

Instruction matters: spelling of vowels by children in England and the US

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Abstract Letter names are stressed in informal and formal literacy instruction with young children in the US, whereas letters sounds are stressed in England. We examined the impact of these differences on English children of about 5 and 6 years of age (in reception year and Year 1, respectively) and US 6 year olds (in kindergarten). Children in both countries spelled short vowels, as in *bag*, more accurately than long vowels, as in *gate*. The superiority for short vowels was larger for children from England, consistent with the instructional emphasis on letter sounds. Errors such as *gat* for words with long vowels such as *gate* were more common among US children, reflecting these children's use of vowels' names as a guide to spelling. The English children's performance on a letter knowledge task was influenced by the fact that they are often taught letter sounds with reference to lowercase letters and letter names with reference to uppercase letters, and their spellings showed some effects of this practice. Although emphasis on letter sounds as opposed to letter names influences children's patterns of performance and types of errors, it does not make the difficult English writing system markedly easier to master.

Keywords Spelling · Vowels · Letter names · Letter sounds · Letter knowledge · Literacy instruction

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Introduction

Cross-linguistic studies of literacy development have shown lower levels of performance among learners of English than among learners of many other alphabetic writing systems (Caravolas, 2004; Seymour, Aro, & Erskine, 2003). This difference has been attributed to the complexity of the English writing system and to properties of spoken English. Although differences among languages' writing systems and sound systems may explain some of the differences in literacy acquisition that are found across children in different countries, differences in formal and informal literacy instruction are likely to be important too (Caravolas, 2004). One way to tease apart the two sets of factors is to compare children from different societies who are learning to read and write the same language but who have different sorts of experiences. In the present study, we used this cross-cultural approach to compare young learners of English from England and the US.

The role of letter names in early literacy instruction has been long debated (Feitelson, 1988; Foulin, 2005), with some claiming that knowledge of conventional letter names provides an important foundation for literacy development and others arguing that children should begin by learning the sounds that letters make in words rather than the letters' names. The US and England have taken different positions on this debate. The US does not have a government-mandated literacy curriculum, but letter names are stressed in early informal and formal literacy instruction. Young US children are exposed to letters at home, through television programs such as *Sesame Street*, and in preschool programs. When letters are individually presented, it is their uppercase forms that are usually used with young children (Treiman, Cohen, Mulqueeny, Kessler, & Schechtman, 2007). In surveys, parents and teachers of US preschoolers report that they tend to identify letters by their conventional names, such as /em/ for <M>, rather than by the sounds that they make in words, such as /m/ for <M> (Ellefsen, Treiman, & Kessler, 2009; we use angled brackets to enclose letters, when it is important to be clear on their specific shapes, and slashes to enclose IPA symbols for phonemes). Consistent with the survey findings, analyses of conversations in preschoolers' homes suggest that US parents do not often speak about letters as making sounds, although they do speak about letters by name (Robins, Treiman, Rosales, & Otake, in press). When US children enter kindergarten, as they normally do in the fall after they have passed their fifth birthday, they can often name a number of letters, performing better on uppercase ones than on lowercase ones (Ellefsen et al., 2009; McBride-Chang, 1999; Worden & Boettcher, 1990). US kindergartners are taught about the sounds that letters make in words, learning for example that <M> corresponds to /m/. However, teachers and parents report in surveys that they continue to refer to letters by their names in many situations (Ellefsen et al., 2009). Given this emphasis on letter names, US kindergartners perform less well when asked to provide the sounds that letters make in words than when asked for the letters' names (McBride-Chang, 1999; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998). Moreover, US children sometimes make spelling errors that reflect their use of letters' names. For example, they may spell the nonword /warb/ with an initial *y* because its first two phonemes match the name of this letter, /wai/ (Ellefsen et al., 2009).

Parents and teachers of young children in England report in surveys that they stress letter sounds to a greater extent than US ones, and letter names less (Ellefsen et al., 2009). During reception year, which children in England usually begin before their fifth birthday, a national literacy curriculum emphasizes the teaching of letter sounds and phonics (Department for Education and Skills, 2007). A school's adherence to this curriculum is monitored by government inspectors. Letter sounds are normally taught using lowercase letters. Thus, reception year children are taught to refer to <m> as /m/ rather than as /ɛm/. The conventional letter names are taught at school after the letter sounds are known—often toward the end of reception year and sometimes at the beginning of Year 1, the next academic year. Letter names are often taught using uppercase forms. In line with the emphasis on letter sounds, young children from England tend to perform better when asked to provide the sound of a letter than when asked to provide the letter's name (Caravolas, Kessler, Hulme, & Snowling, 2005; Ellefsen et al., 2009). In addition, children from England are less likely than US children to make letter-name influenced spelling errors such as using *y* at the beginning of /warb/ (Ellefsen et al., 2009).

