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The spelling of vowels is influenced by Australian and British English dialect differences

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Abstract

Two experiments examined the influence of dialect on the spelling of vowel sounds. British and Australian children (6 to 8 years) and university students wrote words whose unstressed vowel sound is spelled /i/ or /e/, and pronounced /ɪ/ or /ə/. Participants often (mis)spelled these vowel sounds as they pronounced them. When vowels were pronounced similarly in both dialects (e.g., *comic*, with /ɪ/; *fossil*, with /ə/), British and Australian writers wrote the correct spelling similarly often. For vowels pronounced as /ɪ/ in British English but /ə/ in Australian English, and spelled with /i/ (e.g., *muffin*), British writers correctly wrote /i/ significantly more than Australian writers. For vowels with this same pronunciation pattern but which were spelled instead with /e/ (e.g., *rocket*), Australian writers correctly wrote /e/ significantly more than British writers. Dialect-related phonological differences influenced the spelling of both beginning and skilled spellers, across both familiar and unfamiliar words.
Spelling vowels: the effects of dialect on British and Australian children and adults

Learning to spell in English can be a long and complicated process. While there are many regularities to be learned, there are also many exceptions. Conventional models of English spelling development propose that children progress through a series of stages, characterised by the use of quantitatively different strategies (Ehri, 1986; Gentry, 1982; Henderson, 1985; Marsh, Friedman, Welch, & Desberg, 1980). According to most of these models, children begin by spelling on the basis of phonology. Initially, they focus on only the most salient of a word’s sounds and attempt to represent them with the appropriate letters; eventually they come to represent each of the sounds in a word. In recent years evidence has accumulated to suggest that other strategies also play a role in young children’s spelling. Children as young as 4 or 5 years have been shown to employ orthographic and morphological knowledge, at least to a modest extent, in their spelling (Cassar & Treiman, 1997; Treiman & Cassar, 1996; Treiman, Cassar, & Zukowski, 1994). However, there is a wealth of evidence that early spelling is overwhelmingly based on phonology (e.g., Nunes, Bryant, & Bindman, 1997; Read, 1986; Treiman, 1993; Varnhagen, McCallum, & Burstow, 1997; Zutell, 1980).

Children are therefore more likely to achieve conventionally correct spellings for words which are spelled in the same way as they are pronounced (e.g., not, yet) than for words whose letter-sound correspondences are more difficult to predict (e.g., note, yeast), or are rather obscure (e.g., knight, yacht). Since many letters are pronounced differently in different dialects of English, we might expect that children who speak different dialects would make errors which would reflect their dialect’s pronunciation. Thus, the linguistic characteristics of children’s spoken language could have important effects on their early spelling progress, which could provide evidence about the specificity of children’s early sensitivity to phonological differences.

Read (1986) cites several early studies which found dialect-related spelling differences between White and African American speakers of English in the first few grades of school (e.g.,
Kligman, Cronnell, & Verna, 1972), and between sixth-graders from different geographical regions of the USA (e.g., Graham & Rudorf, 1970). However, many of these differences were small and inconsistent, and in some studies dialect differences may have been confounded with differences in social or educational background (Read, 1986). Nevertheless, more recent research has found dialect-related spelling in better matched samples (Terry, 2004; Pittman, Joshi, Boulware-Gooden, & Graham, 2007). It seems that dialect can influence spelling in the primary school years. Fewer authors have concentrated on the effects of dialect in younger children, who are just beginning to learn to spell in English. However, there is both observational and experimental evidence that young American spellers often spell intervocalic \( t \) with \( d \) (e.g., PREDE for \( pretty \) and LADR for \( letter \)) (Read, 1986; Treiman, 1993; Treiman et al., 1994). These spellings reflect the usual American pronunciation of this sound as a flap of the tongue against the alveolar ridge, a sound that is voiced and therefore more similar to \( d \) than to \( t \).

Other research has provided stronger evidence for the idea that the phonological properties of spoken language can constrain children’s spelling development, regardless of social or educational background. Treiman, Goswami, Tincoff, and Leevers (1997) compared the spelling of \( r \) after vowel sounds in American children (who speak a rhotic dialect and pronounce the \( r \) in words such as \( girl \)) and British children (who speak a non-rhotic dialect and do not pronounce this \( r \)). In the beginning stages of learning to spell, American children sometimes misspelled \( girl \) as GRL, whereas British children sometimes misspelled it as GEL. The less advanced British spellers also omitted the \( r \) from such words as \( doctor \) (misspelled as e.g., DOCKE) and \( corn \) (e.g., CON), and incorrectly inserted it into such words as \( china \) (e.g., CHINER). Interestingly, the more advanced British spellers were even more likely than their less advanced peers to add an incorrect \( r \) to words like \( china \), probably because they overgeneralised their knowledge of the spelling of similar-sounding words which do end in \( r \), such as \( mother \).

One question is whether children are also sensitive to less obvious pronunciation differences. The inclusion and omission of post-vocalic \( r \) in rhotic and non-rhotic dialects of English is a
salient difference, and it is perhaps not surprising that it has effects on children’s early spelling. However, some evidence suggests that young spellers are indeed able to detect, and to represent in their writing (what to adults seem to be) quite subtle differences, not conventionally represented by the orthography. Young spellers have been observed to write, for example, CHRIE for try, or CHRAC for truck, both of which accurately represent the phonological similarity between the sound of ch and that of t pronounced before r (e.g., Read, 1986; Treiman, 1993). Similarly, beginning spellers occasionally write SGIE for sky, suggesting an awareness of the fact that k after s is unaspirated, and therefore can sound similar to g (Treiman, 1993).

