Spelling Pronunciation and Visual Preview both Facilitate Learning to Spell Irregular Words

Maartje Hilte
Pieter Reitsma

PI Research—Vrije Universiteit, Amsterdam

Spelling pronunciations are hypothesized to be helpful in building up relatively stable phonologically underpinned orthographic representations, particularly for learning words with irregular phoneme-grapheme correspondences. In a four-week computer-based training, the efficacy of spelling pronunciations and previewing the spelling patterns on learning to spell loan words in Dutch, originating from French and English, was examined in skilled and less skilled spellers with varying ages. Reading skills were taken into account. Overall, compared to normal pronunciation, spelling pronunciation facilitated the learning of the correct spelling of irregular words, but it appeared to be no more effective than previewing. Differences between training conditions appeared to fade with older spellers. Less skilled young spellers seemed to profit more from visual examination of the word as compared to practice with spelling pronunciations. The findings appear to indicate that spelling pronunciation and allowing a preview can both be effective ways to learn correct spellings of orthographically unpredictable words, irrespective of age or spelling ability.

Key Words: Children, loan words, orthography, reading, spelling, spelling pronunciation, training

INTRODUCTION

The main issue in spelling is that one must know how to translate spoken language into written language. Generally, less skilled spellers attempt to translate every phoneme into a corresponding grapheme because their orthographic memory for letter patterns and sequences is weak. However, phonemes cannot always be matched directly to a sequence of corresponding graphemes, especially in English and French irregular words. One possible way to assist spellers with learning phoneme-grapheme complexity is to use an artificial pronunciation based on the letter sequence of the word spelling, a so-called

spelling pronunciation. For example, the spelling pronunciation of the word "Wednesday" could be pronounced as /wed-nes-day/ instead of its normal pronunciation /wenzde/. This strategy may be beneficial for several reasons. First of all, pronouncing every letter in each syllable of a word may help by dividing the word into more regular parts and by establishing a firm phoneme-grapheme relation (Holmes & Ng, 1993). Second, the strategy of spelling pronunciation can function as a kind of mnemonic because the correct spelling of a word is memorized more easily when the irregular bonding between sound and letters is transformed into a more regular relation (Searleman & Herrmann, 1994). Hence, the pronunciation of every distinct grapheme helps the graphemes to function as sound symbols in lexical memory (Drake & Ehri, 1984).

However, it can also be argued that spelling pronunciation is not a beneficial strategy at all, especially for poor spellers because of their well-known phonological difficulties. Using spelling pronunciation relies heavily, after all, on phonological skills such as memorizing every distinct phoneme that is explicitly pronounced or storing unfamiliar sound sequences in short-term memory. Visual-spelling patterns or orthographic cues may instead be more relevant to poor spellers (Rack, Snowling, & Olson, 1992; Siegel, Share, & Geva, 1995). Also, one could suggest that age is an important factor in determining the effects of spelling pronunciation. Because older spellers may be relatively more focused on visual-spelling patterns, the effects of exercises with spelling pronunciation may have differential effects for younger and older spellers. Therefore, the aim of the present study is to systematically compare the effects of spelling pronunciation for skilled and less skilled spellers, and for different age groups.

Several researchers contend that spelling pronunciation is a very effective strategy to improve spelling ability. Ormrod and Jenkins (1989) analyzed the effect of seven distinct strategies that most students use while trying to remember the spelling of difficult words. The strategy of spelling pronunciation appeared to be the most effective method to learn the correct spelling. Spelling pronunciation was especially effective for skilled spellers. This finding is supported by others, who argue that poor spellers rarely come up with strategies themselves, suggesting that they are less likely to adopt a spelling pronunciation strategy on their own (Drake & Ehri, 1984). And when they actually do adopt a spelling pronunciation strategy, they often form incorrect spelling pronunciations, which are generally misleading and rarely bring about the correct spelling (Holmes & Malone, 2004). This particular problem can easily be solved by using explicit instructions on spelling pronunciation or by simply providing these artificial (spelling) pronunciations (Graham, 1999; Graham, Harris, & Chorzempa, 2002). Further empirical evidence showed that providing spelling pronunciations was more effective than providing standard pronunciation to spellers in both normal and special education (Hilte, Bos, & Reitsma, 2005; Schiffelers, Bosman, & van Hell, 2002).