In the present study, we focused on English and US children's knowledge about vowel letters and their ability to use vowel letters in spelling words and nonwords. Vowels are a potential problem for the teaching of letter sounds for English because they (like some consonant letters, such as *c*) have more than one common pronunciation. If children are taught a single sound for each letter, which sound should be chosen? In England, children are taught that a vowel's sound is its lax or short pronunciation, such as /æ/ for *a*. This is the vowel's pronunciation in words such as *bag*. The tense or long pronunciation of the vowel, which tends to occur in longer and more complex words such as *tame* and *baby*, is considered the letter's name and is taught later, as are vowel digraphs (two-letter spellings) such as *ai*. In the US the short pronunciation of the vowel is taught in words such as *bag*. However, the long pronunciation—the letter's name—is used in many situations, as described earlier. In the current study, we examined spelling of words like *bag* and *tame* and knowledge of individual vowel letters among three groups of children: US kindergartners, English reception year children, and English Year 1 children.

Our spelling task included items with different types of vowels. Some, such as *bag* in the word condition of the spelling task and /dæp/ in the nonword condition, contained lax medial vowels. Specifically, these items contained the short vowels that are taught as the sounds of *a*, *e*, *i*, *o*, and *u*. Other items, such as *tame*, contained tense medial vowels that are the names of vowel letters. A short vowel in the middle of a monosyllabic word is usually spelled in English with a single vowel letter, as in *bat* and *dock*. A long vowel in this position is usually spelled with two letters. Many long vowels have several common spellings, including a vowel letter followed by *e* at the end of the word, as in *gate*, sometimes called a split digraph, or a sequence of two vowel letters, as in the digraphs of *rain* and *keep*. The degree of spelling uncertainty is generally greater for long vowels in monosyllabic words than for short vowels. Given this uncertainty, and given young children's difficulties in the spelling of digraphs (Caravolas et al., 2005; Treiman, 1993), it is not surprising that children in both England and the US spell monosyllabic words and nonwords with short vowels more accurately than those with long vowels (Davis & Bryant, 2006;

Viise, 1996). No previous study, however, has directly compared the spelling of long and short vowels by children from the two countries. We hypothesized that the benefit for short vowel items over long vowel items would be larger for both groups of English children than for US children because the short vowel is the letter sound that is stressed in England.

Given the emphasis on letter names in the US, we expected that US children would sometimes spell a long vowel using only the letter that has this name. Previous studies have found many such errors in the invented spelling of young US children. For example, these children sometimes write *gat* for *gate*, symbolizing the vowel sound with just the letter *a* and omitting the *e* that occurs at the end of the word's conventional spelling. Likewise, US children may misspell *pail* as *pal* (Beers & Henderson, 1977; Read, 1975; Reece & Treiman, 2001; Treiman, 1993). Some researchers have suggested, in fact, that such errors signal a stage of spelling development that occurs for all learners of English during which children rely heavily on letter names (Bear & Templeton, 1998; Young, 2007). However, an alternative explanation for errors such as *gat* for *gate* is that children sometimes remember the first letter of a digraph but forget or fail to include the second (Treiman, 1993). If the complexity of the conventional digraph is the primary explanation for spelling errors such as *gat* for *gate*, then English children should make as many errors of this sort as US children. If the emphasis on letter names contributes, as we hypothesize, then English children should make fewer such errors than US children.

Whereas most of the spelling errors that children make on vowels are substitutions, young children sometimes fail to include any vowel letter at all. We were interested in whether this tendency to omit vowels varies as a function of type of instruction. For children in England who are taught letter sounds, a word like *gum* begins with a stop consonant–vowel sequence that is similar to the label that the children learn as the sound of the letter *g* (normally /gə/). Thus, these children might sometimes use *g* to represent both the initial stop consonant and vowel sound in a word like *gum*, an error that would be scored as a vowel omission. English children are supposed to be taught that the sound of *m* is /m/ (although the letter sound can also be pronounced as /mə/). If so, then English children should make fewer *u* omissions on words like *mud*, which begin with consonants that may be sustained, than on words like *gum*, which begin with stop consonants.

We also asked whether and how instructional practices affect children's performance in tasks involving individual vowel letters. On each trial of our letter-knowledge task, the child heard a vowel phoneme such as /eɪ/ or /æ/. The child was asked to find the corresponding letter or letters given four choices: the upper- and lowercase forms of the correct letter, <A> and <ɑ> in this example, and the upper- and lowercase forms of an incorrect letter, such as <P> and <p>. Because letter sounds are typically taught in England with reference to lowercase letter forms and letter names with reference to uppercase forms, we predicted that children from England might sometimes choose <ɑ> but not <A> when asked for /æ/ and <A> but not <ɑ> when asked for /eɪ/. US children, we hypothesized, would be more likely than English children to choose both the uppercase and lowercase forms of the correct letter.