One subtle difference between dialects of English, well known to linguists but not to general speakers of the language, is the pronunciation of word-internal vowel sounds in unstressed syllables in British versus Australian English. For the unstressed vowel sound in words such as honest, rabbit, boxes, and naked, British English favours the use of /ɪ/ (as in pig), whereas Australian English tends to use the neutral, central vowel /ə/ (Bernard, 1985; Trudgill & Hanna, 2002; Wells, 1982). This difference is recognised in the differing pronunciations given in two standard dictionaries of these dialects of English. The Oxford English dictionary (British English) transcribes the unstressed vowel sound of such words with /ɪ/, whereas the Macquarie Dictionary (Australian English) transcribes this same sound with /ə/. If young spellers systematically take into account the subtle phonological characteristics of their language, we might expect British and Australian children to make different types of errors on these words. British children might tend to use i for this final unstressed vowel sound, while Australian children might instead use a range of other spellings, since any vowel, if unstressed, can be realised as the neutral sound /ə/. However, a survey of the spelling of unstressed /ə/ in English CVCVC words (from the MRC Psycholinguistic database; Wilson, 1988) showed that the most common spelling of this vowel, in Australian English, is e, which is 1.75 to 3 times more likely than any other vowel spellings. Australian spellers might therefore be expected to use e to spell this sound.
Alternatively, there may be no consistent pattern in the letters that children choose to represent unstressed vowel sounds. Vowels are particularly difficult to categorise and spell correctly (Ehri, Wilce, & Taylor, 1987; Varnhagen, Boechler, & Steffler, 1999), because, compared to consonants, they have relatively poor spelling-to-sound consistency and high potential confusability. Vowel errors make up a substantial proportion of children’s spelling errors in general (Read, 1986; Treiman, 1993). Treiman noted that her first-grade participants often confused the letters e and i, and wrote MIN for men and THIM for them. She suggested that these misspellings stemmed from the fact that in the children’s regional dialect (from Indiana, USA), these words tend to be pronounced with /ɪ/, and thus the spellings are reasonable phonological representations of the words in question. However, she also acknowledges that similar misspellings sometimes occur in children who speak other dialects of English, and that from this homogeneous participant group, we cannot be sure whether these errors really represent spelling based on dialect. Thus, one interesting and still open question is to what extent young children who fail to spell vowels conventionally correctly, nonetheless spell them in a way that is phonologically plausible in their particular dialect of English.

Models of spelling development suggest that as children progress through more advanced stages, they cease to rely as strongly on sound, and make use of more sophisticated strategies (orthographic and morphological) as well (Ehri, 1986; Gentry, 1982; Henderson, 1985; Marsh et al., 1980). Accounts of adult spelling differ in their claims about the importance of phonology in the process of skilled spelling. Dual-route models propose that adults spell from memory when writing highly frequent words, and words with irregular spellings, but that they decide on the spellings of other words on the basis of phonology (e.g., Barry, 1994; Katz & Frost, 2001; Kreiner, 1992; 1996; Kreiner & Gough, 1990). A single-route account (Burt & Fury, 2000) suggests instead that adults do not construct a word’s spelling from its constituent sounds, but from word-specific knowledge, and from more general knowledge about common letter patterns and morphological information. This is referred to by Pennington, Lefly, Van Orden, Bookman,
and Smith (1987) as the *phonological bypass hypothesis*: the idea that other strategies overtake the role of phonology in later spelling processes. Single-route models based on connectionist principles (e.g., Olson & Caramazza, 1994; Plaut, McClelland, Seidenberg, & Patterson, 1996) see that sensitivity to orthographic patterns builds up over exposure to written English words.

However, there is evidence that in at least some cases adults continue to be influenced by sound when spelling difficult words. Treiman and Barry (2000) examined the spelling of post-vocalic *r* by American and British university students. The pattern of errors shown was remarkably similar to that of the American and British children studied by Treiman et al. (1997). The British adults made errors which reflected the non-rhotic nature of their dialect. They sometimes omitted *r* after a vowel, in both word-medial and word-final position (e.g., HAUD for *horde*; LEPA for *leper*), where they do not pronounce this *r*. They also sometimes incorrectly inserted *r* in words which, although not spelled with *r* (e.g., TORNY for *tawny*; POLKAR for *polka*), are pronounced similarly to words which are spelled with *r* (e.g., *corny*, *poker*). The American adults made these types of errors very rarely. However, they did make other errors, and many of these reflected characteristics of their own pronunciations, such as confusions of *t* and *d* stemming from the American tendency to “flap” these sounds (e.g., AUTOBLE for *audible*; PAGOTTA for *pagoda*). More recently, Treiman (2004) examined adult spelling errors arising from the characteristics of African American Vernacular English (AAVE). Speakers of AAVE tend to devoice final obstruents, so that they pronounce the final consonant of a word such as *rigid* with a sound closer in pronunciation to a *t* than a *d*. Treiman found that African American university students were more likely than White students to use *d* for *t*, and vice versa, in their spelling. This confusion was more likely among those who often devoiced final *d*, and also when the words were pronounced by an African American rather than a White experimenter. These studies provide evidence that the phonological characteristics of a writer’s dialect can influence their spelling not only in the beginning stages of spelling development, but also in adulthood.
The present study aimed to extend the study of dialectical influences on spelling errors to a new group: speakers of Australian English. It examined the rather subtle difference discussed above: the pronunciation of word-internal vowel sounds in unstressed syllables as /ɪ/ by speakers of British English versus /a/ by speakers of Australian English. The main question was whether British and Australian beginning spellers would demonstrate a sensitivity to the differing pronunciation of these vowels in their dialects. If so, then we would expect British children, who pronounce these vowels with /ɪ/, to make fewer errors on words which are spelled with i, such as *muffin* and *visit*. We would expect them to make more errors on words which are spelled with e, such as *wicked* and *ticket*. In contrast, Australian children, who pronounce these vowels with /a/, might be expected to make fewer errors on words which are spelled with e, and more errors on words which are spelled with i. If the influence of phonology wanes in the face of increasing experience with common letter patterns, we might expect to see little difference in the spelling of adults of different dialect groups, since experience with letter patterns will be the same for both. However, some previous research suggests that dialectical differences continue to influence adult spelling (Treiman, 2004; Treiman & Barry, 2000). For this reason, the spelling of these same sounds, in more difficult words, was also examined in British and Australian adult spellers.