In contrast, Thaler, Landerl, and Reitsma (2006) studied the effect of spelling pronunciation extensively, and showed that spelling pronunciation turned out not to be helpful at all. In four different studies, it was examined whether pronunciation of silent phonemes in German words (e.g., pronouncing explicitly the /h/ in the German word *bahn* instead of its standard pronunciation /ban/) would produce a phonological code that would promote correct spelling by poor spellers. Various types of German words were presented: long vowel words, short vowel words followed by a doubled consonant, and words including a silent h. The spelling of the word was simultaneously presented with the phonological stimuli, either the spelling pronunciation or standard pronunciation, and the targeted grapheme was visually highlighted in both conditions. Participants were both skilled and less skilled spellers from Grades 2 and 3. No significant beneficial effect of spelling pronunciation compared to normal pronunciation was found, not even in the last and most carefully designed study. Nor were differences between skilled and less skilled spellers found. The experimenters (Thaler, Landerl, & Reitsma, 2006) compared their study to another study (Landerl, Thaler, & Reitsma, 2006) in which they did find an effect for spelling pronunciation. These differences can be understood by a difference in stimuli used in the training. Landerl and collegues (2006) did find a beneficial effect of spelling pronunciation when they used words of foreign (mostly English) origin, so-called loan words, which had an extremely irregular spelling compared to the relatively regular spelling in German. Moreover, all other studies that did find a beneficial effect for spelling pronunciation used English words or loan words as stimuli, too (Drake & Ehri, 1984; Holmes & Malone, 2004, Ormrod & Jenkins, 1989; Schiffelers, Bosman, & van Hell, 2002). Similarly, Hilte, Bos, and Reitsma (2005) found in an item-analysis that the words from French or English origin did profit more from spelling pronunciation than Dutch words that had only small deviations from transparent spelling. Thus, inconsistencies in findings for the effects of spelling pronunciation during training may well be related to differences in the degree of transparency in words. Spelling pronunciation is beneficial, especially with words that deviate significantly in terms of regular phoneme-grapheme correspondences. Therefore, in the present study, only loan words are used in order to determine the effects of spelling pronunciation.

Another important variable that might contribute to different findings is a difference in design. As noted by Hilte, Bos, and Reitsma (2005), the study of Landerl, Thaler, and Reitsma (2006) in which spelling pronunciation appeared to be effective, provided no visual-spelling patterns when spelling (or normal) pronunciation was presented. In contrast, in the study (Thaler, Landerl, & Reitsma, 2006), in which no effect of spelling pronunciation was found, visual-spelling patterns were presented simultaneously to the phonological information. Hilte, Bos, and Reitsma (2005) argued that these visual-spelling

patterns might have overruled the phonological information, and hence no effect of spelling pronunciation was visible. They, therefore, investigated the effect of spelling pronunciation once again in an improved design. To disentangle the effects of spelling pronunciation from the effect of providing visual-spelling patterns at the same time, the effect of spelling pronunciation was not only compared to the effect of standard pronunciation, but also to an effect of merely presenting visual-spelling patterns. Confounding of the effects of visual-spelling patterns with those of phonological information, either spelling or standard pronunciation was hence not possible in this design, because no visual-spelling patterns were presented simultaneously to phonological information. It appeared that providing spelling pronunciations was more effective than providing standard pronunciations. Explicit cueing of spelling pronunciation was, however, as effective as allowing a preview of the word. Apparently, the process involved when presenting spelling pronunciations may have led to relatively stable knowledge about the specific orthographic patterns of the words that are trained. Both spelling pronunciations and information on visual-spelling patterns can help poor spellers to spell specific words. However, the previous study did not systematically compare age groups or contrast normal versus poor spellers. Therefore, in the current study, we aim to extend the recent findings (Hilte, Bos, & Reitsma, 2005) on the efficacy of spelling pronunciations on both skilled and less skilled spellers with varying ages.

Younger spellers are less informed about language structure and have less consolidated concepts of words. Their orthographic knowledge is less automatic than that of older children. Analyses of error-types have shown that children shift from concrete phonemic analysis to a more abstract linguistic representation in the orthography (Notenboom & Reitsma, 2003; Schlagal, 2001). The development of spelling proficiency is a continuous process reflecting gradual changes in children's use of phonological and orthographic information (Ehri, 1992; Notenboom & Reitsma, 2003). In more transparent languages like Dutch, spelling instruction in Grade 1 typically involves the spelling of phonologically regular words. But soon, more irregular words, in terms of transparency, are introduced in Dutch spelling instruction (Landerl & Reitsma, 2005; Notenboom & Reitsma, in press; Reitsma & Verhoeven, 1990). The results of several studies suggest that after acquisition of the alphabetic principle, learning to spell in Dutch involves a continuous accumulation of different segments of orthographic knowledge. Because of these changes, different effects of visual-spelling or phonological cues in spelling instruction may occur between various grades. The current experiment, therefore, studies the effect of providing phonological and visual-spelling information during practice in spelling in three different grades. Grade 3 children (who commonly have less control of orthographic information) may benefit more from phonological cues, whereas Grade 5 and 6 children (who have more orthographic information) may profit more from

visually presented spelling information. In other words, spelling pronunciation might be more effective in younger spellers.

Further, differences between various ages in the effect of spelling pronunciation have rarely been studied. Several studies investigated the effect of spelling pronunciation in older spellers only, Grades 5 or 6, or students (Hilte, Bos, & Reitsma, 2005; Holmes & Malone, 2004; Landerl, Thaler, & Reitsma, 2006; Ormrod & Jenkins, 1989). Among other studies focused on younger children, only Thaler, Landerl, and Reitsma (2006) addressed beginning spellers.