Method

Participants

A total of 179 children took part. There were 53 reception year children from England (mean age 5 years, 3 months; 28 girls), 61 Year 1 children from England (mean age 6 years, 3 months; 30 girls), and 65 kindergartners from the US (mean age 6 years, 3 months; 33 girls), all native speakers of English. In both countries, testing took place toward the end of the school year. The children from England attended one of 9 schools located in Birmingham, Essex, London, Newcastle, Warwickshire, or York. Two of the schools were stated-supported and church-affiliated, 6 were state-supported and not church-affiliated, and one was independent. The independent school emphasized letter sounds and phonics in reception year, following a similar policy as state-supported schools. The US children attended one of 6 schools (4 church-affiliated and 2 independent) located in or near St. Louis, Missouri. One of these schools, different from most other US schools, included both a junior kindergarten (similar to preschool) and a senior kindergarten; we tested senior kindergartners at this school.

Spelling task

Materials

The word condition had seven words in each of four categories. All were monosyllabic, and all were pronounced with a single initial consonant, a vowel, and a single final consonant. We did not use words with final *r*, which is typically not pronounced in England. Table 1 shows examples of the items in each category, and the Appendix provides a full list. One category of words contained long vowels that matched a letter name. These words had a two-letter spelling of the vowel, either a split digraph, as in *huge*, or a digraph with adjacent letters, as in *keep*. The words in the second category, such as *bag*, had short *a*, *e*, *i*, or *o*. The words in the third and fourth categories had short *u*. The words in these two last categories differed from one another in the nature of the initial consonant. In one category, the initial consonant was a stop, specifically /b/, /d/, /g/, /k/, /p/, or /t/. In other type of short *u* word, the initial consonant was a sustained consonant: /f/, /s/, /v/, /z/, /m/, or /n/. We avoided words that are spelled differently in England and the US, as with *colour* and *color*.

Table 1 Types of items in spelling task and examples of each type

Item type	Word condition	Nonword condition
Long vowel	<i>bike, huge</i>	<i>tibe, goke</i>
Short <i>a, e, i, o</i>	<i>bag, dock</i>	<i>pem, gop</i>
Short <i>u</i> , initial stop consonant	<i>gum, buzz</i>	<i>pum, gug</i>
Short <i>u</i> , initial sustained consonant	<i>mud, suck</i>	<i>vum, sud</i>

The words in the four categories were equated as closely as possible for their frequencies in reading materials for young children in the UK (using the Children's Printed Word Database, which provides word frequency counts for children aged 5 through 9; Masterson, Stuart, Dixon, & Lovejoy, 2010) and the US (using the summed frequency counts for kindergarten/first grade through third grade from Zeno, Ivens, Millard, & Duvvuri, 1995). Given the nature of short and long vowel spellings in English, the words differed in the lengths of their conventional spellings. The average was 3.3 letters for short vowel words and 4.0 letters for long vowel words.

A nonword condition was included to determine whether the same pattern of results would be found on items whose spellings children had not previously encountered. The nonwords fell into the same categories as the words. Examples appear in Table 1, and the Appendix provides a complete list. We show the spellings of the nonwords rather than their pronunciations because the pronunciations sometimes differ by dialect. For example, *gop* would generally be pronounced as /gɑp/ in the US and /gɒp/ in England. The spelling that is shown for each nonword contains the most common spelling of each phoneme given the surrounding phonemes.

Procedure

Approximately half of the children in each school were assigned to the word condition and the other half to the nonword condition. Because time constraints did not allow us to present all of the spelling items to each child, we divided the word and nonword items into two lists of 14 items each. Each list contained either 3 or 4 items from each category. The items in each list were arranged in a random order. Approximately half of the children in each condition were assigned to each list. (Due to an error, one child spelled 7 items from one list and 7 items from the other list.) A simple sentence was devised for each word.

The children were individually tested. For the word condition, the examiner said each word, said the sentence using the word, and then said the word again. The child was asked to repeat and then spell the word. If the child did not repeat the word correctly, the experimenter pronounced it again and gave the child another chance to repeat it. After the child had written the word, the experimenter asked the child to identify any unclear letters but did not comment on the accuracy of the child's spelling.

The children in the nonword condition were told that items were the names of creatures, pictures of which were shown on the child's answer sheet. The experimenter pronounced each item and asked the child to repeat it. If the child did not repeat a nonword correctly, the experimenter pronounced it again and asked the child to say it again before spelling it. If the child could not repeat an item after three attempts, which was very uncommon, the child was asked to spell the nonword. Children were encouraged to use the spelling they thought best, and the experimenter asked them to identify any potentially ambiguous letters.

