Children’s spelling of syllabic /r/ and of letter-name vowels:

Broadening the study of spelling development

Charles Reece
Rebecca Treiman
Wayne State University

Correspondence:
Rebecca Treiman
Psychology Department
Wayne State University
71 W. Warren Ave.
Detroit MI 48202
phone: 313-577-2852
fax: 313-577-7636
email: rtreiman@sun.science.wayne.edu

Abstract

Many previous studies of children’s spelling have adopted a narrow approach, examining one linguistic structure at a time and paying little attention to differences among children or changes with development. We broadened the focus by examining two different but potentially related patterns -- stressed syllabic /r/ and letter-name vowels -- and by examining changes in performance from fall to spring of first grade. The results show how children move from using one letter for each phonological unit (e.g., SR for sir, KON for cone) to appreciating the function of “extra” letters (e.g., the vowel letter of sir, the e of cone). Errors such as SRE for sir may arise during this process, reflecting overgeneralization of the silent e pattern. The results are generally consistent with the view that spelling becomes more “orthographic” with development. However, the course of development is not always as predicted by existing stage theories.
Children’s spelling of syllabic /r/ and of letter-name vowels:

Broadening the study of spelling development

Within the first few years at school, children’s attempts to write words change dramatically. Children move from apparently random strings of letters such as WT for cone to correct or near-correct spellings such as CONE or KONE for cone. How is it that children progress from more primitive to more sophisticated spellings? In recent years, an increasing amount of research has been carried out to describe the changes that take place in children’s spellings and to examine the mechanisms behind these changes.

Studies of children’s spelling may be divided into two categories. One set of studies uses what we may call a narrow approach. These studies have focused on children’s spellings of specific linguistic patterns. For example, researchers have studied children’s spelling of word-final consonant clusters (e.g., Read, 1975; Treiman, Zukowski, & Richmond-Welty, 1995; van Bon & Uit De Haag, 1997) and of /t/ and /d/ before /r/ (e.g., Read, 1975; Treiman, 1985). Studies using a narrow approach have generally examined one structure at a time, investigating the effects of specific linguistic factors on performance. For example, researchers have asked whether children’s ability to spell final consonant clusters varies with the types of phonemes in the cluster, comparing clusters beginning with nasals (as in sink) to clusters beginning with liquids (as in horse) and other types of phonemes.

The narrow approach has a number of good qualities. Studies in this tradition have paid careful attention to linguistic factors. The studies are generally strong from a statistical and methodological point of view. Another positive feature is the way in which information from spelling errors has often been supplemented with data from other
tasks. For example, researchers have collected data from the same children on spelling of consonant clusters and oral segmentation of syllables with such clusters (Treiman et al., 1995; Van Bon & de Haag, 1997).

The narrow approach has some weaknesses, however. Even when data on a variety of linguistic structures are available from the same children (as in Treiman, 1993), the focus has been on individual linguistic structures rather than on overall patterns of performance shown by particular children. Researchers who have adopted a narrow approach have not usually followed individual children’s growth across time. Instead, they have generally carried out cross-sectional studies.

A second approach to the study of children’s spelling may be called the broad approach. Studies in this group share a number of characteristics, including an emphasis on individual differences among children and on developmental changes in performance. Studies in this tradition have often assessed children’s spelling of a variety of linguistic structures, postulating particular relationships among the structures. Many of these studies have used a longitudinal approach. Whereas studies in the narrow tradition have been quantitative and statistical in nature, studies in the broad tradition have often relied on qualitative descriptions or less formal analyses. One such study is that of Beers and Henderson (1977), who followed the development of 25 first-grade children over six months. The authors discussed the changes that occurred in the children’s spelling but did not provide quantitative data on error types.

Studies using the broad approach have led to stage theories of spelling development. These theories postulate that children pass through a series of qualitatively different stages when learning to spell. Each stage is characterized by reliance on a
distinct type of knowledge. There are relationships among a child’s spellings of
different linguistic patterns because the spellings of each pattern reflect the knowledge
and skills that the child possesses during that stage. Stage theories have been proposed
by Ehri (1986), Henderson (1985), and Gentry (1982). Although each researcher posits
slightly different stages, the theories are similar in many respects. We focus here on the
stage theory of Gentry because it is representative and because it has been the basis for
much work on spelling assessment and instruction. In Gentry’s view, children progress
from precommunicative spellings -- apparently random letter strings such as WT for cone
-- to semiphonetic spellings that represent some of a word’s sounds (e.g., C or KO for
cone). The next stage of development is characterized by phonetic spellings, which
provide a complete map of a word’s phonetic features (e.g., KON for cone). This is
followed by the transitional stage, during which children increasingly rely on
conventional orthographic forms (e.g., COAN for cone). Children finally achieve correct
spelling.

The strength of the broad approach lies in its attempts to relate children’s
performance on different linguistic patterns and to characterize the abilities of individual
children. Sometimes, however, there has been a tendency to gloss over linguistic
differences. For example, existing stage theories claim that children in the semiphonetic
stage represent sounds or sound sequences that correspond to the name of a letter with
that letter whenever possible (Gentry, 1982). In this view, young children are as likely to
spell jar as JR as to spell mess as MS. Both /ɑr/ and /ɛs/ are the names of letters, and so
a letter-name strategy would yield single-letter spellings in both cases. However,
research within the narrow approach has shown that letter-name spellings of r are more
common than letter-name spellings of other consonants. This difference appears to reflect the special linguistic bond that exists between a vowel and a following /r/ (Treiman, 1993, 1994). The notion that children have a letter-name strategy that they use across the board is thus too simple.

In the present work, we attempted to bring the narrow and broad approaches together in the study of certain specific phenomena. Our goal was to maintain the positive features that have characterized the narrow approach, including its attention to linguistic detail, its quantitative rigor, and its use of various tasks. However, we sought to broaden the focus by examining more than one linguistic structure at a time and by examining individual children’s patterns of performance as well as group data. Our goal was to examine the links among different phenomena in a more detailed way than has been done in studies adopting the broad approach, but with more attention to individual differences and patterns of growth than in studies adopting the narrow approach. Nunes, Bryant and Bindman (1997) have used a similar strategy in their study of morphological patterns in English spelling.

The major issue of interest here was children’s spelling of words like sir. The printed form of sir is similar to that of sip in that both words contain an initial consonant, a vowel, and a final consonant. However, the spoken forms of the words in American English are rather different. Sip contains three units of sound -- an initial consonant, a vowel, and a final consonant. Each phoneme in the spoken form of the word is represented with its own letter in the printed form. Sir contains two units of sound -- an initial consonant followed by a unit that is often referred to as syllabic /r/. In stressed syllables, syllabic /r/ is written with a vowel letter (or letters) followed by r. The most
common vowel letters are e as in her, i as in sir, and u as in fur. In the words to which young children are exposed (based on words in the preprimer through fourth grade levels of the Harris and Jacobson [1972] lists), ur is the most common spelling of stressed syllabic /r/ (34%), followed by ir (26%) and er (16%). The remaining cases use some other spelling, as in learn and courage.

Several studies, both within the narrow tradition and the broad tradition, have examined the spelling of syllabic /r/ by young speakers of American English (Beers & Henderson, 1977; Read, 1975; Treiman, 1993; Treiman, Berch, Tincoff, & Weatherston, 1993; Treiman, Goswami, Tincoff, & Leivers, 1997). All of these researchers have reported that beginning spellers often represent syllabic /r/ with r alone, without a vowel. For example, children may misspell sir as SR or blur as BR. These single-letter spellings make sense given that syllabic /r/ is phonologically a single unit rather than a vowel + consonant sequence. The r errors further suggest that children consider the unit to be similar to consonantal /r/. There is some disagreement about what happens when children begin to include a vowel letter in their spellings of syllabic /r/. Treiman and her colleagues (Treiman, 1993; Treiman et al., 1993, Treiman et al., 1997) have reported that children sometimes place the vowel in the wrong position relative to the r, as in SRI or SRE for sir. However, the other studies cited above did not report any errors of this kind.