Considering the well-known phonological deficits of poor spellers, spelling pronunciations might be more beneficial for skilled spellers than for less skilled spellers. On the other hand, because of the phonological deficits of poor spellers, they particularly may need the extra phonological help that spelling pronunciations give. Findings of several studies on the effect of spelling pronunciation on skilled and less skilled spellers are somewhat confusing. In one study, spelling-match spellers (average spellers) benefited more than students with learning disabilities (Bosman, van Hell, & Verhoeven, 2005). In contrast, another study showed that less skilled spellers benefited more than skilled spellers (Drake & Ehri, 1984). In addition, Thaler, Landerl, and Reitsma (2006) showed that less skilled spellers performed equally well as age-adequate spellers in applying the spelling pronunciation technique. Therefore, to better understand the effects of spelling pronunciation, differences between skilled and less skilled spellers were studied in the present training experiment.

Interestingly, spelling skills are generally highly correlated with reading skills, mostly varying from .50 and .80 (Frith, 1980). However, correlations appeared to be considerably lower in less skilled readers and spellers (Ehri, 2000; Greenberg, Ehri, & Perin, 1997). Spelling requires the production, rather than the recognition, of a visual-spelling pattern, and is consequently more difficult. Reading partial cues often suffice to identify a word (Holmes & Ng, 1993), but in spelling, knowledge about the exact pattern of sound-letter correspondences and the specific orthographic details is required. Children who experience difficulties in developing well-specified visual-spelling representations may be relatively skilled readers but less skilled spellers. These children cannot process nor remember all detailed orthographic knowledge when they are exposed to written words. Thus, reading and spelling skills are not always strongly related. The effects, then, of spelling pronunciation and visual-spelling patterns in spelling exercises may well be different for both spelling level and reading level. Consequently, in this study, reading skills are also taken into account. It can be argued that skilled readers are relatively more skilled in transferring orthographic knowledge, acquired from reading, into the more active spelling processes. A training with visual-spelling patterns as cues is, therefore, expected to be especially helpful for skilled readers. Less skilled readers, on the other hand, would seem to profit most

from practice with spelling pronunciations, because spelling pronunciations actively help them to process every distinct grapheme.

In summary, in the current study. we aimed to extend the recent findings on the effect of spelling pronunciations in loan words on skilled and less skilled spellers of varying ages (Grades 3, 5, and 6), while taking reading skills into account. In order to find more detailed information on the effect of practice with spelling pronunciations, the effect was not only compared to practice with normal pronunciations, but also to training in which visual-spelling patterns were presented.

METHOD

PARTICIPANTS

A total of 184 Dutch children, 93 boys and 91 girls, from Grades 3, 5, and 6 of six primary schools participated in the study. All students' primary language was Dutch. Prior to the experiment, spelling skills were determined by means of a Dutch standardized spelling test (Cito, 2003). Whole classes participated and no children were excluded. As a result, spelling ability could vary from very poor to very good, relative to the published norms. For the purpose of the present study, however, children were divided into two groups relative to the 50th percentile of the norm: less skilled spellers and skilled spellers. A total of 89 third grade spellers (31 were classified as less skilled, 58 were classified as skilled), 43 fifth grade spellers (22 less skilled, and 21 skilled), and 52 sixth grade spellers (24 less skilled, and 28 skilled) participated in this study. The mean age was 8 years, 11 months for the Grade 3 participants, 11 years for the Grade 5 participants, and 12 years, 3 months for the Grade 6 participants. Although we did not use further diagnostic measures, it is possible that among the less skilled spellers there were a few dyslexics. For example, the number of children that scored below the 15th percentile of the spelling test was 30.

Reading level was assessed by means of a standardized test for reading-decoding (Brus & Voeten, 1972). This reading test consists of a list of unrelated words. Participants had to read correctly as many words as possible in one minute of time. The score of the test was based on the number of words read correctly. Two parallel versions of the test were administered and average scores of both versions were used in further analyses.

TRAINING PROCEDURE AND MATERIALS

In order to provide the spelling exercises, an attractive multimedia program was developed for children and was installed on the computers of all participating schools. Word stimuli appeared in the middle of the screen in a font similar to the fonts used in schoolbooks. Digitized speech was used to present the words auditorily, depending on the type of exercise (condition). On top of the screen, an instruction text appeared to make sure that it was clear what the participants had to do. On the lower part of the screen, a button on the left could be

clicked to repeat the pronunciation of the word, if necessary an infinite number of times. A button on the right could be clicked to repeat the instruction for a more extensive explanation. A button on the right side of the middle of the screen was used to proceed to the next trial during the exercises. On the top corner, the children could see how many items they had to do before they would finish.

A list of 24 so-called loan words, originating from the English and French languages, was selected. Almost all the words used are normally taught in Grade 6 or beyond. All words had a relatively high irregular phoneme-grapheme relation. Dutch spelling rules are insufficient to arrive at the correct spelling, and knowledge of the spelling of the words could not be generalized to other words.

