeze, sneeze, buzz, froze, fizz. Derived words, with s: noisy, rosy, nosy, loser, wisest, chosen; with z: breezy, freezer, Sneezy, buzzer, frozen, fizzy. Control words, with s: daisy, easy, busy, poison, pleasant, raisin; with z: crazy, bulldozer, wizard, razor, dozen, dizzy.

NB. Four ‘Control’ words are related to other words: crazy to craze, razor to raze, easy to ease, and pleasant to please. However, craze, raze, and ease are much rarer than their derived forms, and seemed unlikely to be known by most of the children tested. Please is relatively frequent, but its connection to pleasant was thought not to be obvious to young children.

Study 1: Sentence Analogy Task of Morphological Awareness

Practice analogies

1. The sun is shining. It’s a sunny day.

   There’s fog all around. It’s a ______ (day).

2. Betty is good at cooking. She’s a good cook.

   Sue is good at reading. She’s a good ______.

3. Ben likes building things. He wants to be a builder.

   Laura likes nursing sick people. She wants to be a ________.

Test analogies

1. That man comes from France. He is French.

   That man comes from England. He is ________.

2. That lady is good at dancing. She’s an excellent dancer.

   That lady is very good at acting. She’s a famous ________.

3. Everyone talks about how good Bill is at music. They say he is very musical.

   Everyone talks about Angela’s beauty. They say she is very ________.
4. He’s going to count along two. It’s the second one.

He’s going to count along four. It’s the __________ (one).

5. I sometimes feel full of anger. Then I am angry!

I sometimes feel full of fury. Then I am ________!

6. John likes to cycle in the park. He’s a keen cyclist.

Jack likes to run in the park. He’s a keen ________.

7. Tim is better at maths than anyone else in the class. He’s the best at maths.

Jill is faster at running than anyone else in the class. She’s the ________ (at running).

8. Mum told me about all the colours in the painting. She said it’s very colourful.

Mum told me about the dangers if you climb that wall. She said it’s very ________.

**Study 2: Experimental Words**

Clue words (in parentheses) and pseudowords presented in each sentence context type. The spellings given for the pseudowords are just one possible way of representing their sounds.

‘Base provided’ sentences, inflected words, with -s: (mease) meases, (pluse) pluses, (ploze) plozes, (coize) coizes, with -ed: (jaise) jaised, (drease) dreased, (oze) ozed, (wuze) wuzed.

Derived words, with -y: (kaise) kaisy, (glise) glisy, (boze) bozy, (fruze) fruzy; with -er: (taise) taiser, (hise) hiser, (moize) moizer, (woze) wozer. ‘Copy word’ sentences, inflected words, with -s: (zoses) zoses, (oises) oises, (fizes) fizes, (reazes) reazes, with -ed: (chised) chised, (steesed) steesed, (bazed) bazed, (neazed) neazed. Derived words, with -y: (thaisy) thaisy, (toosy) toosy, (tazy) tazy, (moozy) moozy; with -er: (beaser) beaser, (cluser) cluser, (pazer) pazer, (bleezer) bleezer. ‘Pseudoclue’ sentences, inflected words, with -s: (noses) jises, (roses) doises, (dozes) bizes, (sizes) foozes, with -ed: (pleased) mosed, (closed) preased, (amazed) truzed, (sneezed) fozed. Derived words, with -y: (busy) naisy, (easy) nisy, (breezy) foizy, (lazy) wuzy; with -er: (loser) keaser, (laser) voser, (buzzzer) aizer, (bulldozer) drazer.
Study 2: Tasks of Morphological Awareness

First practice item of each task shows full analogy format. Subsequent items show sentence frame, followed by Puppet 1 target word, Puppet 2 response, Puppet 1 target, Child response.

Plurals

Practice analogies.

a. I want to see the big mountain. I want to see the big mountains.
   
   I want to see the big hill. ____________________________.

b. Look at the _______ over there. (children - child, trees - ?)

Test analogies.

1. I found the pretty _______ in the woods. (leaf - leaves, box - ?)
2. I like the _______ from next door. (cat - cats, mouse - ?)
3. The _______ cooked a cake. (women - woman, boys - ?)
4. I hurt my _______ on the way here. (feet - foot, teeth - ?)

Verbs

Practice analogies

a. I talk to my friends. I talked to my friends.
   
   I play with my friends. ____________________________.

b. I ______ a bird in the tree. (heard - hear, saw - ?)