The syllabic /r/ studies of Treiman et al. (1993) and Treiman et al. (1997) were cross-sectional in nature, a limitation that is common in studies adopting the narrow approach. In Experiment 1, we carried out a short-term longitudinal study, testing children in the fall of first grade and again in the spring. We could thus follow individual children’s performance on syllabic /r/ across the school year.
In Experiment 1, we also examined a second linguistic pattern that is of interest in itself and because of its possible relationship with syllabic /r/. This pattern involves “long” (i.e., tense or diphthongized) vowels as in cone and time. In such words, the vowel is often spelled with the letter whose name matches the phoneme together with an e at the end of the word. Previous studies within both the narrow and broad traditions have shown that young children often use only the spelling that is suggested by the letter name, omitting the final e that is found in the conventional spelling of these words (Beers, Beers, & Grant, 1977; Beers & Henderson, 1977; Read, 1975; Treiman, 1993; Varnhagen, McCallum, Burstow, Pawlik, & Poon, 1997). For example, children use a lone o to spell the vowel of cone and a lone i for the vowel of time.

What kinds of changes take place as children progress from letter-name only spellings to spellings with a final e? According to existing stage theories, letter-name spellings predominate during the semiphonetic stage of spelling development (for vowels that children represent at all) and during the phonetic stage. Before children begin to spell the vowels correctly, they pass through a transitional stage that is characterized by spellings such as COWN for cone and MAET for mate. During this stage, children are thought to know that long vowel must be “marked” in some way. However, they do not fully understand the use of “silent” letters. Beers et al. (1977) and Beers and Henderson (1977) found a number of transitional vowel spellings among first graders. However, Varnhagen et al. (1997) found very few such spellings among children at each of the first- through sixth-grade levels. Given this disagreement, we revisited the issue of transitional spellings in Experiment 1. We asked whether there is a period of
development during which transitional spellings of long vowels predominate, as hypothesized by existing stage theories.

Another theoretically important question regarding letter-name vowels concerns the consistency of children’s spellings. Stage theories predict that children should perform in the same way for all letter-name vowels, using the same strategy for each. However, Varnhagen et al. (1997) found some inconsistency. The first graders in that study were more likely to use letter-name only spellings for words with /e/ (e.g., bake) than for words with /ai/ (e.g., time) and /o/ (e.g., home). To address this question, the present study compared children’s spellings of words with /e/, /ai/, /o/, and /yu/.

In addition to examining children’s spelling of syllabic /r/ and of letter-name vowels, we looked at the links between the two linguistic patterns. Existing stage theories make some specific predictions about these links. The phonetic stage of spelling development is thought to be characterized by single r spellings of syllabic /r/ (e.g., SR for sir) and letter-name spellings of long vowels (e.g., CON for cone). During the following stage, the transitional stage, children should spell syllabic /r/ with a vowel letter followed by r (e.g., SER for sir) and should often spell long vowels with sequences of two or more letters (e.g., COWN for cone). In Experiment 1, we asked whether syllabic /r/ spellings and long vowel spellings are related in the way predicted by existing stage theories.

Experiment 1

Method

Participants
Thirty-five first graders participated (21 boys, 14 girls), all native speakers of English. The children’s mean age was 6 years, 6 months (range 5.6 - 6.9) at the beginning of the fall test phase. The children were in one of two first-grade classes at a parochial school located in a middle-class suburb of Detroit, Michigan. The fall test phase for one class ran from late October to mid-November, and the spring test phase was from late March to late April. For the other class, the fall test ran from mid-November to mid-December (five of the children finished this phase in early January). The spring test for the latter class was from May to the first week of June. As measured by the spelling subtest of the Wide Range Achievement Test-Third Revision (WRAT 3; Jastak & Wilkinson, 1993), the children’s average spelling level at the time of the fall test was first grade (mean absolute score = 476) with a range from kindergarten to third grade (462-491). At the spring test, the average spelling level was second grade (mean absolute score = 483) with a range from first grade to fourth grade (466-496). An analysis of variance (ANOVA) using the factors of time and class confirmed that the children’s spelling performance improved from fall to spring. However, there were no significant differences between the performances of the children in the two classes.

A questionnaire given to the two teachers revealed similar teaching methods, further supporting the decision to analyze the results of the two classes together. In both classes, the children began to learn about silent final e through vocabulary words from a reading series in November or December and in a phonics book in January. Explicit tuition about the spelling of syllabic /r/ words via the phonics book did not begin until May, but syllabic /r/ words occurred throughout the year in the reading series. Both teachers used a combination of phonics and whole language methods to teach spelling
and reading. Once a week, the children received ten words to learn for a spelling test that would be given later in the week. Corrective feedback was given on all spelling tests the following week.

**Stimuli**

The experimental spelling test contained a total of 36 words. As Table 1 shows, six words had a final syllabic /r/ and six had a medial syllabic /r/. For each type of syllabic /r/ word, there was a set of control words that were similar to the syllabic /r/ words in length and grade level at which the word is typically introduced. As many letters as possible were shared between the control words and the syllabic /r/ words. The syllabic /r/ words were slightly (but not significantly) more frequent than the control words, working against our hypothesis that children would have special difficulty with the syllabic /r/ words.

The remaining 12 words were designed to assess children’s knowledge of the vowel + final e spelling pattern. There were three words with each of the vowels /e/, /ai/, /o/, and /yu/. The conventional spellings in these words were a + final e, i + plus final e, o + final e, and u + final e, respectively. The letter-name words were similar to the syllabic /r/ words in number of letters, grade level, and frequency.

The various types of words on the spelling test were randomly intermixed for presentation. One randomized order was used with all of the children in the fall and a different order was used in the spring. Appendix A provides a complete list of the stimuli.

**Procedure**
The fall test was spread over three sessions. The first session, which was carried out with groups of two or three children, included 24 of the spelling words. The second session, also carried out in groups of two or three, consisted of the remaining 12 spelling words followed by another task that is not reported here. During the third session of the fall test, the spelling subtest of the WRAT 3 was individually administered following the published directions. For the spring test, all 36 spelling words were given in the first session. The second session included the spelling subtest of the WRAT 3 and a test that is not reported here. The spring testing was done in groups of two or occasionally three children.

For the experimental spelling test, each word was presented a minimum of three times. The experimenter pronounced the word, then used it in a sentence, and then pronounced the word again. The word was repeated once more if a child asked or did not appear to be paying attention. The child then spelled the word with a pencil on wide-lined paper. If a letter seemed to be reversed (b and d reversals being the most common), the experimenter commented that it was difficult to discern that particular letter. This comment usually prompted the child to state the correct letter or make a correction on the paper. Otherwise, no probing took place in response to misspellings.

**Results**

**Spellings of syllabic /r/ words and control words**

Our first analyses focused on children’s spellings of the syllabic /r/ words and the control words. These analyses were carried out to verify that the children in this study, like those in the studies cited earlier, spelled syllabic /r/ words such as sir differently from control words such as sip. Also, since some previous studies have reported errors such as
Children’s spelling 13

SRI and SRE for sir but others have not, we wanted to determine whether such vowel-consonant reversals were more common for the syllabic /r/ words than the control words.

In scoring the children’s spellings of the syllabic /r/ words and the control words, we first determined whether the spelling included one or more vowel letters, correct or not, in any position. Some spellings of sir that contained a vowel were SRUE, SUW, POP, SER, and SIR. As Table 2 shows, children were less likely to include a vowel letter in words that contained a syllabic /r/ than in control words. The difference between syllabic /r/ words and control words, collapsed across position, was 41% in the fall and 21% in the spring. Children’s tendency to include vowel letters increased from the fall to the spring of first grade.

Statistical support for the above conclusions came from ANOVAs using the factors of time (fall versus spring), position (final versus medial), and stimulus type (syllabic /r/ versus control). In this and the following ANOVAs, data were analyzed by subjects ($F_1$) and by items ($F_2$). There was a main effect of stimulus type, $F_1(1, 34) = 59.50; F_2(1, 20) = 203.57; p < .001$ for both. Children were less likely to include vowel letters in syllabic /r/ words than control words. A main effect of time was found as well, $F_1(1, 34) = 31.98; F_2(1, 20) = 512.85; p < .001$ for both. A significant interaction between time and stimulus type was also found, $F_1(1, 34) = 6.71, p = .014; F_2(1, 20) = 122.45, p < .001$. This interaction reflects the larger increase in vowel inclusion for syllabic /r/ words than for control words from the fall to the spring, control words being close to ceiling in the fall. Finally, an interaction between time and position emerged, $F_1(1, 34) = 5.93, p = .02; F_2(1, 20) = 11.19, p = .003$. This interaction reflects a greater
improvement from fall to spring for final position words (24%) than for medial position words (18%). No other effects were significant by both subjects and items.