Letter knowledge task

Materials

Each child received 10 items, 2 for each of *a*, *e*, *i*, *o*, and *u*. One of the items for each letter tapped knowledge of the corresponding long vowel sound, the letter's name. The other item tapped knowledge of the short vowel sound. For example, the long vowel question for *a* asked children to "find the /eɪ/" and the short vowel question asked them to "find the /æ/." Four options were provided for each question: the uppercase form of the correct letter (<A> in the example), the lowercase form of the correct letter (<a>), the uppercase form of an incorrect letter (e.g., <P>), and the lowercase form of the same incorrect letter (e.g., <p>; the incorrect letters were never *a*, *e*, *i*, *o*, or *u*). The four options were displayed on a line in a randomly determined order. Two forms of the letter knowledge task were constructed that differed in the identity of the incorrect letters. The questions for the different vowels were intermixed on each form.

Procedure

Approximately half of the children in each school were assigned to each form of the letter knowledge task. The child was asked to circle the correct letter or letters for each question. The experimenter did not indicate how many responses were correct for each question. With the exception of one child who was given the letter knowledge task in a separate session, the letter knowledge was given in the same session as the spelling task, after a short break.

Results

Spelling task

Five reception year children from England did not produce any spellings that could be scored, either because they declined to write any of the items or because they produced such things as curlicues or straight lines across the page. The results of these children are not included in the analyses of the spelling task.

Spelling accuracy

Table 2 shows the proportion of cases in which the children's spelling of an item matched the target spelling. The target spelling was defined as the conventional spelling in the case of words and the spelling shown in the [Appendix](#) in the case of nonwords. All groups of children performed better on short vowel items than long vowel items. However, supporting our hypothesis, the difference between the two types of items was larger for both groups of English children than for US children. Statistical support for this statement came from a mixed model analysis that was

Table 2 Proportion of children's spellings that match target spellings

Group	Vowel length	Proportion
England reception year	Long	.01
	Short	.42
England year 1	Long	.18
	Short	.76
US kindergarten	Long	.13
	Short	.48

carried out using the software package lme4 (Bates, Maechler, & Bolker, 2011). We used this method because it accounts for random variation between participants and between test items in a single analysis, which is a more accurate way of determining sources of variability than using multiple analyses of variance (Locker, Hoffman, & Bovaird, 2007). The analysis included, in addition to the random factors of participants and items, the factors of group (England reception year, England Year 1, and US kindergarten; the last group served as the reference group), lexicality (word, nonword), and vowel length (long, short) and the interactions between group and lexicality and group and vowel length. There was a main effect of vowel type ($p < .001$) and a main effect for the contrast between English reception year children and US kindergartners ($p = .004$), such that the English reception year children performed more poorly overall than the US kindergartners. The main effect for the contrast between the English Year 1 children and the US kindergartners was not statistically significant ($p = .16$). Importantly, both the contrast between English reception year children and US kindergartners and the contrast between English Year 1 children and US kindergartners interacted with vowel type ($p = .005$ and $p = .007$, respectively). That is, whereas all groups of children spelled short vowel items more accurately than long vowel items, the benefit for short vowels over long vowels was substantially larger for both groups of English children than for US children. Lexicality did not enter into any significant effects, meaning that the pattern of results was similar for words and nonwords.

Vowel omissions

The percentage of spellings that contained no vowel letter in any position was very low for English Year 1 children and US kindergartners, 2 %, causing problems for a mixed-model analysis that included all groups. The English reception year children omitted vowels 22 % of the time on average, and a mixed-model analysis for this group that included the variables of item category (long vowel; short *a, e, i, o*; short *u* initial stop consonant, short *u* initial sustained consonant) and lexicality showed no significant effects. The omission rate when the initial consonant and the vowel were very similar to a taught letter sound, as in items like *gum* that begin with a stop consonant, was virtually identical to the omission rate when the initial consonant and vowel do not constitute a taught letter sound, as in items like *mud* that begin with a sustained consonant.

Vowel identity and case

Given that children generally used a vowel letter, which letter did they use? We focused on the use of what we call the single appropriate vowel letter: *a* for short and long *a*, *e* for short and long *e*, *i* for short and long *i*, *o* for short and long *o*, and *u* for short and long *u*. When the vowel sound is short, as in *bag*, this is the correct spelling. When the vowel is long, as in *gate*, this single letter is incorrect. Children may use this letter because its name is the phoneme being spelled, because it is part of the conventional two-letter spelling, or for both reasons. Table 3 reports the proportion of spellings of short and long vowels that used this single letter. The US kindergartners were less likely than either group of English children to use the single appropriate vowel for short vowel items, and they were more likely to use this single vowel letter for long vowel items. That is, the US children showed a higher rate of spellings such as *gat* for long vowel items such as *gate* than did either group of English children. These impressions were supported by a mixed-models analysis using the factors of group, vowel type, lexicality, and the interactions between group and vowel type and group and lexicality. There was a main effect for the contrast between US kindergartners and English reception year children ($p = .002$) and a main effect for the contrast between US kindergartners and English Year 1 children ($p = .02$). These main effects were qualified by interactions with vowel type ($p < .001$ for both). Thus, the US children produced about as many *a* spellings for a tense vowel such as /eɪ/ as for a lax vowel such as /æ/, whereas both groups of children from England produced many more *a* spellings for the lax vowel, the letter sound they are taught, than for the tense vowel.