A total of six words were practiced by presenting the visual-spelling pattern, six words were practiced by presenting spelling pronunciation, and six words were practiced by presenting normal pronunciation. The remaining six control words were not practiced at all. Assigning specific words to conditions was varied between participants so that when data were collapsed over subjects, all 24 words appeared in each condition about equally as frequent. In the Appendix, the 24 Dutch loan words, their English translations, their (adult and youth) frequencies, and the spelling pronunciations corresponding to the Dutch language used in this study, are listed. The printed word frequencies of the words in this study are considerably low (Burnage, 1990; Staphorsius, Krom, & de Geus, 1988). All words used in this study occur less than 1,000 times in Dutch adult literacy and less than four times in Dutch youth literacy. As a comparison, a common, and relatively frequent word like *brood* (bread) occurs 2,616 times in a text specifically for adults and 43 times in a text specifically for children from 7 to 12. Effects of word frequencies on differential training effects were taken into account in further analyses. Although we did not individually test whether the words were known, it was assumed that most words were known auditorily. If the children indicated that they did not know the meaning of a word, the experimenter explained the meaning during the first dictation task. In order to further minimize any unlikely confusion about the meaning of the words, a picture representing the word was presented during all practice conditions, and the words were dictated in sentences in the pre- and posttests.

DESIGN AND PROCEDURE

A within-subjects design was used: all 184 children who participated in the training program received all three training conditions. But also, all words were practiced in every condition (spelling exercise), though varied over subjects. In each session within the computer program, the words were presented in a different order.

Prior to the training sessions, all 24 words were dictated and this dictation test served as a pretest in order to know the spelling level of the participants before the training program. Within the dictation test,

all words, including the control words, were randomized. Words were dictated within a sentence first and subsequently repeated separately. Children had to try to write down the words correctly with paper and pencil. When the dictation test was completed, the experimenter provided an explanation to the children about how to practice with the multimedia training program. A reading test was administered individually.

During the following four weeks, the children had to practice independently six sessions with the training program. Children practiced about twice a week, and never more than once a day. Each training session consisted of 18 words that had to be practiced. Because three types of spelling exercises were used, six words were practiced in every condition. The following three spelling exercises were evaluated.

1. *Visual preview*: The spelling of a word is presented in the middle of the screen. Thus, the children could examine the visual-spelling pattern of a word. A picture that represents the meaning of the word is presented on the left side of the screen. The child has to scrutinize the spelling. After the child thinks how to spell the word, the continuation button is pressed and the word disappears. The child then has to type the word by heart in a text box in the middle of the screen. After pressing the continuation button once again, the program gives feedback: the program shows the child's spelling in green with a curl (for correct) or in red (for incorrect) with a cross. The proper spelling is presented in a green color just above the typed word.

2. *Spelling pronunciation*: The general format and procedure of this exercise is similar to the one described before. The difference is that instead of the visual-spelling information, phonological information on the word is presented. The word is spoken twice on the computer. When the normal pronunciation is given, the spelling pronunciation of the word follows. A button could be clicked to repeat the latter pronunciation. After the child thinks how to spell the word, the continuation button is pressed and the child has to type the correct spelling by heart.

3. *Normal pronunciation*: The general format and procedure of this exercise is again similar to the one described before. Instead of hearing the spelling pronunciation in this spelling exercise, a normal pronunciation of the word to be spelled is presented twice auditorily.

After the children had completed six training sessions, a posttest was administered. The posttest consisted of a similar dictation test as in the pretest. One month after the posttest, the same dictation test was administered again as a test for retention. For each word in pretest, posttest, and retention test, it was determined whether the

spelling was completely correct or not. The number of words that were spelled correctly was analyzed in order to determine the effect of the three training conditions compared to the control condition and to each other.

RESULTS

Differential effects of the various training conditions were established by comparing the number of words that were spelled correctly before, directly after training, and a month after training for each of the three training conditions. The mean percentage of correctly spelled words for all conditions over time is shown in Figure 1, and separately for each grade in Table I. As is clear from both the figure and the table, in the direct posttest, the percentage of words that were spelled correctly substantially increased as a result of training, and tended to diminish a little bit from posttest to retention test. As is clear from Table I, differences between effects of the three training conditions diminish and even disappear as children grow older.

First, overall statistical analyses (subject-analysis, F_1, and an item-analysis, F_2) on the data of all children showed that the main effects, training condition (visual preview, spelling pronunciation, normal pronunciation, and control condition) $F_1(3,525) = 99.48$, $p < .001$, $\eta_p^2 = .36$, $F_2(3,69) = 62.82$, $p < .001$, $\eta_p^2 = .73$, and time (before, directly after,
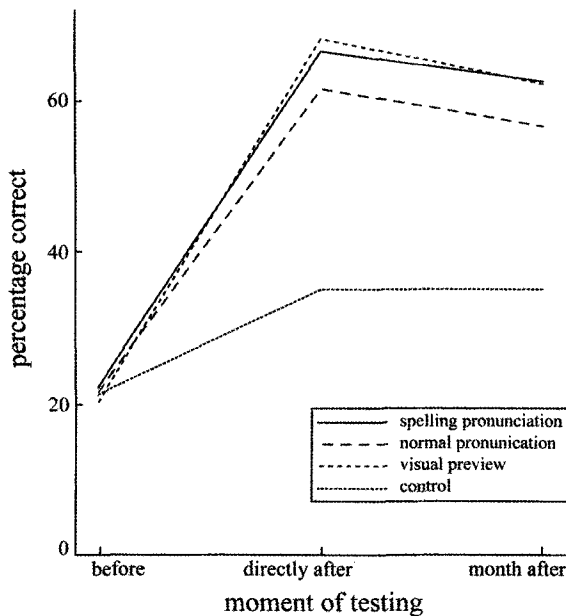

Figure 1. Mean accuracy (% correct) of practice and control words before, directly after, and a month after training as a function of practice condition.