We also scored the spellings for whether they contained the correct postvocalic consonant letter, defined as the letter following the vowel in the conventional spelling of the word. For blur, DR, BLIRE, and BLRE all contain the correct postvocalic consonant letter (r), whereas BLEN and MAC do not. We expected that children would generally include the r of syllabic /r/ words. However, previous findings with English-speaking children (e.g., Read, 1975; Treiman, 1993; Treiman et al., 1995) led us to expect frequent omissions for the postvocalic consonants of medial control words like pump and sink, which are the first consonants of final clusters. As Table 3 shows, these predictions were supported.

ANOVA using the factors of time, position, and stimulus type revealed a three-way interaction,  $F(1, 34) = 11.70, p = .002$; $F(1, 20) = 19.17, p < .001$. This interaction occurred because the largest increase in postvocalic consonant inclusion from fall to spring occurred for the medial control words. There was relatively little room for improvement for the other types of words. Additionally, there were two significant two-way interactions: time by position,  $F(1, 34) = 20.36; F(1, 20) = 54.01; p < .001$ for both, and position by stimulus type,  $F(1, 34) = 40.94, p < .001; F(1, 20) = 10.15, p = .005$. All main effects were significant: time,  $F(1, 34) = 27.01; F(1, 20) = 66.11; p < .001$ for both, position,  $F(1, 34) = 56.12; F(1, 20) = 31.81; p < .001$ for both, and stimulus type,  $F(1, 34) = 44.48, p < .001; F(1, 20) = 13.32, p = .002$.

The third characteristic that we scored was order. Of the spellings that included one or more vowel letters and the correct postvocalic consonant letter, in what proportion
were the vowel(s) and the consonant unambiguously in the correct order? Examples of spellings with correct ordering are PUR and PUAR for purr and SARN for spur. We considered order to be incorrect if any vowel letter followed the postvocalic consonant letter, even if another vowel letter preceded the consonant. Thus, SIRE, RE, and SRRU were counted as incorrectly ordered spellings for sir.

The results, shown in Table 4, reveal that correct ordering was less common for syllabic /r/ words than for control words. Statistical analyses confirmed the main effect of stimulus type, $F_1 (1,18) = 26.26$; $F_2(1, 20) = 77.77$; $p < .001$ for both. In addition, the items analysis indicated that correctly ordered spellings were more common in the spring than the fall, especially for syllabic /r/, $F_2(1,20) = 6.83$, $p = .017$ for the interaction of time and stimulus type; $F_2(1,20) = 9.42$, $p = .006$ for the main effect of time. These effects were not significant in the subjects analysis, most likely because we had to exclude from this analysis the results of those 16 children who did not produce at least one spelling that included both a vowel letter and the correct postvocalic consonant letter for at least one word in each cell.

Finally, we examined the vowel letters that children chose for their syllabic /r/ spellings. Previous studies have documented that children often fail to include a vowel in their spelling of syllabic /r/, but they have not usually considered which vowel letter children use when they do include a vowel. For the words in this study, the conventional vowel letter was either u or i. As Table 5 reveals, however, the children used e more often than either u or i in both the fall and the spring.

**Spellings of letter-name vowels**
Children’s spellings of the letter-name words were divided into four categories. The least advanced spellings were placed in the category of primitive spellings. These spellings did not include a representation of the vowel, as in ML for mule, used an unexpected letter for the vowel, as in MAL for mule, or deviated substantially from the correct spelling in terms of the consonant letters, as in HCT for mule. According to broad-based stage theories, such spellings are thought to occur during the precommunicative and semifonetic stages. Letter-name spellings contained one instance of the correct vowel letter but no final e. For example, MUL and MULL for mule belong to the letter-name category. Such spellings are thought to characterize the phonetic stage. At the next level of sophistication, according to stage theories, are transitional spellings. Here, two or more letters are used to symbolize the vowel, as in MEUL, MUUOL, or MYOOL for mule. These spellings are thought to occur during the transitional stage of spelling development. Finally, correct spellings contained one instance of the correct vowel letter and a final e, as in MULE or MULLE for mule. In these cases, the vowel is spelled in the conventional way.2

Table 6 shows, for each vowel, the mean proportions of spellings that fell into each category in the fall and spring tests. Primitive spellings sometimes occurred during the fall but were quite uncommon in the spring. Spellings that used only the letter name vowel also decreased in frequency from fall to spring, whereas correct spellings consisting of the letter-name vowel plus final e increased. Transitional spellings were infrequent at both test periods, except in the case of the vowel /yu/.

ANOVA comparisons using the factors of time (fall versus spring) and vowel (/e/, /ai/, /o/, /yu/) were carried out for each type of spelling. For primitive spellings, the only effect
that was significant by subjects and by items was the main effect of time, $F_1(1,34) = 14.52; F_2(1,8) = 48.49; \ p < .001$ for both. Primitive spellings decreased in frequency from the fall to the spring.

Letter-name spellings also showed a significant decrease from fall to spring, $F_1(1,34) = 31.81; F_2(1,8) = 94.24; \ p < .001$ for both. There was also a main effect of vowel, $F_1(3, 102) = 11.11, \ p < .001; F_2(3,8) = 6.81, \ p = .014$, and a significant interaction between vowel and time, $F_1(3,102) = 5.39, \ p = .002; F_2(3,8) = 4.52, \ p = .039$.

In the fall, there were fewer letter-name spellings of /yu/ than of the other vowels, which did not differ significantly from one another. In the spring, letter-name spellings were less common overall. Also, there were no longer reliable differences among the four vowels in the frequency of such spellings.

Transitional spellings were more common for /yu/ than for the other vowels ($F_1(3,102) = 20.34; F_2(3,8) = 27.99; \ p < .001$ for both). Pooling over the two tests, transitional spellings occurred 30% of the time for /yu/ but only 5% of the time for the other vowels, which did not differ significantly from one another.

Finally, the analyses of correct spellings showed a significant main effect of time, $F_1(1,34) = 80.53; F_2(1,8) = 236.40; \ p < .001$ for both. Conventional spellings with final e increased from the fall to spring. A main effect of vowel also emerged ($F_1(3,102) = 6.36, \ p = .001; F_2(3,8) = 10.28, \ p = .004$). There were fewer letter-name plus final e spellings for /yu/ than for the other vowels, which did not differ significantly from one another.

Changes in individual children’s spellings of syllabic /r/ from fall to spring
The analyses presented so far have examined group data, as is typically done in studies employing a narrow approach. It is also important to individual children’s performances and how they change across time. To examine changes from fall to spring in individual children’s spelling of syllabic /r/, each spelling of a syllabic /r/ word was classified into one of five categories. Primitive spellings did not include an r, as in SUW for sir or ASSFA for curl. According to stage theories, such spellings should be found during the precommunicative and semiphonetic stages of development. R spellings contained an r but no vowel, as in SR for sir and CRL for curl. These spellings typify the phonetic stage according to existing stage theories. RV spellings contained at least one vowel letter and at least one r, but the vowel letter (or one of the vowel letters, if there were more than one) came after the r rather than before it. Examples are CRLA for curl and SIRE for sir. Such spellings have not been considered by existing stage theories, but were included here because the analyses reported earlier indicated that they do occur among beginning spellers. VR spellings contained one or more vowel letters and r, with the vowel letter(s) preceding the r. The vowel letter(s) had to be incorrect. Examples are SAR for sir and CERL for curl. According to stage theories, spellings of this kind should begin to predominate during the transitional stage of spelling development. Finally, correct spellings had both the conventional vowel letter and an r in the right order, as in SIR for sir and CURLL for curl. After classifying each child’s spellings of each of the 12 syllabic /r/ words, we determined which type of spelling was most prevalent for each child. In the case of a tie, the more advanced type was chosen.

Table 7 shows, for the fall and spring tests, the number of children whose spellings fell into each category. The cells above the diagonal represent the children who
progressed, according to the classification scheme presented above, in their spelling of syllabic /r/ (n = 16). The diagonal consists of the children whose spellings were similar in the fall and the spring (n = 17). Only two children, those in cells below the diagonal, retrogressed. There was a positive correlation between spelling type and performance on the WRAT 3 spelling test when the data from the fall and the spring were examined together, r_s = .58, p < .001. These results suggest that the preceding classification scheme captures the course of development in a reasonable manner, even though it is simplified in some respects (e.g., two children may be classified alike even though one shows a large preference for spellings of a particular type and the other shows a smaller preference).