**Experiment 1**

*Method*

*Participants.* The British group consisted of 60 children aged 6;0 to 7;10 years (36 girls, 24 boys). They were in school years 2 (n = 28) and 3 (n = 32) of two large primary schools in low to middle SES areas in the north-west of England. The Australian group consisted of 60 children aged 6;0 to 8;05 years (38 girls, 22 boys). They were in school grades 1 (n = 30) and 2 (n = 30) of six primary schools in socio-economic areas ranging from low to upper-middle in the south-east of Australia. All participants had English as a first language. Ideally, each child’s dialect would have been assessed, but the time to do this formally was not available. However, the relative
pronunciations of unstressed $e$ and $i$ seem constant across British and across Australian English dialects, regardless of region. There did not appear to be any British participants who had learned their English in another country. Table 1 shows participants’ mean chronological ages and spelling ages (measured on the spelling sub-test of the Wechsler Oral Reading Dimensions (WORD; Rust, Golombok, & Trickey, 1993). One-way ANOVAs confirmed that the two groups did not differ significantly on any of these measures.

**Table 1 about here **

Materials. There were 24 experimental words, each consisting of two syllables in CVCVC structure ($V =$ vowel, $C =$ consonant [cluster]). (Two words, attic and active, lacked an initial consonant.) All had fairly regular spelling patterns. These were categorised into four Word Types, which differed in the spelling ($i$ or $e$) and/or pronunciation ($/ɪ/$ or $/ə/$) of their unstressed vowel, in British vs. Australian English. As detailed in Table 2, there were 12 words whose unstressed vowel was spelled with $i$ and pronounced in the same way in both dialects: 6 with $/ɪ/$ (Same/$ɪ/$) and 6 with $/ə/$ (Same/$ə/$). There were 12 words whose unstressed vowel is pronounced differently in the two dialects: $/ɪ/$ in British English but $/ə/$ in Australian English: 6 spelled with $i$ (Diff/$ɪ$) and 6 with $e$ (Diff/$ə$). It should be noted that the $/a/$ of the Same/$a/$ words can be pronounced as part of the final $l$ (as a ‘syllabic liquid’, as in fossil), or part of the final $n$ (as a ‘syllabic nasal’, as in cousin). The Oxford English Dictionary (OED, for British English), and the Macquarie Dictionary (for Australian English) were consulted for the pronunciations of the critical vowel sounds. One experimental word, fossil, is transcribed in the OED as having two possible pronunciations: $/ɪ/$ (primary pronunciation) and $/ə/$ (secondary pronunciation). This word was nevertheless included, as it was difficult to find enough words of this type with which young children would be familiar. The words had Standard Frequency Indexes ranging from 36 to 59
(Carroll, Davies, & Richman, 1971; Zeno, Ivens, Millard, & Duvvuri, 1995; where a SFI of 40 reflects about one appearance per million words). A one-way ANOVA showed that the mean frequencies of the four word types did not differ significantly for either the Carroll et al. count, \( F(3, 23) = .13, p = .94 \), or the Zeno et al. count, \( F(3, 23) = .42, p = .73 \). Pilot testing ensured that even the words with the lowest frequencies (e.g., \textit{raisin} and \textit{muffin}) were familiar to these populations. The words were presented in one of four different semi-random orders to each group of children.

**Table 2 about here**

**Procedure.** The children were seen in two sessions of about 15 minutes each, in a quiet area near their school classroom. In the first session, children were seen individually and the spelling sub-test of the WORD was administered. In the second session (usually one day later), children were seen in groups of 4-6, and given a booklet in which to write the 24 experimental words. To encourage participation and to make the task less daunting for these beginning spellers, each word was illustrated with a small picture, and the first consonant(s) and vowel were provided. The experimenter read out each word on its own, in a sentence, and on its own again, and asked the children to “finish spelling the word”, by filling in the remaining consonant(s), vowel, and consonant(s). For example, children saw a picture of a ticket and the letters \( Ti \ldots \), and heard “Ticket. I got on the bus and bought my ticket. Ticket.”. They were then asked to finish spelling the word \textit{ticket}. Two easy practice items (\textit{dog} and \textit{baby}) were included to familiarise children with the word-completion task, and participants were encouraged to guess if they were not sure about the spelling of a word. The words were read aloud by a speaker of the local dialect: a Masters student in Australia, and the children’s teaching assistant in the UK.
Results

All children attempted to spell all words. On a very few occasions, the crucial letters seemed to be mis-ordered (e.g., ACTVI for active), but if there was an obvious representation of the final vowel sound among the last 2-3 letters, this was scored, even if it was not in exactly the right place. This study focused on just the children’s spelling of the unstressed vowel sounds of the experimental words, not of any other letters. The number of uses of the commonest spellings, *i* and *e*, of ‘other’ spellings (*a*, *o*, *u*, and combinations such as *ai*) and of omissions of the critical vowels are summarised in Table 3. The children’s use of the correct spelling (*i* or *e*) was examined in a repeated-measures analysis of variance (by-subjects, $F_1$), with Dialect as the between-subjects variable, and Word Type as the repeated-measures variable. The analysis was also conducted by-items ($F_2$).

**Table 3 about here**

The analyses revealed a significant main effect of Dialect only in the by-items analysis, $F_2 (1, 20) = 17.1$, $p = .001$, and a significant effect of Word Type in both analyses, $F_1 (3, 354) = 117.1$, $p < .001$, $F_2 (1, 20) = 30.4$, $p < .001$. However, these effects were qualified by a Word Type by Dialect interaction, $F_1 (3, 354) = 56.4$, $p < .001$, $F_2 (1, 20) = 49.3$, $p < .001$. Newman-Keuls post-hoc tests were conducted on the differences between the two Dialect groups. When the vowels were pronounced similarly in the two dialects, the children tended to spell them similarly. For Same/*ɪ*/ words (e.g., *comic*), the groups did not differ significantly in their (relatively often correct) use of *i* for the critical vowel sound. For Same/*a*/ words (e.g., *fossil*), vowel letter choice was very variable. Both groups of children used a variety of spellings for this vowel, including *i* and *e*, but also *o*, *u*, and other vowels, and they often omitted any representation of this vowel, which probably reflects the tendency for it to be pronounced as part
of the final /l/ or /n/ sound. This sound seems to be a particularly difficult one to represent. When they did use i correctly, Australian children did significantly better than British children, \( p < .05 \).