Table 1. Percentage of correctly spelled words as a function of time and testing and grade level.

	Percentage Words Spelled Correctly		
	Before	Directly After	Month After
Grade 3			
Spelling pronunciation	3.7	49.6	45.1
Normal pronunciation	3.0	44.2	37.8
Visual preview	3.0	52.8	42.9
Control	4.9	10.3	10.9
Grade 5			
Spelling pronunciation	22.1	70.5	66.7
Normal pronunciation	15.9	62.8	56.6
Visual preview	19.0	72.9	67.4
Control	19.0	35.7	33.7
Grade 6			
Spelling pronunciation	42.6	86.2	82.4
Normal pronunciation	47.1	84.6	81.7
Visual preview	39.7	85.3	81.4
Control	42.3	61.9	64.1

and a month after) $F_1(2,350) = 785.35$, $p < .001$, $\eta_p^2 = .82$, $F_2(2,46) = 263.25$, $p < .001$, $\eta_p^2 = .92$ were significant. In addition, the interaction effect between training condition and time was significant, $F_1(6,1068) = 66.72$, $p < .001$, $\eta_p^2 = .27$, $F_2(6,138) = 61.47$, $p < .001$, $\eta_p^2 = .73$. This interaction effect was mainly found due to a training effect, as indicated by a difference between the three training conditions and the control condition, $F_1(1,178) = 115.72$, $p < .001$, $\eta_p^2 = .39$, $F_2(1,23) = 66.02$, $p < .001$, $\eta_p^2 = .74$. Further contrast analyses showed that a spelling pronunciation training is significantly more effective than a normal pronunciation training, $F_1(1,178) = 4.77$, $p < .05$, $\eta_p^2 = .03$, $F_2(1,23) = 10.93$, $p < .005$, $\eta_p^2 = .32$. And visual preview also appeared to be a more effective practice method compared to a normal pronunciation training, $F_1(1,178) = 9.74$, $p < .005$, $\eta_p^2 = .05$, $F_2(1,23) = 5.96$, $p < .05$, $\eta_p^2 = .21$. No significant difference was found between practicing with spelling pronunciations and practicing with visual preview, $F_1(1,178) = 0.54$, $F_2(1,23) = 0.47$ (see Figure 1).

Secondly, an interaction between training condition, time, grade, and spelling skills shows that different effects were found across the various ages and the different spelling levels, $F_1(12,1068) = 2.08$, $p < .05$, $\eta_p^2 = .02$. Because the aim of this study explicitly focused on effects within grades, and differences between less skilled and skilled spellers, for each grade separately, results are further analyzed by focusing on each grade. Main effects, training condition, and time were significant

in all grades separately (Grades 3, 5, and 6) for condition, respectively, $F_1(3,261) = 66.08$, $p < .001$, $\eta_p^2 = .43$, $F_1(3,123) = 27.05$, $p < .001$, $\eta_p^2 = .40$, $F_1(3,150) = 20.91$, $p < .001$, $\eta_p^2 = .30$, and for time respectively, $F_1(2,174) = 286.50$, $p < .001$, $\eta_p^2 = .68$, $F_1(2,82) = 264.48$, $p < .001$, $\eta_p^2 = .87$, $F_1(2,100) = 250.76$, $p < .001$, $\eta_p^2 = .83$. Additionally, an interaction effect between training condition and time is found for each grade, for Grades 3, 5, and 6, respectively, $F_1(6,522) = 50.46$, $p < .001$, $\eta_p^2 = .37$, $F_1(6,246) = 19.49$, $p < .001$, $\eta_p^2 = .32$, $F_1(6,300) = 10.60$, $p < .001$, $\eta_p^2 = .18$.