Changes in individual children’s spellings of letter-name vowels from fall to spring

We examined changes across time in individual children’s spelling of letter-name vowels in a similar way to that done for syllabic /r/. For this analysis, a child was placed in the primitive category if the majority of his or her spellings of letter-name words fell into the category of primitive spellings, as defined earlier. For letter-name children, the majority of spellings used the letter-name vowel, with no final e. Transitional children showed a majority of spellings in the transitional category, and correct children used the letter name followed by final e in the majority of their attempts.

Table 8 presents the results for the fall and spring tests. The most common pattern, shown by 16 children, was to progress from letter-name spellings in the fall to correct spellings in the spring. Another 13 children produced spellings of the same type on both tests, and 6 showed other patterns that indicated advancement according to the preceding scheme. No child retrogressed. The rank-order correlation between spelling
type and performance on the WRAT 3 spelling test, combining data from the fall and spring testing sessions, was \(0.62, p < .001\).

**Relationship between spelling of syllabic /r/ and spelling of other vowels**

One of our main goals in this work was to study the relationship between children’s spellings of syllabic /r/ and their spellings of letter-name vowels. For this purpose, we examined the spellings of letter-name vowels that were produced by children whose dominant spellings of syllabic /r/ fell into different categories. The results are shown in Table 9. The first row of the table shows that children who produced predominantly primitive spellings of syllabic /r/ at a given point in time tended to do the same for letter-name vowels. For these children, 58% of the letter-name spellings fell into the primitive category. Children who primarily used a lone r to represent syllabic /r/ tended to use a lone letter-name vowel to represent vowels such as /e/. For these children, letter-name spellings significantly outnumbered conventional letter-name plus final e spellings by a chi-square test, \(p < .001\). Those children who included a vowel in their spellings of syllabic /r/ also tended to include a final e in their spellings of letter-name vowels. This was true whether the children’s syllabic /r/ spellings often had the vowels in the incorrect position (dominant spelling type for syllabic /r/ of RV) or whether the vowels were generally in the correct position (dominant spelling types VR and Correct). In each case, correct letter-name plus final e spellings significantly outnumbered spellings that included only the letter-name vowel (\(p < .001\) for all).

As mentioned above, e was the most commonly used vowel in the children’s spelling of syllabic /r/. For those children who tended to use a vowel in the incorrect position (dominant spelling type RV), this vowel was often a word-final e, as in SRE for
These children sometimes used an e at the end of the control words as well, as in PUFE for puff or HITE for hint. For the four children with the highest rate of final es in syllabic /r/ words (mean = 73%), incorrect final es occurred 29% of the time on the control words.

Discussion

The present findings provide further information about two phenomena that have been studied in past research -- children’s spelling of syllabic /r/ and children’s spelling of letter-name vowels. In addition, the results provide new evidence about the links between children’s performance on the two linguistic structures.

With regard to syllabic /r/, the findings of the present short-term longitudinal study replicate and extend those of previous cross-sectional work within what we have called the narrow approach to the study of spelling (Treiman et al., 1993; Treiman et al., 1997). During the fall of first grade, children often spelled stressed syllabic /r/ as r alone, with no vowel. The use of vowels increased from the first to the second half of the school year, although vowel omissions were still more common for words like sir than for words like sip during the second test. In addition, spellings of words like sir were more likely to involve a misordering of the vowel and the postvocalic consonant letters than spellings of words like sip. Misordering errors were not mentioned by Read (1975) or Beers and Henderson (1977). The present results, together with the earlier findings of Treiman and her colleagues (Treiman, 1993; Treiman et al., 1993; Treiman et al., 1997), indicate that these errors do occur among first graders. This finding is not expected under current stage theories of spelling development, which postulate that children move directly from r spellings of syllabic /r/ (in the semiphonetic and phonetic stages) to vowel
+ r spellings (in the transitional stage). Our data provide evidence that at least some children go through an intermediate period that is characterized by uncertainty about the placement of the vowel letter relative to the r. Not all children appear to go through such a period of uncertainty, but some do.

With regard to letter-name vowels, the first graders progressed from many letter-name only spellings in the fall to a majority of correct letter-name plus final e spellings in the spring. For /e/, /ai/, and /o/, we found few of the transitional spellings such as MAET for mate that are postulated by stage theories such as that of Gentry (1982). Only for /yu/ did we find an appreciable number of spellings that fit into the transitional category. Our results thus do not show the consistency across vowels that is predicted by stage theories such as that of Gentry (1982). They also shed doubt on the mechanism that such theories postulate as underlying transitional vowel spellings -- a general tendency to “mark” long vowels. In our view, the aberrant results for /yu/ reflect a combination of children’s experience with conventional print and the phonological characteristics of this particular vowel. The letter-name only spelling of /yu/ as u does not occur very often in English. There are no preprimer words with u spellings of /yu/, although there some such words -- a, I, and go -- with letter-name only spellings of /e/, /ai/, and /o/ (Harris & Jacobson, 1972). Children’s exposure to letter-name only spellings of /e/, /ai/, and /o/ in common words such as a, I, and go may promote the belief that it is acceptable to spell these vowels with the only the letter whose name makes that sound. With /yu/, children may be less likely to entertain the letter-name alternative because of their lack of exposure to words that employ this spelling. In deciding how to spell /yu/, children may be more influenced by the diphthongal nature of this vowel. As research by Treiman and Cassar
(1997) indicates, first graders are able to distinguish between diphthongs and monophthongs. As a result, children may produce spellings such as MYOOL for mule.

Varnhagen et al. (1997) reported a lack of consistency in children’s use of letter-name spellings such that these spellings were more frequent for /e/ words than for /ai/ and /o/ words. We did not find a significant difference here. Varnhagen et al. did not report whether transitional spellings were more common for some vowels than for other vowels in their data.

In addition to examining children’s spellings of syllabic /r/ and letter-name vowels in isolation, we examined the relationships between the two patterns. In this way, we hoped to go beyond previous studies that have adopted a narrow approach to the study of spelling development and that have focused on one linguistic structure at a time. We found that children who represented syllabic /r/ with a lone r also tended to represent letter-name vowels with a lone vowel. Children began to use a vowel in their spellings of syllabic /r/ (if not necessarily in the correct location relative to the r) and a final e in their spellings of letter-name vowels at around the same time. These children sometimes even use a final e for “short” vowels, as in PUFE for puff. We will consider the links between these phenomena in more detail in the General Discussion.

In Experiment 2, we delved further into children’s understanding about the spelling of syllabic /r/ by combining data from a spelling production task with data from another task. As discussed earlier, the use of data from other tasks to supplement spelling error data has been a positive feature of the narrow approach, and was adopted in our second experiment. The spelling production task of Experiment 2 used nonsense words, in contrast to the real words of Experiment 1. This allowed us to check whether the
results of Experiment 1 generalized to nonwords, cross-validating the Experiment 1 results.

The supplemental task included in Experiment 2 was a spelling choice task. In this task, children were presented with two potential spellings of a nonword and were asked to circle the spelling that seemed “best” to them. For example, children chose between der and dr for the nonword /dr/. In another session, the children were asked to spell /dr/ and other nonwords containing syllabic /r/. By gathering information about children’s spelling choices, we hoped to gain further information about their knowledge of the spelling of syllabic /r/, and in particular their knowledge of the vowels that are used in these spellings.

Another motivation for using a spelling choice task was to compare children’s ability to produce spellings on their own and their ability to judge previously produced spellings. Earlier studies using a spelling choice task have found a surprising degree of knowledge on the part of young children. The results suggest that children may have a degree of incipient knowledge that can be revealed in a less cognitively demanding situation (a choice task) more readily than in a complex situation (a spelling production task). For example, first graders and even kindergartners show a small but significant preference for nonwords like pess over nonwords like ppes (Cassar & Treiman, 1997; Treiman, 1993). Apparently, children have begun to learn that consonant doublets may occur at the ends of English words but not at the beginnings. They can show this knowledge quite early in a spelling choice task. As another example, Cassar and Treiman (1997, Experiment 3) looked at performance in a spelling choice task by children whose spellings had many characteristics of the phonetic stage as described by
Gentry (1982). For instance, these children spelled *kicked* as KICT and *dime* as DIM. When asked to pick between *kicked* and *kict* or *dime* and *dim*, the children did not consistently choose the spellings that were similar to those they produced themselves. Indeed, some of the children seemed to prefer the correct spellings. Cassar and Treiman used real words in their study, so it is not clear whether these children had a general understanding about the spelling of the past tense, say, or whether they chose the spelling that looked more familiar. In the present study, neither option (e.g., *der*, *dr*) was a familiar printed word. Hence, children could pick the “better” of the two choices only if they had some general knowledge about the spelling of syllabic /r/. Of interest was whether children would reveal a knowledge about vowels in the spelling choice task before they were able to reveal it in their own spellings.