When the vowels were pronounced differently in the two dialects, the differences in spelling were striking. The two groups often spelled the unstressed vowel as they pronounced it, with little regard as to its conventional spelling. For Diff i words (e.g., visit), the British children used i correctly significantly more often than the Australian children, \( p < .01 \), whereas for Diff e words (e.g., ticket), the Australian children used e correctly significantly more often than the British children, \( p < .01 \).

**Discussion**

The results suggest that children in the first years of school are sensitive to subtle differences in the pronunciations of vowel sounds, and that they use these differences in their spelling. For Same/i/ words (e.g., comic), pronounced with /ɪ/ in both dialects, both British and Australian children correctly used i equally often, at a relatively high level of accuracy (70-80%). For Same/a/ words (e.g., fossil, cousin), pronounced with /a/ or with a syllabic liquid/nasal in both dialects, both groups used a range of vowel letters and sometimes omissions, which presumably reflect the tendency for this vowel sometimes to be pronounced as part of its final /l/ or /n/ sound. On the occasions when i was used correctly, the Australian children were correct significantly more often than the British children. The Australian children used i more than the British children for these words. This may reflect the tendency in Australian English for most CVCVC words to be pronounced with a final /a/. Australian children thus have experience in deciding/learning how to spell this sound, in this position. In British English, however, most CVCVC words are pronounced with a final /ɪ/, and only a handful of words (the Same/a/ words in this study) instead have a final /a/. The British children have thus had less experience trying to represent /a/ in this position, which may explain their minimal use of the correct spelling i. However, overall, it
appears that the ambiguity of this neutral sound is confusing for both British and Australian children, and that they begin by spelling it in a variety of ways.

Diffi words (e.g., visit) and Diffè words (e.g., ticket) have different spellings for their unstressed vowel sounds, but similar pronunciations: they tend to be pronounced /ı/ in British English but /a/ in Australian English. The two groups’ spelling of these vowel sounds were virtually ‘mirror-images’, with both Diffi and Diffè words being spelled mainly with i by British children (and much less with e), and mainly with e by Australian children (and much less with i). These results provide striking evidence that the vowel letters chosen by these beginning spellers are indicative of their different pronunciations, rather than their spelling knowledge.

Conventional models of spelling development propose that as children gain more experience with the orthography, they begin to rely less heavily on phonology-based spelling strategies. According to such models, children begin to employ a range of knowledge of morphological and orthographic patterns, as well as more specific knowledge of individual words. If this is the case, the effects of dialect should have only minimal influence on the spelling of skilled adult writers.

Recent evidence, however, is beginning to suggest that sound-based spelling strategies continue to be of importance even during adulthood (e.g., Treiman, 2004; Treiman & Barry, 2000). It is therefore unclear whether the subtle differences in pronunciation of unstressed vowels continue to influence adult spelling, and whether this might differ between words that adults rated as familiar or unfamiliar. Experiment 2 was designed to examine this question.

Experiment 2

Method

Participants. All participants were university students invited to participate by staying an extra 15 minutes after their usual lecture time. No record was made of which students stayed or left, and there was no credit for participation, nor consequences for non-participation. The British group consisted of 50 adults (47 female, 3 male), in first- and second-year university courses in
They attended a university in the north-west of England, close to the location of the two primary schools visited in Experiment 1. The Australian group consisted of 50 adults (37 female, 13 male), in a first-year Psychology course. They attended two campuses of a university in the south-east of Australia. The preponderance of females reflects the usual gender imbalance in Psychology and Language course enrolments. Only data from students who indicated that they had English as a first language were included in the analyses. No record was taken of students’ dialects. However, at both universities, these classes typically include very few students who have learned their English (as a first language) in another English-speaking country. This does not preclude the possibility that others were included, but it does suggest that any instances were few.

Limited testing time did not permit the inclusion of a standardised spelling test in either country. Therefore, in an attempt to allow comparison between the groups, data was collected from a larger group of 120 Australian students. The data from the first 50 Australian students who spelled the same number of words correctly overall as their British counterparts were included in the experiment. The mean ages and overall spelling scores are reported in Table 4.

**Table 4 about here**

*Materials.* The 32 experimental words were similar in phonological and orthographic structure and regularity to those used in Experiment 1, but of much lower written frequency, with SFIs ranging from approximately 10 to 45 (Carroll et al., 1971; Zeno et al., 1995). As in Experiment 1, and summarised in Table 2, there were four word types, which differed in the spelling of their unstressed vowel, and in that vowel’s pronunciation in British versus Australian English. The word types did not differ significantly in terms of their mean frequency according to the Carroll et al. counts, $F (3, 16) = 1.15, p = .37$, or the Zeno et al. counts, $F (3, 16) = 2.64, p = .07$. To increase the scope for variation in scores, adults were asked to write 8, rather than just 6,
words of each type. It proved particularly difficult to find low-frequency Same/a/ words (spelled with \( i \) but pronounced with a final /a/ in both dialects). The Macquarie Dictionary transcribes all these words with a final /a/, while the OED transcribes them with an optional /a/ or an /ɪ/.

According to the OED, the sound /a/ is the primary pronunciation for 6 of the 8 Same/a/ words. The 2 remaining words, stencil and peril, had /ɪ/ as the primary, and optional /a/ as the secondary pronunciation. However, since these words appear to rhyme with, for example, pencil and feral (both transcribed with /a/ in the OED), they were included as Same/a/ words. All words were presented in one of 4 semi-random orders to each group of participants.

**Procedure.** The 32 words were presented to participants in class groups ranging in size from 20 to 30 students, in a single session lasting approximately 15 minutes. In each location, the experimenter was a speaker of the local dialect. The experimenter read out each word once on its own, once in a sentence, and once on its own again. Following Treiman and Barry (2000), the students were also asked to circle the number between 1 and 7 that best captured their familiarity with/knowledge of that word. Students were told to give a word a rating of 7 if they were familiar with it and knew its meaning well. A rating of 4 was to be given for words that they recognised, but for which they did not know the meaning. A rating of 1 was to be given for words that were completely unfamiliar.