When children used the single appropriate vowel spelling, did they write the letter in lowercase or uppercase? Because young children may lack good control over letter height in their writing, we used the letter's shape to decide on its case. For example, the shapes <O> and <A> are rather different, making it easy to determine whether a child wrote a lower- or an uppercase form. We excluded items with *o* and *u* from this analysis because these letters have the same or very similar shapes in uppercase and lowercase. As documented above, the English reception year children did not use the single appropriate vowel letter all that often in the case of long vowels. When they used this letter, however, they chose the uppercase form 14 times out of 32, 44 %. The English reception year children used uppercase spellings at a much lower rate for short vowels, 2 of 78 times or 3 %. The association between vowel type and letter case was significant for the English reception year children by Fisher's exact test

Table 3 Proportion of spellings of vowels that use single appropriate vowel letter (*a* for long and short *a*, *e* for long and short *e*, *i* for long and short *i*, *o* for long and short *o*, *u* for long and short *u*)

Group	Vowel length	Proportion
England reception year	Long	.34
	Short	.66
England year 1	Long	.43
	Short	.95
US kindergarten	Long	.56
	Short	.55

($p < .001$, one tailed). The English Year 1 children used the uppercase form in 5 % (3 of 56) of the cases in which they spelled a long vowel with the single appropriate letter. They never did this for short vowels (0 of 147), yielding a significant association between vowel type and letter case ($p = .01$). The US kindergartners rarely used uppercase shapes for either long vowel or short vowel items (4 of 83 or 5 %, and 2 of 105, or 2 %, respectively), and the association between vowel type and letter case was not significant for this group. Although the numbers are small, it appears that young English children have some tendency to use uppercase <A> when they spell /eɪ/ with this single letter, and similarly for other letters with different upper- and lowercase shapes. This tendency may reflect the fact that letter names are often taught in England in conjunction with uppercase letters.

Letter knowledge task

In the letter knowledge task, children were asked to circle the letter or letters corresponding to long or letter name vowels such as /eɪ/ and short vowels such as /æ/. The choices included both the uppercase and lowercase form of the correct letter and two incorrect letters. Table 4 shows the proportion of cases in which children produced what we might consider a fully correct response: that is, choosing both forms of the correct letter and no incorrect letters. As Table 4 shows, children from England produced many fewer such responses than children from the US. Confirming this impression, a mixed model analysis using the random factors of participants and items and the fixed factors of vowel type (short vs. long) and group (UK reception, UK Year 1, US kindergarten) and the interaction between vowel type and group showed a main effect for the contrast between US kindergartners and UK reception year children ($p = .003$) and a main effect for the contrast between US kindergartners and UK Year 1 children ($p < .001$). Although the UK children tended to perform slightly better on short vowels than on long vowels, whereas the US children showed a small superiority for long vowels, the interaction between vowel type and group was not significant. Nor was the main effect of vowel type significant.

The relatively low rate of fully correct responses for children from England did not reflect a high rate of choices of incorrect letters. These were picked only 5 % of the time by the reception year children and less than 1 % of the time by the Year 1 children. Rather, the children from England often picked one form of the correct letter but not the other. To examine which form of the letter children tended to pick,

Table 4 Proportion of trials on letter knowledge task in which children picked both upper- and lowercase forms of correct letter and no incorrect letters

Group	Vowel length	Proportion
England reception year	Long	.20
	Short	.21
England year 1	Long	.24
	Short	.28
US kindergarten	Long	.54
	Short	.50

we analyzed performance on *a*, *i*, and *e*, which have clearly different shapes in upper and lowercase and where knowledge about one of the shapes would not necessarily allow a child to choose the other. When asked about the long vowel sound, those English reception year children who picked just one form of the correct letter tended to pick the uppercase form (68 of 113, 60 %). Uppercase choices were significantly less common when reception year children were asked about the short vowel sound (33 of 87, 28 %, $p = .001$ for the association between vowel type and letter case according to Fisher's exact test, one tailed). Similar results, although less strong, were found for English Year 1 children (74 choices of the uppercase form of 135 for long vowels, 55 %; 48 choices of the uppercase form of 131 for short vowels, 37 %, $p = .003$ according to Fisher's exact test). For US kindergartners, the proportion of uppercase choices did not differ significantly as a function of vowel type (56 of 90 for long vowels, 62 %; 47 of 88 for short vowels, 53 %). Pooling over short and long vowels, the US kindergartners were the only one of the three groups to show a significant preference for uppercase forms over lowercase letter forms ($p = .04$ by a binomial test, two tailed).