The spelling choice task of Experiment 2 included choices with *e* (e.g., *der* vs. *dr*), choices with *i* (e.g., *kir* vs. *kr*), and choices with *u* (e.g., *lur* vs. *lr*). All three vowel + r sequences – *er*, *ir*, and *ur* – are conventionally pronounced as syllabic /r/. By asking whether children chose the vowel + r option for all three vowels or only for *e*, we could determine whether children possess a general rule that spellings of syllabic /r/ must contain a vowel letter or whether their knowledge is specific to *e*, the vowel that they use most often in their own spellings.

**Experiment 2**

**Method**

**Participants**

Thirty children (15 boys and 15 girls) with a mean age of 6 years, 7 months (range 6,1-7,4) participated. All were native speakers of English. The children were in
one of two first-grade classes at the same school where Experiment 1 had taken place two years earlier. One class was tested in the last half of October and the other class was tested in the first half of November. The children’s average level on the reading subtest of the WRAT 3 (Jastak & Wilkinson, 1993) was first grade (mean absolute score = 474), with a range from kindergarten to third grade (458-491). The average spelling level was first grade (474) as well, with a range from kindergarten to second grade (454-484). The children in the two classes did not differ significantly on these measures.

The teachers were the same as in Experiment 1, and their methods of teaching spelling had not changed since the time of Experiment 1. The children had not been explicitly taught about the need to include a vowel letter in the spelling of syllabic /r/ words at the time that Experiment 2 took place. However, the children had encountered some words with syllabic /r/ in their weekly spelling lists.

Stimuli

Spelling production test. The spelling test included 27 monosyllabic nonwords, all of which contained a stressed syllabic /r/ in their pronunciation. Nine nonwords consisted of a single consonant followed by syllabic /r/, as in /dr/. Another nine nonwords had an initial two-consonant cluster followed by syllabic /r/, as in /flr/. The remaining nine cases involved a single initial consonant followed by a syllabic /r/ and a single final consonant, as in /grp/. Appendix B provides a complete list of the stimuli.

In constructing the nonwords, we avoided /r/ except as syllabic /r/ so that there would be no confusion about which /r/ a child was spelling. Other than syllabic /r/, only phonemes that are typically spelled with single-letter graphemes were used. The stimuli included three real words (cur, myrrh, and burl), but these words are so uncommon
(Zeno, Ivenz, Millard, & Duvvuri, 1995) that they probably functioned as nonwords for the children. We will refer to them as such. The stimuli for the spelling test were randomized, with a different random order used for each class.

Choice test. The choice test was based on the same 27 stimuli that were used for the spelling production test. Two options were offered for each stimulus. In the VR choice, the syllabic /r/ was represented with a vowel letter followed by r. We used the vowels e, i, and u, each vowel occurring an equal number of times. We chose these letters because they are the vowels most often used in the spelling of stressed syllabic /r/ in the words to which children are exposed (see analyses presented above) and in English as a whole (Venezky, 1970). For the R choice, the syllabic /r/ was spelled with only r. For both choices, consonants other than syllabic /r/ were spelled in the way that is typical for English. There were also three practice pairs. For these pairs, one choice was a legal English spelling and the other was frankly illegal, including one or more characters that was not a real letter (e.g., moz vs. 8b$). The test stimuli are shown in Appendix B.

Two random orders were used for the choice test, one for each first-grade class. The order of the two choices was randomly chosen for each stimulus. The test pairs were printed in large type, no more than five per sheet. The three practice pairs were on a separate sheet. Within each pair, the two choices were separated by a dash (e.g., der – dr). The pairs on each sheet were separated by lines.

Procedure

The experiment was carried out in two sessions, which were separated by at least a week. For about half the children, the first session consisted of the spelling production test followed by the reading subtest of the WRAT 3. The second session consisted of the
choice test followed by the spelling subtest of the WRAT 3. The order was reversed for the remaining children. Children were tested in pairs.

**Spelling production test.** The children were told that they would hear some “funny-sounding words.” They were asked to repeat each item after the experimenter. If they erred, the experimenter pronounced the item again and the child repeated it. The experimenter never needed to repeat an item more often than this. Once children were informed that their pronunciation was correct, they were asked to spell the nonword. The children used a pencil and wide-lined paper to produce their spellings. Because two children were tested at the same time, one child repeated and spelled each nonword and then the other child did so. The order in which the children were asked to respond alternated across stimuli. As in Experiment 1, children were questioned if they seemed to have reversed a letter.

**Choice test.** Children were told that they would hear some “funny-sounding words,” which they were asked to repeat. As with the spelling test, no more than one repetition past the child’s first pronunciation was ever necessary. The children were then asked to circle the choice that seemed to them to be the “best” spelling. The experimenter emphasized that there were no right or wrong selections. As in the spelling test, one child waited to repeat the nonword until the other child had done so. The order in which the children were asked to respond alternated across words.

Before beginning the test trials, the children were slowly taken through the practice trials and questioned about their choices. If a child picked the illegal choice, he or she was questioned to clarify any misunderstandings. The standard question about illegal choices involved asking whether the child had ever seen any words spelled with
the “funny-looking” symbols. In such cases, children invariably changed their answer to the legal choice.

Results

Spelling production test

The spellings of the nonwords were scored as in Experiment 1. The children almost always (95% of the time) included an r when spelling syllabic /r/. The percentage of spellings that included a vowel letter was 43%. Of those spellings that contained both a vowel letter and an r, the elements were in the correct order 66% of the time.

The children in Experiment 2 were statistically indistinguishable in age and WRAT 3 spelling score from the children tested in the fall of Experiment 1, attended the same school, and were taught by the same teachers. Comparing the spelling results for Experiment 2 to those observed in the fall of Experiment 1, we found no statistically significant differences. When the children were categorized according to their predominant type of spelling, the results were similar to those observed in the fall of Experiment 1. There was 1 child who produced primarily primitive spellings without an r, 19 children who generally used an r but no vowel, 2 children who produced primarily r + vowel spellings, and 8 children who produced primarily vowel + r spellings. (Correct spellings cannot be differentiated from vowel + r spellings in the case of nonwords, so no separate category of correct spellings was adopted here.) The most common vowel in the children’s spellings of syllabic /r/ was e, as Table 5 shows. The preference for e was stronger for the nonwords of Experiment 2 than for the real words of Experiment 1.

Choice test
Table 10 shows the proportion of VR choices for nonwords with each vowel. The results are presented separately for those children who often spelled syllabic /r/ without a vowel in their own productions and for those children who often used a vowel. For these analyses, we chose a cut-off value of .50 for the proportion of spellings that contained both a vowel letter and an r (i.e., the VR proportion). The mean value of VR was .10 (SD = .13, range 0 to .37) for children in the former group and .97 (SD = .09, range = .70 to 1.00) for children in the latter group. As Table 10 shows, children who did not usually use a vowel in their own spellings generally chose spellings without a vowel as “better” than spellings that contained a vowel. Children who often used a vowel in their own productions appeared to prefer the vowel + r choice when the vowel was e. When the vowel was i or u, however, these children seemed to prefer spellings with a lone r.

Statistical support for the above statements came from ANOVAs using the factors of group (low VR proportion, high VR proportion) and letter (e, i, or u). The main effect of letter, $F_1(2, 56) = 15.72; F_2(2, 24) = 15.11; p < .001$ for both, and the interaction between letter and group, $F_1(2, 56) = 8.58, p = .001; F_2(2, 24) = 11.70, p < .001$, were the only effects that were significant both by subjects and by items. Follow-up tests showed that there were no significant differences among the three vowels for children who often spelled syllabic /r/ with a lone r. For these children, the percentage of VR choices was significantly less than the 50% that would be expected by random guessing. For children who generally included a vowel in their own spellings of syllabic /r/, there was a significant effect of vowel letter, $F_1(2, 18) = 9.80, p = .001; F_2(2, 24) = 28.50, p < .001$. Although the results for this group are relatively weak due to the small number of
children involved, these children appeared to select the vowel + r choice more than 50% of the time only when the vowel was e. With i and u, even the more advanced children seemed to prefer single r spellings.