**Results**

The number of times that the participants used \( i, e, \) and other spellings for the critical vowel sounds was counted (there were too few omissions to warrant a separate omissions category). The proportions are shown in Table 5. Although the differences are not as great as for the children in Experiment 1, dialect does seem to influence adult spelling.
As in Experiment 1, the adults’ use of the correct spelling of the critical vowel (i or e) was examined in a repeated-measures analysis of variance (by-subjects, $F_1$), with Dialect as the between-subjects variable, and Word Type as the repeated-measures variable. The analysis was also conducted by-items ($F_2$). There was a main effect of Dialect, $F_1 (1, 98) = 11.5, p = .001, F_2 (1, 28) = 4.39, p = .04$. There was also a main effect of Word Type, $F_1 (3, 294) = 73.4, p < .001, F_2 (1, 28) = 3.72, p = .02$. However, these effects were qualified by a Word Type by Dialect interaction, $F_1 (3, 294) = 59.7, p < .001, F_2 (3, 28) = 17.4, p < .001$. Newman-Keuls post-hoc tests were conducted on the differences between the two groups. As in Experiment 1, when the vowels were pronounced similarly in the two dialects, participants spelled them similarly. For both Same/i/ words (e.g., colic) and Same/ə/ words (e.g., weevil), the two groups did not differ significantly in their correct use of i for the critical vowel sound.

When the vowels were pronounced differently in the two dialects, the differences in spelling were not as great as they had been in the child spellers, but they were still clearly present. For Diff/i/ words (e.g., tannin), the British adults used i correctly significantly more often than the Australian adults, $p < .01$. For Diff/e/ words (e.g., snippet), the Australian adults used e correctly significantly more often than the British adults, $p < .05$.

If adults rely on word-specific information to spell known words (as proposed in Burt and Fury’s 2000 single-route account), phonology might have an effect only on the spelling of words which are less well known (Treiman & Barry, 2000). However, when educated adults write real words, it is difficult to know how many correct spellings they attain through word-specific knowledge, and how many through the use of spelling strategies. It was thus considered important also to study the spellings of the crucial vowel sounds in familiar and unfamiliar words separately. Table 6 shows the mean proportion of correct vowel spellings that the participants wrote for the words with which they were familiar (i.e., given a rating of 5, 6, or 7), and for the
words with which they were unfamiliar (i.e., given a rating of 1, 2, 3, or 4). Because each participant had a different pattern of word familiarity ratings, different numbers of participants’ spellings contributed to each word type, and these numbers are also shown in Table 6.

Table 6 shows that, as expected, both groups of participants chose the correct vowel spelling more often for words that they rated as “familiar” than as “unfamiliar”. However, although the effects appear stronger for unfamiliar words, the means suggest that the effects of dialect on spelling held for familiar words as well. The overall patterns of means are remarkably similar to those shown by the child spellers in Experiment 1, especially for the unfamiliar words. The mean familiarity ratings (1 = least familiar, 7 = most familiar) were fairly similar across 3 of the 4 Word Types, with means of 3.45 (Same/I/), 3.83 (Same/a/), and 3.64 (Diff/e). However, the mean rating of 5.42 for Diff/i words was relatively high, as it was difficult to find 8 infrequent examples. As can be seen in Table 6, fewer individuals contributed to the spelling of words rated as “familiar” than as “unfamiliar”, especially for the Diff/i words, and so the number of correct spellings for unfamiliar words sometimes comes only from a few participants, and should therefore be interpreted with caution.

Repeated-measures analyses of variance were conducted as before, by subjects ($F_1$) and by items ($F_2$) to test the significance of the differences observed for the correct spelling of the crucial vowel sound in both familiar words and unfamiliar words. (All words were rated as “familiar” by at least one participant. Although 23 words were also rated as “unfamiliar” by at least one participant, 9 were not, and so these words were not included in the “unfamiliar” analysis).

For familiar words, the main effect of Dialect was not significant, although the main effect of Word Type was, by subjects, $F_1(3, 294) = 17.1, p < .001$. However, the Dialect by Word Type interaction remained significant, $F_1(3, 294) = 10.1, p < .001$, $F_2(3, 28) = 9.04, p = .001$. For
unfamiliar words, there was a significant main effect of Dialect only by items, $F_2(1, 19) = 8.70, p < .01$, and a significant main effect of Word Type in both analyses, $F_1(3, 294) = 128.2, p < .001$, $F_2(1, 19) = 19.8, p = .001$. There was also a significant interaction between Dialect and Word Type, $F_1(3, 294) = 27.9, p < .001$, $F_2(3, 198) = 19.5, p < .001$.

Newman-Keuls post-hoc tests were conducted on the means for both familiar and unfamiliar words, and in both cases, the same pattern of significant and non-significant differences was found. It was confirmed that the British and Australian spellers did not differ significantly in their spelling of the crucial vowel letter in Same/ɪ/ and Same/ə/ words, whose vowels are pronounced similarly in the two dialects. In contrast, when the vowels were pronounced differently, their pronunciation was reflected in their spelling, for both familiar and unfamiliar words, with the British adults correct significantly more often than the Australians on Diffɪ words, $p < .01$, and the Australian adults correct significantly more often than the British on Diffə words, $p < .01$.