In contrast, only in Grade 3 was an interaction effect between training condition, time, and spelling skills found, $F_1(6,522) = 4.27$, $p < .001$, $\eta_p^2 = .05$. This interaction effect shows that training conditions differ in effect for skilled and less skilled spellers. The mean percentage of correctly spelled words for all conditions over time for less skilled and skilled spellers in Grade 3, respectively, are represented in Figure 2 and Table II. As the figure and the table show, less skilled spellers (left figure) profit most from visual preview, whereas skilled spellers (right figure) profit most from a training that provides spelling pronunciations. Interaction effects between training condition and time are significant for both skilled spellers, $F_1(6,342) = 53.76$, $p < .001$, $\eta_p^2 = .49$, and less skilled spellers in Grade 3, $F_1(6,180) = 12.84$, $p < .001$, $\eta_p^2 = .30$. No significant difference is found between the visual preview and the spelling pronunciation condition for less skilled
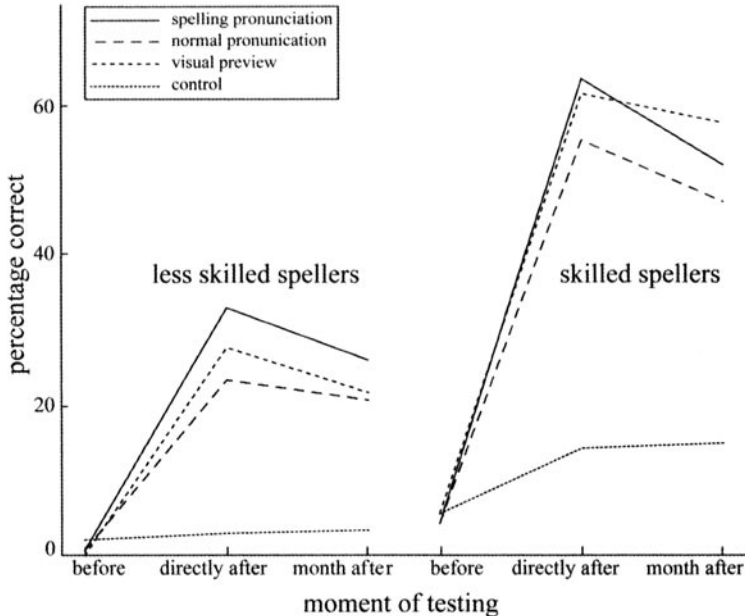

Figure 2. Mean accuracy (% correct) of practice and control words before, directly after, and a month after training as a function of practice condition for less skilled (left) and skilled (right) participants of Grade 3.

Table 2. Percentage of correctly spelled words as a function of time less skilled and skilled spellers from Grade 3.

| | Less Skilled Spellers | | | Skilled Spellers | | |
	before	Directly after	Month after	before	Directly after	Month after
Spelling pronunciation	0	27.4	21.5	5.7	61.5	57.8
Normal pronunciation	0.5	23.1	20.4	4.3	55.5	47.1
Visual preview	0.5	32.8	25.8	4.3	63.5	52.0
Control	2.7	3.2	3.2	6.0	14.1	14.9

spellers, $F_1(1,30) = 0.57$, or for skilled spellers, $F_1(1,57) = 0.90$. The visual preview condition showed itself to be significantly more effective as compared to normal pronunciation in skilled spellers, $F_1(1,47) = 4.13$, $p < .05$, $\eta_p^2 = .07$, and in less skilled spellers of Grade 3, $F_1(1,30) = 6.88$, $p < .05$, $\eta_p^2 = .19$.

Additionally, an item-analysis on all subjects, with condition and time as within subject variables and word frequency as a covariate, showed that differences in word frequencies did not contribute to the interaction effect between condition and time, $F2(6,17) = 1.97$, $p = .13$, $\eta_p^2 = .41$.

Furthermore, we were interested to see whether effects of training in spelling, and in particular, differences between the practice conditions, would be affected by individual differences in reading skills. It was expected that skilled readers are better skilled in transferring orthographic knowledge, acquired from reading, into the more active spelling processes, and may benefit more from visual-spelling patterns than less skilled readers. The Pearson correlation coefficients between reading ability and spelling skill were .60, .62, .73, within Grades 3, 5, and 6, respectively. Thus, these skills have certainly quite some common variance. However, analyses showed that effects of the exercises in spelling were not related at all to reading skill. In particular, there was no indication that differential effects of spelling pronunciation and visual-spelling information during training were related to reading ability.

DISCUSSION

Spelling pronunciation has previously been shown to be an effective strategy for less skilled spellers in Grades 5 and 6 using a similar design to the one employed here. Using visual preview, however, has also been shown to be as effective as a spelling pronunciation training (Hilte, Bos, & Reitsma, 2005). Similar results to these were found in an overall subject analysis. Results in this study show that for irregular words, practice with spelling pronunciations is as beneficial as practice with visual preview, and significantly more effective than practice with normal pronunciation.

From a developmental perspective, it was predicted that the relative effects of various training conditions, with visual or auditory

stimuli, would change across the grades. More specifically, because younger spellers may have less consolidated knowledge of visual-spelling patterns, it was hypothesized that younger spellers would profit more from practice with spelling pronunciations as compared to older spellers. The findings indicate that a gradual shift occurred over time and showed that differences between the three training conditions faded for older spellers. Condition effects diminished and the facilitative effects of spelling pronunciation and visual preview over and above normal pronunciation disappeared in Grade 6. Note that children in Grade 6 spelled a little more than 80% correct in the posttests. The Grade 6 children appeared to profit from practice and feedback on spelling, and they appeared to progress irrespective of the cues they received during practice. It was expected that younger spellers would profit more from spelling pronunciations and normal pronunciations than from visual presentations. However, visual-spelling patterns appeared to be more effective than normal pronunciation in third grade spellers. And the visual study of spellings was as effective as the spelling pronunciation approach. Thus, no particular advantage was found for phonemic training over and above a visual preview training in younger spellers.