**Discussion**

In Experiment 2, we sought to gather further information about children’s knowledge of the spelling of syllabic /r/. One question was whether children’s choices between vowel + r spellings and single r spellings mirrored their own productions. On one scenario, children who have some incipient knowledge that spellings of syllabic /r/ should contain a vowel may be able to reveal this knowledge in the simple situation of a spelling choice test before they can reveal it in the more taxing situation of producing a complete spelling. On a second scenario, children’s performance in the spelling choice task should be consistent with their performance in the spelling production task. This latter outcome would suggest that the two tasks reveal the same degree and type of knowledge.

The results do not support the view that children can more easily reveal a knowledge about the spelling of syllabic /r/ in a choice task than in a production task. Children who did not usually include a vowel in their spellings of syllabic /r/ chose spellings without a vowel (e.g., dr for /dr/) as “better” than spellings with a vowel (e.g., der for /dr/). This held true regardless of the vowel letter that was included in the vowel + r choice. For children who included a vowel in their own spellings of syllabic /r/, the results again pointed to consistency between spelling choice and spelling production. These children tended to choose vowel + r spellings when these spellings contained the same vowel that they preferred in their own productions, e. When the children were
presented with spellings containing vowels that they did not use themselves (ir and ur), they tended to reject them and to select the single r spellings. The results for this group suggest that the spelling choice task, far from being easier than the spelling production task, is actually more challenging. Although the children in the more advanced group almost always used a vowel in their own spellings, they picked the single r choice (e.g., dr) over the er choice (e.g., der) over one third of the time. The outcome is quite striking. It suggests that single r spellings of syllabic /r/ remain compelling for children, difficult to reject when seen.

The findings further suggest that, when knowledge about the conventional spelling of syllabic /r/ emerges among first graders, this knowledge is rather specific. The first graders in Experiment 2 did not appear to know that spellings of syllabic /r/ should contain a vowel letter followed by r or that the spellings of all English syllables should contain a vowel letter. Instead, their knowledge was limited -- syllabic /r/ is spelled with e followed by r. The patterns that children induce from their own experience with print do not appear to be general or abstract, at least at first.

The spellings of nonwords in Experiment 2 were similar to those for real words in Experiment 1. Treiman et al. (1993), who compared spelling of real words with syllabic /r/ and nonwords with syllabic /r/ among the same children, also observed similar patterns of performance in the two cases. Apparently, the phonological processes that play a role in the spelling of nonwords are also important for real words. One difference between the results for nonwords and the results for words was that the preference for e in spellings of syllabic /r/ was greater for nonwords. Children may have been more likely to use ur and ir for the real words of Experiment 1 because they remembered the
conventional spellings of at least some of these words. Still, the influence of
conventional orthography was relatively weak in that children’s overall preference was
for e for words as well as for nonwords.

General Discussion

Many previous studies of children’s spelling have adopted a narrow approach,
looking at particular linguistic structures in isolation and paying little attention to
individual children’s patterns of performance or to changes in performance across time.
Studies that have adopted a broader approach, while they have led to influential theories
of spelling development, have sometimes not paid careful attention to linguistic factors.
In addition, some of these studies have not provided strong quantitative support for their
conclusions. One goal of the present research was to bring the two approaches together
in the study of certain specific phenomena, maintaining the advantages of the narrow
approach while incorporating some of the positive features of the broad approach. This
was done in Experiment 1, with Experiment 2 serving to validate and extend certain of
the results from the first experiment.

Our major interest was in children’s spelling of stressed syllabic /r/. Like
previous researchers (Beers & Henderson, 1977; Read, 1975; Treiman, 1993; Treiman et
al., 1993; Treiman et al., 1997), we found evidence for an early period of development
classified by single r spellings. Spellings such as SR for sir reflect the phonological
form of the word, in which the entire syllabic nucleus has an r coloring. Spellings such
as SR have been characterized as “phonetic” by existing stage theories.

Given the disagreements in the literature about what happens after the initial
“phonetic” spellings, we looked closely at the changes that occur after this point. Our
results show that two things happen as children begin to include a vowel in their spellings of stressed syllabic /r/. The first phenomenon is that children do not always place the vowel correctly relative to the r. At least some children put the vowel after the r rather than before it, as in SRE for sir. Children can be quite consistent in this error, with one child in Experiment 2 using an r followed by a vowel on 27 of 27 opportunities. A second phenomenon is that children show a strong preference for e over other vowel letters. Thus, the children in Experiments 1 and 2 used e more often than other vowel letters in their own spellings of stressed syllabic /r/. Also, the more advanced children in Experiment 2 showed a preference for vowel + r spellings in the choice test only when the vowel letter was e.

Why do children prefer e to other vowel letters when spelling stressed syllabic /r/? One possibility is that children generalize from unstressed syllabic /r/ to stressed syllabic /r/. In English, er is by far the most common spelling of unstressed syllabic /r/, as in water and eager. In the preprimer through fourth grade words of Harris and Jacobson (1972), unstressed syllabic /r/ is spelled as er over 80% of the time. Children may assume that the stressed version of syllabic /r/ should be spelled in the same way as the unstressed version. However, generalization from unstressed to stressed syllabic /r/ cannot easily explain errors such as BRNE for burn and SRE for sir. Unstressed syllabic /r/ is usually spelled with e followed by r. Re spellings (as in acre) are quite uncommon, occurring less than 0.5% of the time in the relevant preprimer through fourth grade words of Harris and Jacobson (1972). A closer examination of the reversal errors in Experiments 1 and 2 revealed that many (53% in Experiment 1 and 49% in Experiment 2) included a word-final e, as in the preceding examples.
We propose that children’s preference for e in spellings of syllabic /r/ and their tendency to place the e in word-final position reflects, in part, their experience with silent es as in make and came. Our data on children’s spelling of letter-name vowels support this proposal by showing that children at first consider TAM an excellent way to spell tame and CON an excellent way to spell cone. When children notice the final es in the conventional spellings of such words, or when they are taught about the final e pattern, they may not understand that the e is related to the vowel. They may consider it an “extra” letter that is added to the end of the word, a mere decoration that has no phonological function. Similarly, children at first consider HR an excellent way to spell her, a word that to them includes two units of sound. When children notice or are taught that the conventional spelling of her contains an e, they may not understand this letter’s role. To them, it may be an extra letter that lacks a phonological purpose, just like the e of make. Spellings such as CONE for cone and SRE or SER for sir may emerge around the same time, as the results of Experiment 1 show, because both reflect children’s belief that English sometimes includes letters that have no obvious phonological function.

English, with its complex writing system, contains a number of cases in which letters do not map straightforwardly onto sounds. Based on our findings, we propose a model of how children learn about “silent” es and other complex relations between sounds and letters that occur in English. Our story begins when children understand that the spellings of words reflect their sounds and when they are able to represent all of the sound units that they hear in words. At this point, children hypothesize that each unit in their conceptualization of a spoken word should be spelled with a single letter and that there should be no “extra” letters. Children thus spell sir as SR (since syllabic /r/ is to
them a single unit) and cone as CON. As another example, children may spell a vowel + liquid sequence with a single letter because it forms a single unit for them. This leads to errors such as MIK for milk (e.g., Treiman et al., 1995). Note that the developmental phase under consideration here is preceded by one(s) in which children’s spellings do not represent the phonological structure of words or represent only some of the sound units that the children hear in words. These spellings have been called “primitive” in the present study, and our data do not shed much light on their characteristics or the reasons for their occurrence.

In the second of the phases investigated here, children’s “one sound – one letter” belief is challenged when they observe that some words contain more letters than sounds. In English, in contrast to some other alphabetic systems, this challenge is substantial. Words like her, make, and the are common, and so even young children have the opportunity to observe that conventional spellings sometimes include letters that do not belong on the view that each letter corresponds to sound. When letters do not fit the “one sound – one letter” framework, children at first consider them as little more than “extra” letters like the k of knee. As a result, children may begin to add letters to the spellings that make sense to them on a phonological basis. For example, children may add a vowel to the phonological spelling SR, resulting in SER, SUR, or SRE. Children’s memories for the position and identity of extra letters that they have seen in words influence the letters that they use in their own spellings and the letters they prefer in orthographic choice tasks. Thus, having observed that e is a common extra letter in English and that it often occurs at the ends of words, children may use a final e in SRE for sir and BRNE for burn. In addition, as documented in Experiment 1 and in Beers et al. (1977), children
may add a final e to short vowel words such as puff and hint, yielding errors such as PUFE and HITE. The fact that final e additions were less common for short vowel words than for syllabic /r/ words in Experiment 1 may reflect children's beginning knowledge that the spellings of all words must contain a vowel letter. A spelling such as PUF for puff, which already contains one vowel letter, is thus less likely to receive another vowel letter than a spelling such as SR for sir.