Discussion

Despite being matched on the overall number of words spelled correctly, the two groups of adults in this experiment showed clear differences in their spelling of the words’ critical vowel sounds. These differences occurred whether or not the words were familiar to the participants. When they spelled Same/ɪ/ words (e.g., *colic*), which both British and Australian English speakers pronounce with /ɪ/, both groups used i correctly in virtually every case. For Same/ə/ words (e.g., *weevil*), which both groups pronounce with either /ə/ or as part of a syllabic liquid, the two groups again showed virtually identical response patterns. Both correctly used i most often when the words were familiar, although for the couple of participants to whom several of these words were unfamiliar, the correct spelling was hardly ever achieved. The neutral vowel /ə/ clearly gives few cues to its conventional spelling, to adults as well as to children. When writing Diffɪ and Diffə words, however, the British and the Australian adults showed virtually ‘mirror-
image’ responses to each other, to a stronger extent in the words rated as unfamiliar, but also in the words rated as familiar. The British adults wrote \textit{i} correctly significantly more often than the Australian adults for familiar and unfamiliar words which they pronounced with /ɪ/ (e.g., \textit{tannin}), while the Australian adults in turn wrote \textit{e} correctly significantly more often than the British adults for familiar and unfamiliar words which they pronounced with /ə/ (e.g., \textit{snippet}). These responses reflect the two dialects’ differing pronunciations for these vowel sounds.

General Discussion

This study investigated the influence of dialect-based pronunciation on children’s and adults’ spelling skills; specifically, their spelling of subtly different vowel sounds. It moved beyond the research conducted thus far on the dialects of English spoken in the US and Britain, to examine another dialect, Australian English, and to determine whether its characteristics influence children’s spelling in a different way from the characteristics of British English. By studying the effects of dialect on the spelling of both beginning writers and skilled adult writers, it also provides evidence about the specificity of the influence of phonology on the spelling process, from its beginning to its mastery. Although participants’ dialect was not assessed individually, the results suggest that these two dialects do indeed influence spelling in contrasting ways. When British and Australian beginning spellers wrote words whose unstressed vowel sound is pronounced /ɪ/ in both dialects (such as \textit{comic}), both groups used i equally often. When they wrote words whose unstressed vowel sound is pronounced more ambiguously in both dialects, with the neutral vowel /ə/ (e.g., \textit{fossil}), both groups wrote a variety of vowel letters. When the words were pronounced differently in the two dialects, the two groups of children showed striking differences in their spelling. For words such as \textit{visit} and \textit{ticket}, which speakers of British English pronounce with /ɪ/, British children were significantly more likely than Australian children to use \textit{i}, resulting in such correct spellings as VISIT but also such errors as TICKIT.
Speakers of Australian English pronounce these words instead with /a/, and Australian children were significantly more likely than British children to use e correctly for these words, producing the opposite pattern of successes (TICKET) and errors (VISET).

This study adds to the small but growing body of evidence that differences in pronunciation that are characteristic of different dialects of English can significantly affect children’s errors, and thus that the dialect a child hears and speaks can influence his or her spelling development (Read, 1986; Treiman, 1993; Treiman et al., 1994; 1997). The present research further shows that this influence can come even from such a subtle dialectical difference as the pronunciation of unstressed vowel sounds. The children in this study were only just beginning to learn to spell, but they were clearly able to distinguish and represent the vowel sounds that they pronounced in their dialect of English.

The strong influence of phonology in the early stages of spelling development has been demonstrated many times in many studies (e.g., Beers & Beers, 1992; Read, 1986; Treiman, 1993; Zutell, 1980). However, the importance of phonology in later writing is less clear, with some accounts suggesting a limited role for phonology in adult spelling (e.g., Burt & Fury, 2000), and others a much more substantial role (e.g., Barry, 1994; Katz & Frost, 2001; Kreiner, 1992; 1996). The question of whether the influence of phonology continues into adult spelling was examined in Experiment 2. Educated adults spelled words which had similar phonological and orthographic structure but much lower frequencies than the words written by the children in Experiment 1. Unsurprisingly, the adults used the conventionally correct letters more often than the children. However, they also made errors, and their patterns of errors were remarkably similar to those shown by the children. For words whose vowel sounds they pronounced similarly, the British and Australian adults did not differ significantly in their spelling. They used i for words pronounced with /ɪ/, such as colic, and they used mostly i but also e for words pronounced with /a/ or a syllabic liquid, such as weevil. For words whose vowel sounds they pronounced differently, the adults produced very similar patterns of spellings and misspellings as the children
in Experiment 1. For words pronounced with /ɪ/ in British English but /ə/ in Australian English, the British adults used i correctly for words such as *tannin* significantly more often than the Australian adults, who in turn used e correctly for words such as *snippet* significantly more often than the British adults.

One single-route account of adult spelling (Burt & Fury, 2000) suggests that when writing words with which they are familiar, adults bypass phonology and make spelling decisions instead on the basis of word-specific knowledge. In this case, phonology (including dialect-related phonological differences) may influence only the spelling of unfamiliar words (Treiman & Barry, 2000). We therefore examined the spelling of the critical vowel sounds of words which the participants rated as familiar, separately from their spelling of vowel sounds in those words which they rated as unfamiliar. Although the differences were larger for unfamiliar words, the significant effects remained for misspellings of familiar words as well. These results demonstrate that just like beginning spellers, adults employ phonology to determine how to spell words, whether or not they know these words and their meanings well. This use of phonology is observed even among educated adult spellers, and even when the phonological difference is a very subtle one. The results are consistent with those of Treiman and colleagues, who have shown that dialect-related phonological differences can account for differences in the spellings and misspellings of British versus American adults (Treiman & Barry, 2000) and of speakers of Standard versus African American Vernacular English (Treiman, 2004).

Taken together, these findings challenge the idea of traditional spelling models, that spelling develops in a sequence of stages, each characterised by the use of increasingly sophisticated strategies, and in which more complex strategies gradually supersede simpler ones (e.g., Ehri, 1986; Frith, 1985; Gentry, 1982; Marsh et al., 1980). Instead, these results fit better with a more flexible account of spelling development, that sees children as possessing a variety of spelling strategies from as early as the years of school, and that during a spelling task, children can move flexibly from one strategy to another, depending on the difficulty of individual words (e.g., Rittle-
Johnson and Siegler, 1999). Although spelling improves with grade level, this improvement may be due not so much to the development of new strategies and the discarding of old ones, but to the increasingly quick and accurate selection of the most appropriate strategy for the word to be spelled (Rittle-Johnson & Siegler, 1999; Steffler, Varnhagen, Freisen, & Treiman, 1998). As Treiman and Barry (2000) note, it seems that as new strategies are learned, they are added to a speller’s repertoire, rather than supplanting the older strategies already in place.