Test analogies

1. He ______ a long way. (walks - walked, runs - ?)
2. Jane ______ the ball over the wall. (threw - throws, kicked - ?)
3. The dog ________ the chair. (scratched – is scratching, chased - ?)
4. Bob _________ the ball to Anne. (gives - gave, sings - ?)
**Nouns**

*Practice analogies:*

a. teacher teach  
b. reading reader  

1. act  actress  
   singer ______  cooking ______  dance ______

2. runner run  
3. ballerina ballet  
4. serve servant  
   cyclist ______  musician ______*  build ______

*musician-music involves two noun forms, because we could not find another type of word-ending. However, it still tests the ability to manipulate grammatically appropriate noun endings.

**Adjectives**

*Practice analogies:*

a. wonder wonderful  
b. luck lucky  

1. wooden wood  
   fame ______  hope ______  dirty ______

2. happiness happy  
3. warm warmth  
4. danger dangerous  
   strength ______  high ______  colour ______
References


*Reading and Writing, 9*, 427-449.


Table 1

*Mean Proportion of ‘s’ and ‘z’ Spellings Used Appropriately by Better and Poorer Spellers and Overall, for Base, Derived, and Control words.*

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Spelling required</th>
<th>Poorer spellers (n=38)</th>
<th>Better spellers (n=36)</th>
<th>Overall (n=74)</th>
<th>Overall, ‘s’ &amp; ‘z’ combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>‘s’</td>
<td>0.66 (0.35)</td>
<td>0.92 (0.14)</td>
<td>0.78 (0.30)</td>
<td>0.74 (0.22)</td>
</tr>
<tr>
<td></td>
<td>‘z’</td>
<td>0.54 (0.35)</td>
<td>0.84 (0.23)</td>
<td>0.69 (0.33)</td>
<td></td>
</tr>
<tr>
<td>Derived</td>
<td>‘s’</td>
<td>0.45 (0.38)</td>
<td>0.81 (0.18)</td>
<td>0.62 (0.35)</td>
<td>0.67 (0.21)</td>
</tr>
<tr>
<td></td>
<td>‘z’</td>
<td>0.63 (0.34)</td>
<td>0.82 (0.23)</td>
<td>0.72 (0.31)</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>‘s’</td>
<td>0.39 (0.34)</td>
<td>0.76 (0.22)</td>
<td>0.57 (0.34)</td>
<td>0.61 (0.20)</td>
</tr>
<tr>
<td></td>
<td>‘z’</td>
<td>0.54 (0.33)</td>
<td>0.76 (1.57)</td>
<td>0.65 (0.32)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Standard deviations in parentheses.
Table 2

Children’s Consistency in Representing /z/ in Derived Words (Maximum=444) when they Spelled the /z/ of the Base Words Appropriately or Inappropriately with ‘s’ and ‘z’

<table>
<thead>
<tr>
<th>Spelling of /z/ in Base words</th>
<th>Total number of these spellings</th>
<th>Number of times Base spelling kept consistent in Derived form</th>
<th>Example</th>
<th>Proportion of times Base spelling kept consistent in Derived form</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘s’ appropriate</td>
<td>348</td>
<td>251</td>
<td>noise-noisy</td>
<td>0.72</td>
</tr>
<tr>
<td>‘z’ for ‘s’</td>
<td>83</td>
<td>55</td>
<td>noize-noizy</td>
<td>0.66</td>
</tr>
<tr>
<td>‘z’ appropriate</td>
<td>306</td>
<td>254</td>
<td>fizz-fizzy</td>
<td>0.83</td>
</tr>
<tr>
<td>‘s’ for ‘z’</td>
<td>113</td>
<td>57</td>
<td>fis-fissy</td>
<td>0.50</td>
</tr>
</tbody>
</table>
Table 3

*Correlations Between Children’s Chronological and Spelling Ages, Spelling Consistency, and Measures of Morphological Awareness.*

<table>
<thead>
<tr>
<th></th>
<th>Chron. age</th>
<th>Spelling age</th>
<th>Spelling consistency</th>
<th>Sentence analogy</th>
<th>Base-extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chron. age</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spelling age</td>
<td>0.30*</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spelling consistency</td>
<td>0.27*</td>
<td>0.52**</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentence analogy</td>
<td>0.19</td>
<td>0.47**</td>
<td>0.29*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base-extraction</td>
<td>0.09</td>
<td>0.42**</td>
<td>0.16</td>
<td>0.39**</td>
<td>--</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01
Table 4

*Regression Analysis for the Number of Consistent Spellings of /z/ in Base-Derived Pairs, with Variables Entered in two Fixed Orders.*