Discussion

Cross-linguistic studies have shown that English is a difficult language to learn to read and write (Caravolas, 2004; Seymour et al., 2003) and that English vowels are particularly difficult (Fowler, Liberman, & Shankweiler, 1977; Stage & Wagner, 1992; Treiman, 1993). By comparing English-speaking children from different societies, we can gain insight into which difficulties reflect characteristics of the language and the writing system that hold true for all learners of English and which reflect educational and cultural practices that differ from one English-speaking culture to another. In the present study, we used this cross-cultural approach in studying young children from England and the US. We focused on children's knowledge about vowel letters and their ability to use vowel letters in spelling.

A major difference between England and the US is in the degree to which parents and teachers of young children focus on letter sounds. In England, adults often refer to a vowel letter such as *a* as /æ/ rather than by its conventional name (Ellefsen et al., 2009). Likewise, government policy dictates a stress on letter sounds in early literacy instruction. Our results suggest that this emphasis on letter sounds contributes to the large benefit in spelling accuracy that English children show for words with short vowels, such as *bag*, over words with long vowels, such as *tame*. Part of this benefit reflects the lesser complexity and greater predictability of the vowel spelling in words like *bag*—fixed characteristics of the English writing system and of its relationship to the spoken language. However, another reason why children in England perform better on short vowels than on long vowels is the emphasis that is put on links like that between *a* and /æ/ in England. Thus, we replicated previous findings that both US and English children show an advantage in spelling accuracy for items such as *bag* over those such as *tame* (Caravolas et al., 2005; Davis & Bryant, 2006; Viise, 1996). We went beyond these findings by

showing that the advantage is substantially larger for young children from England than for young children from the US.

Children's invented spellings provide insight into their understanding of sounds and spellings, and previous studies have focused on children's knowledge of letter names as a major source of errors. US children have been found to produce many spellings such as *tam* for *tame* when they attempt to write words with long vowels (Beers & Henderson, 1977; Read, 1975; Reece & Treiman, 2001; Treiman, 1993). Based on such findings, some investigators have claimed that there is a letter-name stage of spelling development that occurs to the same extent for children in all English-speaking cultures, and they have suggested that educators should consider a child's stage of development when planning instruction (Bear & Templeton, 1998; Young, 2007). We found that children from England sometimes produce spellings like *tam* for *tame*, but less often than US children. Our results suggest that errors such as *tam* for *tame* occur, in part, because *a* is the first letter of the conventional split digraph. The errors partly reflect the complexity of the long vowel's spelling, a characteristic of the English writing system that holds across cultures. The stress that is put on letter names in the US, as documented in surveys of parents and teachers (Ellefson et al., 2009), analyses of letter-related conversations that occur in homes (Robins et al., in press), and studies of young children's knowledge of letter names versus sounds (McBride-Chang, 1999, Treiman et al., 1998), also promotes errors like *tam* for *tame* in US children. That is, letter name knowledge is one contributor to the errors but not the only contributor.

Previous studies have shown that the invented spellings of children in different English-speaking countries differ in ways that reflect properties of the children's dialects and home languages (Kemp, 2009; Rickard Liow & Lau, 2006; Treiman, Goswami, Tincoff, & Leever, 1997). Our results complement and extend these findings by showing that the invented spellings of children in England and the US also differ in ways that reflect the cultures' emphasis on letter names and teaching practices involving uppercase and lowercase letters. In a young US child, for example, *tam* is as likely to be an attempt to spell *tame* as an attempt to spell *tam*. It is more likely to spell *tam* for a child from England, but if it contains an uppercase *a* it may be an attempt at *tame*. Early spelling is not the same for children in different English-speaking cultures, and theories about its course of development must consider these differences.

The English children in our study came from different parts of the country, but the sample size was not large enough to permit a comprehensive study of dialect-related spelling differences. A critical assumption for the present study, and one that should be largely correct, is that speakers pronounce the vowel in a word such as *dock* similarly to how they pronounce the vowel when it occurs alone, as the letter sound. The distinction between short and long vowels is also critical for the present study, and it is generally preserved in regional accents.

Wholesale omissions of vowels were uncommon among the children in our study, and the English reception year children were the only group to make an appreciable number of such errors. Their omission rates did not differ for the stressed vowels of words such as *gum*, with an initial stop consonant, and the stressed vowels of words such as *mud*, with an initial sustained consonant. Ellefson

et al. (2009) found preliminary evidence for a difference between stops and sustained consonants when they examined omissions of unstressed final vowels, such as the /ə/ of /'nugə/ and /'sumə/, and they suggested that children from England sometimes use a single letter (e.g., *g*) to spell both of the phonemes in the sound label they are taught for it (e.g., /gə/). Additional study will be needed to determine whether English children sometimes use *g* to spell both /g/ and the vowel of a word like *gum* when tested earlier during reception year.