The present findings also have implications for models of skilled adult spelling. It seems that skilled adult writers do not learn to “bypass” phonology in their spelling (Pennington et al., 1987), or come to rely on word-specific knowledge of letter patterns when writing familiar words, without recourse to phonology (Burt & Fury, 2000). Instead, these findings support an account which allows a role for phonology in the adult spelling of both known and unknown words, even when the phonological patterns are very subtle and non-contrastive. This is not to ignore the role of the statistical learning of orthographic and morphological patterns in experienced spellers: clearly this type of learning makes an important contribution to skilled spelling (e.g., Kemp & Bryant, 2003; Treiman, Kessler, & Bick, 2002). Rather, it suggests that adults, like children, have a variety of spelling strategies at their disposal, and are able to select the strategy or strategies most appropriate for a particular word to be spelled. If word-specific knowledge is insufficient, phonological knowledge can be employed as well, or instead.

In summary, the present results provide further evidence that the use of phonology is not confined to the beginning stages of writing. It is an essential part of the spelling process for skilled adult spellers as well, even when writing familiar (albeit infrequent) words. It seems that the characteristics of spoken English, as it is pronounced in one’s own dialect, can indeed influence spelling, not only in children just learning to deal with a complex spelling system, but also throughout adulthood.
Spelling vowels in British and Australian English

References


Table 1

*Mean Chronological and Spelling Ages (in Months), and WORD Scores for British and Australian Children. Standard Deviations in Parentheses.*

<table>
<thead>
<tr>
<th>Country</th>
<th>Chron. age</th>
<th>Raw score</th>
<th>Standard score</th>
<th>Spelling age</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK ((n = 60))</td>
<td>7;01 (6.06)</td>
<td>17.67 (4.22)</td>
<td>99.07 (15.89)</td>
<td>7;01 (8.49)</td>
</tr>
<tr>
<td>Aus ((n = 60))</td>
<td>7;03 (7.69)</td>
<td>18.77 (3.26)</td>
<td>100.87 (10.05)</td>
<td>7;03 (6.28)</td>
</tr>
</tbody>
</table>
Table 2

Spelling and Pronunciation of Critical Vowels in the 4 Word Types, and Mean Written

*Frequencies* of Stimuli used for Children and Adults. Standard Deviations in Parentheses.

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Spelling</th>
<th>British Pronunc.</th>
<th>Australian Pronunc.</th>
<th>Expt 1: Child stimuli</th>
<th>Expt 2: Adult stimuli</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Expt</td>
<td></td>
<td>Expt 1:</td>
<td>Expt 2:</td>
</tr>
<tr>
<td></td>
<td>Example</td>
<td>Word freq</td>
<td>Example</td>
<td>Word freq</td>
<td>Example</td>
</tr>
<tr>
<td>Same/i/</td>
<td>i</td>
<td>/i/</td>
<td>/i/</td>
<td>comic</td>
<td>49.6 (4.11)</td>
</tr>
<tr>
<td>Same/a/</td>
<td>i</td>
<td>/a/**</td>
<td>/a/**</td>
<td>fossil</td>
<td>47.7 (3.53)</td>
</tr>
<tr>
<td>Diffi</td>
<td>i</td>
<td>/i/</td>
<td>/a/</td>
<td>muffin</td>
<td>48.3 (7.24)</td>
</tr>
<tr>
<td>Diff e</td>
<td>e</td>
<td>/i/</td>
<td>/a/</td>
<td>rocket</td>
<td>43.8 (5.02)</td>
</tr>
</tbody>
</table>

* Word frequencies given are from Carroll et al. (1971), but are very similar to the Zeno et al. (1995) frequencies, with differences of 3.4 or less in all cases.

** or syllabic liquid/nasal
### Table 3

**Mean Proportions of Spelling Types Given to Critical Vowels by British and Australian Children.**

*Standard Deviations in Parentheses. Correct Spellings Shown in Bold.*

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Spelling given</th>
<th>UK children (n = 60)</th>
<th>Aus children (n = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same/i/</td>
<td>i</td>
<td>0.80 (0.21)</td>
<td>0.72 (0.31)</td>
</tr>
<tr>
<td>e.g., comic</td>
<td>e</td>
<td>0.06 (0.16)</td>
<td>0.16 (0.22)</td>
</tr>
<tr>
<td></td>
<td>omitted</td>
<td>0.10 (0.14)</td>
<td>0.09 (0.13)</td>
</tr>
<tr>
<td></td>
<td>other*</td>
<td>0.04 (0.10)</td>
<td>0.03 (0.08)</td>
</tr>
<tr>
<td>Same/a/</td>
<td>i</td>
<td>0.09 (0.13)</td>
<td>0.21 (0.28)</td>
</tr>
<tr>
<td>e.g., fossil</td>
<td>e</td>
<td>0.16 (0.25)</td>
<td>0.36 (0.33)</td>
</tr>
<tr>
<td></td>
<td>omitted</td>
<td>0.33 (0.28)</td>
<td>0.23 (0.25)</td>
</tr>
<tr>
<td></td>
<td>other*</td>
<td>0.42 (0.26)</td>
<td>0.20 (0.19)</td>
</tr>
<tr>
<td>Diffi</td>
<td>i</td>
<td>0.70 (0.21)</td>
<td>0.29 (0.30)</td>
</tr>
<tr>
<td>e.g., muffin</td>
<td>e</td>
<td>0.10 (0.16)</td>
<td>0.53 (0.31)</td>
</tr>
<tr>
<td></td>
<td>omitted</td>
<td>0.15 (0.18)</td>
<td>0.11 (0.22)</td>
</tr>
<tr>
<td></td>
<td>other*</td>
<td>0.05 (0.11)</td>
<td>0.07 (0.12)</td>
</tr>
<tr>
<td>Diff e D</td>
<td>i</td>
<td>0.63 (0.32)</td>
<td>0.18 (0.23)</td>
</tr>
<tr>
<td>e.g., rocket</td>
<td>e</td>
<td>0.21 (0.33)</td>
<td>0.64 (0.31)</td>
</tr>
<tr>
<td></td>
<td>omitted</td>
<td>0.10 (0.17)</td>
<td>0.13 (0.22)</td>
</tr>
<tr>
<td></td>
<td>other*</td>
<td>0.06 (0.13)</td>
<td>0.05 (0.14)</td>
</tr>
</tbody>
</table>

*“Other” spellings include other vowel spellings, such as o and u, and vowel combinations, such as ai and ou.*
Table 4

Mean Chronological Age and Number of Experimental Words Spelled Correctly Overall for
British and Australian Adults. Standard Deviations in Parentheses.