Because of well-known phonological deficits in poor spellers, it was furthermore expected that less skilled spellers would profit more from visual preview as compared to skilled spellers. But it could also be argued that less skilled spellers would need some phonological help because of their phonological deficits. If so, practice with spelling pronunciations would have yielded more gain than practice with visual preview for less skilled spellers. Results showed significant differences in effect of the various conditions between skilled and less skilled spellers across ages. No differences between skilled and less skilled spellers in older spellers were found, but younger spellers did show differences with regard to the effects of the various training conditions. Young less skilled spellers benefited considerably more from visual preview whereas young skilled spellers gained slightly more from spelling pronunciations. This result supports the idea that because of their limited phonological skills, at least in the case of irregular spellings, less skilled spellers benefit most from practice with visual-spelling patterns and orthographic clues.

This finding that young less skilled spellers profit most from visual preview as compared to spelling pronunciations provides some new insight into the underlying processes of both of these training types. Hilte, Bos, and Reitsma (2005) found that practice with spelling pronunciations was as effective as practice with visual preview. They argued that the underlying process of the two conditions is one and the same and is exhaustively used in either one. In both conditions, the participants are exposed to the correct spelling, although the modality is different. Spelling pronunciation may function as a primer to generate the correct spelling pattern, particularly for the difficult and/or ambiguous part of the word. Our current findings, in which

the effects of spelling pronunciation and orthographic cues diverge, do not support this conjecture. Both conditions may prime the correct spelling, but apparently spelling pronunciations and visual preview have different effects in young spellers. Although spelling pronunciation practice may be a way to learn spellings of unconventionally structured words generally, visual-orthographic information may provide more useful information for young less skilled spellers. This interaction effect in the youngest group is, however, not a large effect (effect size is small). Further research with young children is needed before strong conclusions can be drawn.

It should be further recalled that the words in this study were all loan words that deviate significantly in terms of regular phoneme-grapheme correspondences. Earlier studies showed a beneficial effect for spelling pronunciation when using English words or loan words as stimuli (Drake & Ehri, 1984; Holmes & Malone, 2004, Ormrod & Jenkins, 1989; Schiffelers, Bosman, & van Hell, 2002). Spelling pronunciation seems to be less effective in Dutch or German words that have only small deviations from orthographic transparency (Hilte, Bos, & Reitsma, 2005; Landerl, Thaler, & Reitsma, 2006). Irregularities are rather uncommon in the Dutch language. In fact, all Dutch words, irrespective of the degree of transparency, can be practiced by providing visual-spelling patterns, while spelling pronunciation may not be very useful in words with regular sound-letter relations. Moreover, providing visual-spelling patterns is even more beneficial as compared to spelling pronunciation in young less skilled spellers. Thus, it could be questioned, as a matter of fact, whether spelling pronunciation should be used as a strategy in a relatively transparent spelling like the Dutch spelling.

The fact that practice with visual-spelling patterns was effective for most participants, especially for less skilled young spellers, gives the impression that reading exercises or reading in general may also have a positive contribution to spelling ability. It should be noted, though, that normal reading is somewhat different from scrutinizing visual-spelling patterns. The question of whether reading skills automatically transfer to spelling skills is unresolved, though long debated. Some research has shown that spelling training programs appear to be beneficial for both reading and spelling ability, whereas reading training programs show considerably small effects on spelling ability (Conrad, 2005). Thus, orthographic knowledge gained in reading does not always transfer to spelling (Conrad, 2005; Fletcher-Flinn, Shankweiler, & Frost, 2004). In ordinary reading, people do not need to explicitly examine each orthographic feature of a written word and may even identify words by using only partial information (Holmes & Ng, 1993). In the current study, the task in the visual preview condition was to scrutinize the spelling thoroughly and to store it in memory so that all detailed information could be retrieved. This special attention to all letters of a word may well be the key factor for the effectiveness of this orthographic task.

It should be noted further that the current experiment did not study transfer effects of reading skills to spelling ability. Reading skills were taken into account in order to study differential effects of spelling pronunciation and visual preview on skilled and less skilled readers. It has been argued that skilled readers, who still may have difficulties in developing well-specified orthographic representations, could have unexpectedly poor spelling skills. Results show that reading and spelling skills are correlated, though not perfectly. Current findings showed that correlations become higher when children grow older. It was hypothesized that skilled readers are generally better skilled in transferring orthographic knowledge, acquired from reading, into the more active spelling processes. A training with visual preview was consequently expected to be especially helpful for skilled readers. Less skilled readers were furthermore expected to profit most from practice with spelling pronunciations because spelling pronunciations actively help them to process every distinct grapheme. Neither hypotheses could be confirmed. No significant correlation was found between reading ability and differences in effect of spelling pronunciation versus visual preview. Visual preview was as effective as providing spelling pronunciations for both skilled and less skilled readers. Specifically, in less skilled younger spellers, where visual preview was more effective than spelling pronunciations, no relation was found between reading skills and benefits of visual preview. Because all participants were instructed to pay special attention to the spelling of the word when the visual-spelling pattern was presented, less skilled readers could also transfer this information to the actual spelling. By paying extra attention to the written letter pattern, less skilled readers benefited as much as skilled readers from the visual-spelling pattern.