<table>
<thead>
<tr>
<th>Order entered</th>
<th>Outcome measure</th>
<th>( r^2 ) change</th>
<th>( B )</th>
<th>S.E. ( B )</th>
<th>beta</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Step 1</td>
<td>Chronological age</td>
<td>0.072*</td>
<td>0.029</td>
<td>0.025</td>
<td>0.122</td>
</tr>
<tr>
<td></td>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spelling age</td>
<td>0.214**</td>
<td>0.059</td>
<td>0.015</td>
<td>0.459</td>
</tr>
<tr>
<td></td>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analogy score</td>
<td>0.002</td>
<td>0.081</td>
<td>0.168</td>
<td>0.055</td>
</tr>
<tr>
<td>B. Step 1</td>
<td>Chronological age</td>
<td>0.072*</td>
<td>0.029</td>
<td>0.025</td>
<td>0.122</td>
</tr>
<tr>
<td></td>
<td>Step 2</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analogy score</td>
<td>0.061*</td>
<td>0.081</td>
<td>0.168</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spelling age</td>
<td>0.155**</td>
<td>0.059</td>
<td>0.015</td>
<td>0.459</td>
</tr>
</tbody>
</table>

* \( *p < 0.05, \**p < 0.01 *
Table 5

*Mean Proportion of Times that the Representation of /z/ in the Clue/Pseudoclue was Retained in the Experimental Pseudowords, by Poorer Spellers, Better Spellers, and Overall.*

<table>
<thead>
<tr>
<th>Sentence type and Word type</th>
<th>Spelling provided in clue</th>
<th>Poorer spellers (n = 36)</th>
<th>Better spellers (n = 39)</th>
<th>Overall (n = 75)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Provided</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflected</td>
<td>s</td>
<td>0.80 (0.32)</td>
<td>0.92 (0.15)</td>
<td>0.86 (0.25)</td>
</tr>
<tr>
<td></td>
<td>z</td>
<td>0.77 (0.31)</td>
<td>0.90 (0.17)</td>
<td>0.83 (0.25)</td>
</tr>
<tr>
<td>Derived</td>
<td>s</td>
<td>0.75 (0.32)</td>
<td>0.89 (0.25)</td>
<td>0.82 (0.29)</td>
</tr>
<tr>
<td></td>
<td>z</td>
<td>0.80 (0.31)</td>
<td>0.84 (0.23)</td>
<td>0.82 (0.27)</td>
</tr>
<tr>
<td><strong>Copy Word</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflected</td>
<td>s</td>
<td>0.77 (0.31)</td>
<td>0.89 (0.23)</td>
<td>0.83 (0.28)</td>
</tr>
<tr>
<td></td>
<td>z</td>
<td>0.80 (0.29)</td>
<td>0.90 (0.20)</td>
<td>0.85 (0.25)</td>
</tr>
<tr>
<td>Derived</td>
<td>s</td>
<td>0.79 (0.34)</td>
<td>0.84 (0.23)</td>
<td>0.82 (0.29)</td>
</tr>
<tr>
<td></td>
<td>z</td>
<td>0.81 (0.27)</td>
<td>0.91 (0.20)</td>
<td>0.86 (0.24)</td>
</tr>
<tr>
<td><strong>Pseudoclue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflected</td>
<td>s</td>
<td>0.45 (0.36)</td>
<td>0.41 (0.28)</td>
<td>0.43 (0.31)</td>
</tr>
<tr>
<td></td>
<td>z</td>
<td>0.48 (0.36)</td>
<td>0.44 (0.28)</td>
<td>0.46 (0.32)</td>
</tr>
<tr>
<td>Derived</td>
<td>s</td>
<td>0.38 (0.29)</td>
<td>0.40 (0.31)</td>
<td>0.39 (0.30)</td>
</tr>
<tr>
<td></td>
<td>z</td>
<td>0.49 (0.32)</td>
<td>0.60 (0.26)</td>
<td>0.55 (0.30)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations in parentheses.
Table 6

*Mean Proportions of Words Correctly Transformed in Tasks of Morphological Awareness, by Poorer and Better Spellers, and Overall. Standard Deviations in Parentheses.*