Not until a third phase, we propose, do children begin to truly understand the function of such letters as the e of her and the e of cone. Children’s belief that each unit of sound is symbolized by a single letter has been challenged by exposure to words such as her and cone. Children now incorporate this knowledge by appreciating that some sounds are represented with two or more letters, either contiguous letter sequences (as with er and th) or non-contiguous sequences (as with o followed by final e). Children now begin to understand that the er of her is a two-letter spelling or digraph that represents syllabic /r/. They understand that the final e of cone helps to indicate the pronunciation of the vowel. Because children now treat vowel + r sequences as units, they can place the vowel letter in the correct position relative to the r when spelling syllabic /r/.

At a broad level, our proposed developmental sequence is consistent with the idea embodied in stage theories that spelling becomes more “orthographic” with development. However, our view differs in a number of ways from existing stage theories. One difference is that the first of the three phases discussed above combines aspects of Gentry’s (1982) semiphonetic and phonetic stages. During this period, some of children's spellings (e.g., CON for cone) represent all of the sound units in the adult conception of a
word. However, other spellings do not represent all of the sounds that an adult hears (e.g., MIK for milk). Spellings of the latter type would likely be considered semiphonetic by Gentry. Moreover, our data do not show the cross-vowel consistency that is predicted by stage theories. The children in Experiment 1 did not produce consistent spellings for letter-name vowels, being more likely to produce multiple-letter or “transitional” spellings for /yu/ than for other vowels. This difference, we proposed, reflects the conventional spellings to which children have been exposed together with their sensitivity to the diphthongal nature of /yu/. Young children may be more likely to spell /o/ as o than to spell /yu/ as u because their experience with words like no and go strengthens the letter-name strategy in the case of /o/. Thus, children’s spelling may be influenced by their exposure to print from quite early in the course of development, a view also put forward by Cassar and Treiman (1997) and Treiman (1993).

Our results further suggest that children’s understanding of spelling conventions is not necessarily more advanced when tested in a simple choice task than when tested in a spelling production task. We found in Experiment 2 that children who spelled syllabic /r/ without a vowel also picked spellings without a vowel as “better” than those with a vowel. Interestingly, even children who almost always used a vowel in their own productions were sometimes tempted by spellings without a vowel in the spelling choice test. These findings point to the strength of the “one sound – one letter” principle, even for children who have begun to move beyond it. Children give up this intuitively appealing principle in a slow and piecemeal fashion, first for er and only later for other vowels.
By examining children’s spellings of letter-name vowels and syllabic /r/ within the same framework, we have taken a step beyond the narrow approach to spelling development that has examined one phenomenon at a time. We have uncovered some links between the two phenomena, links that appear to reflect generalizations from spellings like MAKE to spellings like SRE for sir. Our results paint a more fine-grained picture of development than that given by existing stage theories, which are based on what we have called a broad approach to the study of spelling. We believe that it is possible to maintain the positive features of the narrow approach to spelling research while also incorporating the best qualities the broad approach. Such a combined approach, which also characterizes the study of Nunes et al. (1997), has much potential to illuminate the course of spelling development.
References


Appendix A. Stimuli for Experimental Spelling Task of Experiment 1

Final syllabic /r/: sir, stir, blur, fur, purr, spur
Final control: kit, skip, club, dug, puff, spun
Medial syllabic /r/: burn, dirt, firm, curb, curl, surf
Medial control: pump, sink, hint, dump, bunk, dust
Letter name, a: mate, tame, cane
Letter name, i: ripe, pine, lime
Letter name, o: vote, code, cone
Letter name, u: mule, cute, cube
Appendix B. Stimuli for Spelling Test and Choice Test, Experiment 2

<table>
<thead>
<tr>
<th>Pronunciation</th>
<th>VR choice</th>
<th>R choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>/dr/</td>
<td>der</td>
<td>dr</td>
</tr>
<tr>
<td>/dʒr/</td>
<td>jer</td>
<td>jr</td>
</tr>
<tr>
<td>/nr/</td>
<td>ner</td>
<td>nr</td>
</tr>
<tr>
<td>/kr/</td>
<td>kir</td>
<td>kr</td>
</tr>
<tr>
<td>/vr/</td>
<td>vir</td>
<td>vr</td>
</tr>
<tr>
<td>/zr/</td>
<td>zir</td>
<td>zr</td>
</tr>
<tr>
<td>/lr/</td>
<td>lur</td>
<td>lr</td>
</tr>
<tr>
<td>/mr/</td>
<td>mur</td>
<td>mr</td>
</tr>
<tr>
<td>/tr/</td>
<td>tur</td>
<td>tr</td>
</tr>
<tr>
<td>/flr/</td>
<td>fler</td>
<td>flr</td>
</tr>
<tr>
<td>/klr/</td>
<td>kler</td>
<td>klr</td>
</tr>
<tr>
<td>/snr/</td>
<td>sner</td>
<td>snr</td>
</tr>
<tr>
<td>/dwr/</td>
<td>dwir</td>
<td>dwr</td>
</tr>
<tr>
<td>/plr/</td>
<td>plir</td>
<td>plr</td>
</tr>
<tr>
<td>/twr/</td>
<td>twir</td>
<td>twr</td>
</tr>
<tr>
<td>/glr/</td>
<td>glur</td>
<td>glr</td>
</tr>
<tr>
<td>/skr/</td>
<td>swur</td>
<td>swr</td>
</tr>
<tr>
<td>/grp/</td>
<td>gerp</td>
<td>grp</td>
</tr>
<tr>
<td>/brl/</td>
<td>berl</td>
<td>brl</td>
</tr>
<tr>
<td>Sound</td>
<td>Spelling</td>
<td>Children’s spelling</td>
</tr>
<tr>
<td>-------</td>
<td>----------</td>
<td>---------------------</td>
</tr>
<tr>
<td>/vrk/</td>
<td>verk</td>
<td>vrk</td>
</tr>
<tr>
<td>/firt/</td>
<td>firt</td>
<td>frt</td>
</tr>
<tr>
<td>/lrg/</td>
<td>lirg</td>
<td>lrg</td>
</tr>
<tr>
<td>/mrd/</td>
<td>mird</td>
<td>mrd</td>
</tr>
<tr>
<td>/durf/</td>
<td>durf</td>
<td>drf</td>
</tr>
<tr>
<td>/jurb/</td>
<td>jurb</td>
<td>jrb</td>
</tr>
<tr>
<td>/zurn/</td>
<td>zun</td>
<td>zrn</td>
</tr>
</tbody>
</table>
Author Note

This research was supported by National Science Foundation Grants SBR-9408456 and SBR-9807736. We thank the children and staff of Saint Veronica’s School for their cooperation. Thanks to Brett Kessler, Derrick Bourassa, and several anonymous reviewers for their comments.
Footnotes

1. w and y were counted as vowel letters in this and subsequent analyses.

2. The categorization was based primarily on the spelling of the vowel. A spelling could be placed in the letter name, transitional category, or correct category if the consonants were represented with conventional letters, letters that represented a phoneme with an adjacent place of articulation, or letters that represented a phoneme with the opposite value of voicing. In addition, a single consonant omission or a single consonant addition was allowed. Thus, TAN for tame, FOTT for vote, and KU for cute were scored as a letter-name spellings.