<table>
<thead>
<tr>
<th>Country</th>
<th>Chronological age (years)</th>
<th>No. words correct (max. = 32)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>UK (n = 50)</td>
<td>18-42</td>
<td>22.06 (6.83)</td>
</tr>
<tr>
<td>Aus (n = 50)</td>
<td>17-61</td>
<td>21.04 (7.31)</td>
</tr>
</tbody>
</table>
Table 5

*Mean Proportions of Spelling Types Given to Critical Vowels by British and Australian Adults.*

*Standard Deviations in Parentheses. Correct Spellings Shown in Bold.*

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Spelling given</th>
<th>UK adults ($n = 50$)</th>
<th>Aus adults ($n = 50$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same/i/</td>
<td>i</td>
<td>0.99 (0.03)</td>
<td>0.99 (0.04)</td>
</tr>
<tr>
<td>e.g., colic</td>
<td>e</td>
<td>0.00 (0.02)</td>
<td>0.01 (0.03)</td>
</tr>
<tr>
<td></td>
<td>other</td>
<td>0.01 (0.03)</td>
<td>0.00 (0.03)</td>
</tr>
<tr>
<td>Same/ə/</td>
<td>i</td>
<td>0.78 (0.08)</td>
<td>0.83 (0.08)</td>
</tr>
<tr>
<td>e.g., weevil</td>
<td>e</td>
<td>0.18 (0.09)</td>
<td>0.16 (0.07)</td>
</tr>
<tr>
<td></td>
<td>other</td>
<td>0.04 (0.07)</td>
<td>0.01 (0.04)</td>
</tr>
<tr>
<td>Diff/i</td>
<td>i</td>
<td>0.94 (0.10)</td>
<td>0.63 (0.19)</td>
</tr>
<tr>
<td>e.g., tannin</td>
<td>e</td>
<td>0.04 (0.08)</td>
<td>0.13 (0.11)</td>
</tr>
<tr>
<td></td>
<td>other</td>
<td>0.02 (0.06)</td>
<td>0.24 (0.16)</td>
</tr>
<tr>
<td>Diff/e</td>
<td>i</td>
<td>0.22 (0.18)</td>
<td>0.08 (0.09)</td>
</tr>
<tr>
<td>e.g., snippet</td>
<td>e</td>
<td>0.78 (0.18)</td>
<td>0.84 (0.15)</td>
</tr>
<tr>
<td></td>
<td>other</td>
<td>0.00 (0.03)</td>
<td>0.08 (0.11)</td>
</tr>
</tbody>
</table>
Table 6

*Mean Proportions of Correct Spellings Given to Critical Vowels in Words Rated as Familiar and Unfamiliar by British and Australian Adults, and Mean Number of Participants who Rated each Word Type as Familiar/Unfamiliar. Standard Deviations in Parentheses.*

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Proportion</th>
<th>Mean n</th>
<th>Proportion</th>
<th>Mean n</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>correct</td>
<td>contributing</td>
<td>correct</td>
<td>contributing</td>
</tr>
<tr>
<td>Words rated as familiar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same/I/</td>
<td>0.97 (0.15)</td>
<td>28.3 (11.4)</td>
<td>0.99 (0.05)</td>
<td>28.0 (15.3)</td>
</tr>
<tr>
<td>Same/a/</td>
<td>0.86 (0.10)</td>
<td>44.6 (10.7)</td>
<td>0.86 (0.10)</td>
<td>47.4 (3.87)</td>
</tr>
<tr>
<td>Diffi</td>
<td>0.96 (0.15)</td>
<td>32.5 (11.8)</td>
<td>0.81 (0.19)</td>
<td>29.8 (13.5)</td>
</tr>
<tr>
<td>Diffê</td>
<td>0.85 (0.18)</td>
<td>35.3 (9.83)</td>
<td>0.90 (0.15)</td>
<td>30.6 (15.7)</td>
</tr>
<tr>
<td>Words rated as unfamiliar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Same/I/</td>
<td>0.83 (0.37)</td>
<td>16.1 (13.1)</td>
<td>0.91 (0.27)</td>
<td>18.8 (15.1)</td>
</tr>
<tr>
<td>Same/a/</td>
<td>0.05 (0.21)</td>
<td>3.88 (8.84)</td>
<td>0.07 (0.25)</td>
<td>1.62 (2.34)</td>
</tr>
<tr>
<td>Diffi</td>
<td>0.74 (0.39)</td>
<td>14.2 (10.5)</td>
<td>0.26 (0.29)</td>
<td>16.1 (2.34)</td>
</tr>
<tr>
<td>Diffê</td>
<td>0.38 (0.36)</td>
<td>11.6 (9.23)</td>
<td>0.62 (0.36)</td>
<td>19.6 (12.6)</td>
</tr>
</tbody>
</table>
Appendix

Experimental words

Experiment 1. Type A: attic, comic, clinic, plastic, active, massive. Type B: nostrils, fossil, devil, cousin, raisin, basin. Type C: dolphin, muffin, denim, stupid, visit, rabbit. Type D: ticket, rocket, gadget, packet, target, wicked.

Experiment 2. Type A: Doric, colic, rubric, arsenic, pensive, missive, cursive, furtive. Type B: tonsils, fossil, weevil, basil, lentil, stencil, peril, vigil. Type C: pectin, vermin, tannin, squalid, lurid, livid, gambit, trellis. Type D: rickets, snippet, rennet, gannet, privet, gullet, limpet, russet.