<table>
<thead>
<tr>
<th>Analogy Type</th>
<th>Poorer spellers</th>
<th>Better spellers</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 36)</td>
<td>(n = 39)</td>
<td>(n = 75)</td>
</tr>
<tr>
<td><strong>Sentence analogies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plurals</td>
<td>0.81 (0.19)</td>
<td>0.92 (0.17)</td>
<td>0.86 (0.19)</td>
</tr>
<tr>
<td>Verbs</td>
<td>0.59 (0.78)</td>
<td>0.85 (0.18)</td>
<td>0.73 (0.26)</td>
</tr>
<tr>
<td>Combined</td>
<td>0.70 (0.20)</td>
<td>0.89 (0.13)</td>
<td>0.80 (0.19)</td>
</tr>
<tr>
<td><strong>Word analogies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nouns</td>
<td>0.54 (0.29)</td>
<td>0.76 (0.22)</td>
<td>0.65 (0.28)</td>
</tr>
<tr>
<td>Adjectives</td>
<td>0.47 (0.25)</td>
<td>0.51 (0.20)</td>
<td>0.49 (0.23)</td>
</tr>
<tr>
<td>Combined</td>
<td>0.50 (0.21)</td>
<td>0.63 (0.18)</td>
<td>0.57 (0.20)</td>
</tr>
<tr>
<td>Overall</td>
<td>0.60 (0.18)</td>
<td>0.76 (0.13)</td>
<td>0.68 (0.17)</td>
</tr>
</tbody>
</table>
Table 7

Correlations Between Children’s Chronological and Spelling Ages, Performance on the Sentence and Word Analogy Tasks, and Correct Spelling of /z/ for Inflected and Derived Pseudowords in ‘Base provided’ and ‘Copy word’ Sentence Contexts.

<table>
<thead>
<tr>
<th>Analogy Type</th>
<th>Chron. age</th>
<th>Spell. age</th>
<th>Inflected pseudoword</th>
<th>Derived pseudoword</th>
<th>Inflected pseudoword</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Correct letter provided in sentence contexts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Base provided</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chron. age</td>
<td>--</td>
<td>0.26*</td>
<td>0.24*</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Spell. age</td>
<td>0.33**</td>
<td>--</td>
<td>0.26*</td>
<td>0.23*</td>
<td>0.25*</td>
</tr>
<tr>
<td>Sentence Plurals</td>
<td>0.08</td>
<td>0.25*</td>
<td>0.24*</td>
<td>0.17</td>
<td>0.16</td>
</tr>
<tr>
<td>analogies Verbs</td>
<td>0.23*</td>
<td>0.41**</td>
<td>0.35**</td>
<td>0.34**</td>
<td>0.17</td>
</tr>
<tr>
<td>Combined</td>
<td>0.20</td>
<td>0.45**</td>
<td>0.36**</td>
<td>0.32**</td>
<td>0.20</td>
</tr>
<tr>
<td>Word Adjs</td>
<td>0.08</td>
<td>0.17</td>
<td>0.16</td>
<td>0.30**</td>
<td>0.07</td>
</tr>
<tr>
<td>analogies Nouns</td>
<td>0.14</td>
<td>0.43**</td>
<td>0.29*</td>
<td>0.31**</td>
<td>0.39**</td>
</tr>
<tr>
<td>Combined</td>
<td>0.15</td>
<td>0.42**</td>
<td>0.29*</td>
<td>0.39**</td>
<td>0.31**</td>
</tr>
<tr>
<td>Analogies overall</td>
<td>0.19</td>
<td>0.49**</td>
<td>0.37**</td>
<td>0.40**</td>
<td>0.29*</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01
Table 8


<table>
<thead>
<tr>
<th>Variable and step</th>
<th>‘Base provided’ sentences</th>
<th>‘Copy word’ sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r^2$ chge</td>
<td>$B$</td>
</tr>
<tr>
<td>1. Chron. age</td>
<td>0.066*</td>
<td>0.043</td>
</tr>
<tr>
<td>2. Spelling age</td>
<td>0.035</td>
<td>0.004</td>
</tr>
<tr>
<td>3. Sent. an. score</td>
<td>0.070*</td>
<td>0.281</td>
</tr>
</tbody>
</table>

Outcome: /z/ correct in inflected pseudowords

Variable and step

1. Chron. age     | 0.055*     | 0.055| 0.036 | 0.176 | 0.001     | 0.003| 0.032 | 0.011 |
| 2. Spelling age  | 0.026      | 0.002| 0.008 | 0.027 | 0.004     | -0.002| 0.007 | -0.030 |
| 3. Word. an. score| 0.100**  | 0.396| 0.134 | 0.348 | 0.047     | 0.225| 0.120 | 0.238 |

**p<0.01, *p<0.05