In England, letter sounds are generally taught with reference to lowercase letters and letter names are taught later, often using uppercase letters. Correspondingly, the English children in our study were less likely than the US children to select both forms of the correct letter in the letter knowledge task. These children sometimes selected just the lowercase shape to match the short vowel sound and just the uppercase shape to match the long vowel sound. The English practice of teaching letters' sounds with reference to lowercase letters and letters' names with reference to uppercase letters may be problematic, these results suggest, because it does not encourage children to treat the upper- and lowercase shapes as different versions of the same letter. The US children were less likely than the children from England to select just one form of the correct letter in the letter knowledge task. When they did so, they tended to pick the uppercase form. This preference probably reflects the stress that is placed on uppercase letter forms in the teaching of individual letters to young US children. When the US kindergartners in our study spelled words, however, they tended to use lowercase letters for the medial vowels studied here.

The English reception year children, most of whom had been in school for about the same amount of time as the US kindergartners, performed significantly worse on our spelling task. This was true even though our task contained a higher proportion of words with short vowel sounds than words with long vowel sounds, which should have been to the English children's advantage. The letter sound and phonics instruction that the English reception year children received, evidently, was not enough to overcome the fact that they were about a year younger than the US kindergartners. The English Year 1 children, who were about the same age as the US kindergartners, performed at a similar level to the US kindergartners on our spelling task when pooling over all words. When asked to spell nonwords whose spellings they could not have previously memorized as wholes, the English Year 1 students did not show an overall superiority over the US kindergartners. The results suggest that the educational practices used in England, including the early introduction of formal reading instruction, are not markedly more helpful than those in the US in allowing children to generalize to novel items.

The practice of referring to letters by their sounds was motivated by the idea that letter sounds are more useful than letter names in learning to read and spell (e.g., Feitelson, 1988). However, letter names may be worth learning because most of them, in English as in other languages, contain a phoneme that the letter symbolizes (Treiman & Kessler, 2003). Children who are familiar with the names of letters take advantage of this fact (Ellefson et al., 2009; McBride-Chang, 1999; Treiman et al., 1998). A further benefit of conventional letter names is that they follow the same phonological patterns as other words of the language. Some sound-based labels, such as /æ/ for *a*, do not; normal English words never end with short vowels.

Informal and formal instruction that stresses letter names as opposed to sounds leads to different patterns of performance and different types of errors for young learners of English. However, one set of practices does not make mastering this complex writing system markedly easier than the other.

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Appendix

Long vowel items

Words: *bike, bone, gate, huge, keep, kite, tame*

Nonwords: *bime, dape, goke, gope, peam, pute, tibe*

Short *a, e, i, o* items

Words: *bag, beg, bill, dock, pat, pet, top*

Nonwords: *bim, dap, gock, gop, pab, pem, tib*

Short *u*, initial stop consonant items

Words: *bus, buzz, cup, cut, duck, gum, tub*

Nonwords: *bub, dup, gub, gug, pum, tud, tup*

Short *u*, initial sustained consonant items

Words: *fun, fuzz, mud, mug, nut, suck, sun*

Nonwords: *fup, mub, nup, sud, sug, vum, zub*

References

- Bates, D., Maechler, M., & Bolker, B. (2011). *lme4: Linear mixed-effects models using S4 classes*. R package version 0.999375-39. <http://CRAN.R-project.org/package=lme4>.
- Bear, D., & Templeton, S. (1998). Explorations in spelling: Foundations for learning and teaching phonics, spelling, and vocabulary. *The Reading Teacher, 52*, 222–242.
- Beers, J. W., & Henderson, E. H. (1977). A study of developing orthographic concepts among first-grade children. *Research in the Teaching of English, 11*, 133–148.
- Caravolas, M. (2004). Spelling development in alphabetic writing systems: A cross-linguistic perspective. *European Psychologist, 9*, 3–14. doi:10.1027/1016-9040.9.1.3.
- Caravolas, M., Kessler, B., Hulme, C., & Snowling, M. (2005). Effects of orthographic consistency, frequency, and letter knowledge on children's vowel spelling development. *Journal of Experimental Child Psychology, 92*, 307–321. doi:10.1016/j.jecp.2005.08.001.
- Davis, C., & Bryant, P. (2006). Causal connections in the acquisition of an orthographic rule: A test of Uta Frith's developmental hypothesis. *Journal of Child Psychology and Psychiatry, 47*, 849–856. doi:10.1111/j.1469-7610.2006.01597.x.
- Department for Education and Skills. (2007). *Letters and sounds: Principles and practice of high quality phonics (Ref: 00281-2007FLR-EN)*. London, England: DFES Publications Centre.
- Ellefson, M., Treiman, R., & Kessler, B. (2009). Learning to label letters by sounds or names: A comparison of England and the United States. *Journal of Experimental Child Psychology, 102*, 323–341. doi:10.1016/j.jecp.2008.05.008.