In addition, the reading test used in this study was one in which participants had to read correctly as many words as possible in one minute. All words in this reading test concerned well-known Dutch words with corresponding grapheme-phoneme relations, whereas all words in the training program concerned loan words with inconsistent phoneme-grapheme mappings. Although skilled readers may be more frequently exposed to visual-spelling patterns, the visual-spelling patterns of loan words are not very common in the Dutch language (see also frequency of words in Appendix A). This may well be a reason for the fact that no correlations were found between reading skills (based on the reading test with regular words), and the differences between the training with visual preview and the spelling pronunciation training (all loan words). In future research, it might be appropriate to determine reading skills by reading loan words when relations between reading and spelling skills of loan words are studied. Further, studying the effect of spelling pronunciation and examining relations between reading skills and differences in effects of spelling pronunciation and visual preview in a more opaque written language may show differential benefits for skilled versus less skilled readers.

In the present study, a complete within-subject design was used and the children received all three training conditions, albeit with different words. One might raise concerns about the possibility of learning effects from one condition to the other. However, the effect would have been that differences between conditions were less obvious than currently found. Significant differences between training conditions were found. Because the words being used in this study have no apparent resemblance to one another in terms of orthographic structure or spelling patterns, it is likely that learning effects are predominantly word-specific. Moreover, no transfer to control words occurred. Nevertheless, to rule out possible contamination between conditions, a replication study in which children are randomly assigned to only one of the different conditions is needed.

In conclusion, the present study has shown that there are at least two effective ways to improve the outcomes of spelling exercises for words with inconsistent phoneme-grapheme mappings. One is to provide the visual-spelling pattern of a word for study, and the other is to present a special pronunciation corresponding to the word's spelling. Both types of training were equally effective for both younger and older spellers in this study. In each of the two training conditions, detailed information was provided about the correct spelling, and this may be the reason for these comparable findings. However, Grade 3 spellers, with poorer spelling skills, seemed to benefit more from training with visual preview than the spelling pronunciation training. This finding seems to suggest that the underlying processes of the two conditions are not exactly similar. It also shows that studying visual-spelling patterns is an effective way to learn the correct spelling of irregularly structured words, irrespective of age or spelling ability.

Moreover, taking all research findings on the effect together, spelling pronunciation appears mainly effective in highly irregular orthographies, whereas the study of visual-spelling patterns is also beneficial in more transparent spelling systems such as Dutch. Presenting visual-spelling patterns allows children to inspect the orthographic letter pattern specifically, which helps to store detailed information in memory. The findings indicate that this specific way of examining words, in which attention is paid to each letter of a sequence, has transfer effects to spelling ability. Visual-orthographic cueing appears to be an effective way to learn correct spellings of unpredictable words. Given the relatively strong effects seen here for the use of visual preview in learning unpredictably spelled words, further research is warranted, particularly with young spellers (both less skilled and skilled) and also with more opaque orthographies.

Address correspondence to: Maartje Hilte, PI Research—VU, P.O. Box 366, 1115 ZH Duivendrecht, The Netherlands. E-mail: sm.hilte@psy.vu.nl

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APPENDIX

Training words, English translations, corresponding adult written word frequencies in Dutch, youth written word frequencies in Dutch, and Spelling Pronunciations (International Phonetic Alphabetic) of the Dutch loan words:

Words (Dutch loan words)	English translations	Spelling pronunciation for Dutch loan words (in IPA)	Adult frequency	Youth frequency
barbecue	*barbecue*	bɑrbɛkuɛ	67	—
bouillon	*broth*	bɔujlɔn	362	3
boulevard	*avenue*	bɔulɛvɑrt	357	1
champignon	*mushroom*	ɤɑmpiɤnɔn	13	—
enthousiast	*enthusiast*	ɛnthɔusɪɑst	763	1
etui	*pencil case*	etœy	58	1
fondue	*fondu*	fɔnduɛ	6	1
giraffe	*giraffe*	ɤɪrɑfɛ	19	2
handicap	*handicap*	hɑndɪkɑp	369	3
interview	*interview*	ɪntɛrfiev	729	2
jeans	*jeans*	jɛɑns	184	—
journaal	*newscast*	jɔurnɑl	144	1
jungle	*jungle*	junɤlɛ	226	1
keeper	*goalkeeper*	kepɛr	45	2
militair	*soldier*	mɪlɪtɑjr	646	1
parachute	*parachute*	pɑrɑɤutɛ	161	—
pistache	*pistachio*	pɪstɑɤɛ	3	-
portefeuille	*wallet*	pɔrtɛfœylɛ	451	1
punaise	*drawing pin*	punɑjsɛ	20	—
pyjama	*pajamas*	pijɑmɑ	298	1
sergeant	*sergeant*	sɛrɤɛɑnt	833	—
souvenir	*keepsake*	souvɛnir	72	—
trottoir	*pavement*	trɔtɔjr	451	2
yoghurt	*yogurt*	jɔɤhʏrt	116	2