3. Spellings could be classified in the R category or a more advanced category if the consonants were represented with conventional letters, letters that represented a phoneme with an adjacent place of articulation, or letters that represented a phoneme that differed only in voicing. In addition, a single consonant omission or a single consonant addition was allowed. Spellings that did not fit these criteria, such as CREESRCKI for curl, were classified as primitive.
Table 1

Sample Stimuli for Experiment 1 and Characteristics of Stimuli

<table>
<thead>
<tr>
<th>Type</th>
<th>Examples</th>
<th>n</th>
<th>Number of Letters</th>
<th>Frequency&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final syllabic /r/</td>
<td>sir, stir</td>
<td>6</td>
<td>3.67</td>
<td>505.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Final control</td>
<td>kit, skip</td>
<td>6</td>
<td>3.67</td>
<td>382.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Medial syllabic /r/</td>
<td>burn, dirt</td>
<td>6</td>
<td>4.00</td>
<td>504.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Medial control</td>
<td>pump, sink</td>
<td>6</td>
<td>4.00</td>
<td>465.2</td>
<td>3.8</td>
</tr>
<tr>
<td>Letter-name vowel</td>
<td>mate, mule</td>
<td>12</td>
<td>4.00</td>
<td>335.9</td>
<td>3.9</td>
</tr>
</tbody>
</table>

<sup>a</sup>Average raw frequencies (out of 17,247,580 tokens) from Zeno, Ivenz, Millard, & Duvvuri (1995)

<sup>b</sup>From Harris and Jacobson (1972)
Table 2

Mean (and Standard Deviation) Proportions of Spellings in Experiment 1 that Contained a Vowel Letter in Any Position

<table>
<thead>
<tr>
<th>Stimulus Type</th>
<th>Fall M</th>
<th>Fall SD</th>
<th>Spring M</th>
<th>Spring SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final syllabic /r/</td>
<td>.48</td>
<td>.39</td>
<td>.84</td>
<td>21</td>
</tr>
<tr>
<td>Final control</td>
<td>.87</td>
<td>.28</td>
<td>.99</td>
<td>.06</td>
</tr>
<tr>
<td>Medial syllabic /r/</td>
<td>.47</td>
<td>.43</td>
<td>.73</td>
<td>.36</td>
</tr>
<tr>
<td>Medial control</td>
<td>.90</td>
<td>.24</td>
<td>1.00</td>
<td>.00</td>
</tr>
</tbody>
</table>
Table 3

Mean (and Standard Deviation) Proportions of Spellings in Experiment 1 that Contained the Correct Postvocalic Consonant Letter

<table>
<thead>
<tr>
<th>Stimulus type</th>
<th>Fall M</th>
<th>Fall SD</th>
<th>Spring M</th>
<th>Spring SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final syllabic /r/</td>
<td>.95</td>
<td>.18</td>
<td>.99</td>
<td>.06</td>
</tr>
<tr>
<td>Final control</td>
<td>.96</td>
<td>.19</td>
<td>.95</td>
<td>.13</td>
</tr>
<tr>
<td>Medial syllabic /r/</td>
<td>.82</td>
<td>.31</td>
<td>.94</td>
<td>.17</td>
</tr>
<tr>
<td>Medial control</td>
<td>.46</td>
<td>.31</td>
<td>.81</td>
<td>.27</td>
</tr>
</tbody>
</table>
Table 4

Mean (and Standard Deviation) Proportions of Spellings in Experiment 1 that Contained a Vowel Letter and the Correct Postvocalic Consonant Letter in the Correct Order Relative to all Spellings that Contained Both a Vowel Letter and the Correct Postvocalic Consonant Letter

<table>
<thead>
<tr>
<th>Stimulus Type</th>
<th>Fall M</th>
<th>Fall SD</th>
<th>Spring M</th>
<th>Spring SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final syllabic /r/</td>
<td>.55</td>
<td>.46</td>
<td>.69</td>
<td>.36</td>
</tr>
<tr>
<td>Final control</td>
<td>.95</td>
<td>.14</td>
<td>.96</td>
<td>.18</td>
</tr>
<tr>
<td>Medial syllabic /r/</td>
<td>.48</td>
<td>.49</td>
<td>.68</td>
<td>.37</td>
</tr>
<tr>
<td>Medial control</td>
<td>.97</td>
<td>.12</td>
<td>.99</td>
<td>.04</td>
</tr>
</tbody>
</table>
Table 5

Proportions of Vowel Letters of Various Types Used in Syllabic /r/ Spellings of Experiments 1 and 2

<table>
<thead>
<tr>
<th>V letter(s)</th>
<th>Exp. 1, Fall</th>
<th>Exp. 1, Spring</th>
<th>Exp. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>.12</td>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td>e</td>
<td>.39</td>
<td>.45</td>
<td>.75</td>
</tr>
<tr>
<td>i</td>
<td>.04</td>
<td>.03</td>
<td>.03</td>
</tr>
<tr>
<td>o</td>
<td>.05</td>
<td>.02</td>
<td>.01</td>
</tr>
<tr>
<td>u</td>
<td>.27</td>
<td>.32</td>
<td>.15</td>
</tr>
<tr>
<td>Other</td>
<td>.13</td>
<td>.17</td>
<td>.05</td>
</tr>
</tbody>
</table>
Table 6

Mean (and Standard Deviation) Proportions of Spellings of Various Types for Letter-name Stimuli in Experiment 1

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Fall</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Primitive</td>
<td>Letter name</td>
</tr>
<tr>
<td>/e/</td>
<td>.13</td>
<td>.32</td>
</tr>
<tr>
<td>/ai/</td>
<td>.25</td>
<td>.35</td>
</tr>
<tr>
<td>/o/</td>
<td>.15</td>
<td>.31</td>
</tr>
<tr>
<td>/yu/</td>
<td>.28</td>
<td>.36</td>
</tr>
</tbody>
</table>
Table 7

Types of Spellings of Syllabic /r/ Produced by Individual Children in Fall and Spring of Experiment 1

<table>
<thead>
<tr>
<th>Type in Spring</th>
<th>Primitive</th>
<th>R</th>
<th>RV</th>
<th>VR</th>
<th>Correct</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type in Fall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primitive</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>R</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>10</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>RV</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>VR</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Correct</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>7</td>
<td>4</td>
<td>17</td>
<td>5</td>
<td>35</td>
</tr>
</tbody>
</table>
Table 8

Types of Spellings of Letter-Name Vowels Produced by Individual Children in Fall and Spring of Experiment 1

<table>
<thead>
<tr>
<th>Type in Spring</th>
<th>Primitive</th>
<th>Letter name</th>
<th>Transitional</th>
<th>Correct</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type in Fall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primitive</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Letter name</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>Transitional</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Correct</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>29</td>
<td>35</td>
</tr>
<tr>
<td>Dominant Spelling Type for Syllabic /r/</td>
<td>Spellings of Letter-name Stimuli</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Primitive</td>
<td>Letter-name</td>
<td>Transitional</td>
<td>Correct</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Primitive</td>
<td>.58</td>
<td>.37</td>
<td>.25</td>
<td>.25</td>
<td>.10</td>
</tr>
<tr>
<td>R</td>
<td>.16</td>
<td>.26</td>
<td>.46</td>
<td>.31</td>
<td>.13</td>
</tr>
<tr>
<td>RV</td>
<td>.02</td>
<td>.04</td>
<td>.18</td>
<td>.26</td>
<td>.09</td>
</tr>
<tr>
<td>VR</td>
<td>.04</td>
<td>.08</td>
<td>.13</td>
<td>.19</td>
<td>.11</td>
</tr>
<tr>
<td>Correct</td>
<td>.00</td>
<td>.00</td>
<td>.03</td>
<td>.04</td>
<td>.07</td>
</tr>
</tbody>
</table>

**Note.** Results are pooled over fall and spring tests.
Table 10

Mean (and Standard Deviation) Proportions of VR Choices in Choice Test of Experiment 2

<table>
<thead>
<tr>
<th>Group</th>
<th>Vowel letter</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>e</td>
<td>i</td>
<td>u</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>VR &lt; .50</td>
<td>.32*° .29</td>
<td>.26*° .31</td>
<td>.29*° .30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in spelling test</td>
<td>(n = 20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VR &gt; .50</td>
<td>.62° .35</td>
<td>.27° .37</td>
<td>.31° .38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>in spelling test</td>
<td>(n = 10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All children</td>
<td>.42 .34</td>
<td>.26*° .32</td>
<td>.30*° .32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n = 30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05 by subjects when compared to chance performance (.50) by two-tailed t test.
° p < .05 by items when compared to chance performance (.50) by two-tailed t test.
1 w and y were counted as vowel letters in this and subsequent analyses.

2 A spelling could be placed in the letter name, letter name + e, or transitional category if the consonants were represented with conventional letters, letters that represented a phoneme with an adjacent place of articulation, or letters that represented a phoneme with the opposite value of voicing. In addition, a single consonant omission or a single consonant deletion was allowed. Thus, TAN for tame, FOTT for vote, and KU for cute were scored as a letter-name only spellings.

3 Spellings could be classified as Type II or higher if the consonants were represented with conventional letters, letters that represented a phoneme with an adjacent place of articulation, or letters that represented a phoneme that differed only in voicing. In addition, a single consonant omission or a single consonant deletion was allowed. Spellings that did not fit these criteria, such as CREESRCKI for curl, were classified as Type I.