- Feitelson, D. (1988). *Facts and fads in beginning reading: A cross-language perspective*. Norwood, NJ: Ablex.
- Foulin, J. N. (2005). Why is letter-name knowledge such a good predictor of learning to read? *Reading and Writing: An Interdisciplinary Journal*, 18, 129–155. doi:10.1007/s11145-004-5892-2.
- Fowler, C. A., Liberman, I. Y., & Shankweiler, D. (1977). On interpreting the error pattern in beginning reading. *Language and Speech*, 20, 162–173.
- Kemp, N. (2009). The spelling of vowels is influenced by Australian and British English dialect differences. *Scientific Studies of Reading*, 1, 53–72. doi:10.1080/10888430802633474.
- Locker, Jr., L., Hoffman, L., & Bovaird, J. A. (2007). On the use of multilevel modeling as an alternative to items analysis in psycholinguistic research. *Behavior Research Methods*, 39, 723–730. doi:10.3758/BF03192962.
- Masterson, J., Stuart, M., Dixon, M., & Lovejoy, S. (2010). Children's printed word database: Continuities and changes over time in children's early reading vocabulary. *British Journal of Psychology*, 101, 221–242. doi:10.1348/000712608X371744.
- McBride-Chang, C. (1999). The ABCs of the ABCs: The development of letter-name and letter-sound knowledge. *Merrill-Palmer Quarterly*, 45, 285–308.
- Read, C. (1975). *Children's categorization of speech sounds in English* (NCTE Research Report No. 17). Urbana, IL: National Council of Teachers of English.
- Reece, C., & Treiman, R. (2001). Children's spelling of syllabic /r/ and of letter-name vowels: Broadening the study of spelling development. *Applied Psycholinguistics*, 22, 139–165. doi:10.1017/S0142716401002016.
- Rickard Liow, S., & Lau, L. S. (2006). The development of bilingual children's early spelling in English. *Journal of Educational Psychology*, 98, 868–878. doi:10.1037/0022-0663.98.4.868.
- Robins, S., Treiman, R., Rosales, N., & Otake, S. (in press). Parent–child conversations about letters and pictures. *Reading and Writing: An Interdisciplinary Journal*. doi:10.1007/s11145-011-9344-5
- Seymour, P. H. K., Aro, M., & Erskine, J. M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology*, 94, 143–174. doi:10.1348/000712603321661859.
- Stage, S. A., & Wagner, R. K. (1992). The development of young children's phonological and orthographic knowledge as revealed by their spellings. *Developmental Psychology*, 28, 287–296. doi:10.1037//0012-1649.28.2.287.
- Treiman, R. (1993). *Beginning to spell: A study of first-grade children*. New York: Oxford University Press.
- Treiman, R., Cohen, J., Mulqueeny, K., Kessler, B., & Schechtman, S. (2007). Young children's knowledge about printed names. *Child Development*, 78, 1458–1471. doi:10.1111/j.1467-8624.2007.01077.x.
- Treiman, R., Goswami, U., Tincoff, R., & Leevers, H. (1997). Effects of dialect on American and British children's spelling. *Child Development*, 68, 229–245. doi:10.2307/1131847.
- Treiman, R., & Kessler, B. (2003). The role of letter names in the acquisition of literacy. In R. Kail (Ed.), *Advances in child development and behavior* (Vol. 31, pp. 105–135). San Diego: Academic Press.
- Treiman, R., Tincoff, R., Rodriguez, K., Mouzaki, A., & Francis, D. J. (1998). The foundations of literacy: Learning the sounds of letters. *Child Development*, 69, 1524–1540. doi:10.2307/1132130.
- Viise, N. M. (1996). A study of the spelling development of adult literacy learners compared with that of classroom children. *Journal of Literacy Research*, 28, 561–587. doi:10.1080/10862969609547940.
- Worden, P. E., & Boettcher, W. (1990). Young children's acquisition of alphabet knowledge. *Journal of Reading Behavior*, 22, 277–295. doi:10.1080/10862969009547711.
- Young, K. (2007). Developmental stage theory of spelling: Analysis of consistency across four spelling-related activities. *Australian Journal of Language and Literacy*, 30, 203–220.
- Zeno, S. M., Ivens, S. H., Millard, R. T., & Duvvuri, R. (1995). *The educator's word frequency guide*. Brewster, NY: Touchstone Applied Science Associates.