

## Children's spelling of syllabic /r/ and letter-name vowels: Broadening the study of spelling development

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### 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 tracking 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 letters *i* of *sir* and *e* of *cone*). Errors such as SRE for *sir* may arise during this process, reflecting an 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.

Within the first few years at school, children's attempts to write words change dramatically. Children move from apparently random strings of letters (e.g., WT for *cone*) to correct or near-correct spellings (e.g., 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 focus 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 /t/ and /d/ before /r/ (e.g., Read, 1975; Treiman, 1985). Studies using a narrow approach generally examine one structure at a time, investigating the effects of specific linguistic factors on performance. For example, researchers (e.g., Treiman et al., 1995) have asked whether children's ability to spell final

consonant clusters varies with the type 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 pay careful attention to linguistic factors and are generally strong from a statistical and methodological point of view. Another positive feature is the way in which information from spelling errors is often supplemented with data from other tasks. For example, researchers have collected data from the same children on the spelling of consonant clusters and the oral segmentation of syllables with such clusters (Treiman et al., 1995; van Bon & Uit de Haag, 1997).

The narrow approach does have some weaknesses, however. Even when data on a variety of linguistic structures are available from the same children (as in Treiman, 1993), the focus tends to be on individual linguistic structures rather than overall patterns of performance by particular children. Researchers who have adopted a narrow approach do not usually follow individual children's growth across time; instead, they generally carry 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 developmental changes in performance. These studies often assess children's spelling of a variety of linguistic structures, postulating particular relationships among the structures. Many of the studies use a longitudinal approach. Whereas studies in the narrow tradition are quantitative and statistical in nature, studies in the broad tradition often rely on qualitative descriptions or less formal analyses. For example, Beers and Henderson (1977) followed the development of 25 first grade children over 6 months; they 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, which postulate that children pass through a series of qualitatively different stages when learning to spell. Each stage is characterized by a reliance on a distinct type of knowledge. There are relationships among a child's spellings of different linguistic patterns because the spelling of each pattern reflects 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, their theories are similar in many respects. Here we focus 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 consisting of apparently random letters strings (e.g., 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*). Finally, children achieve correct spelling.

The strength of the broad approach lies in its attempt to relate children's performance on different linguistic patterns and to characterize the abilities of

individual children. Sometimes, however, there is 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 /ar/ 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 /ar/ 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 together the narrow and broad approaches in the study of certain specific phenomena. Our goal was to maintain the positive features that characterize 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 tracking 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 to pay more attention to individual differences and patterns of growth than has been given in studies adopting the narrow approach. Nunes, Bryant, and Bindman (1997) used a similar strategy in their study of morphological patterns in English spelling.

Our major issue of interest 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 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 an *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 Harris & Jacobson's [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, & Leever, 1997). All of these researchers have reported that beginning spellers often represent syllabic /r/ with *r* alone (i.e., 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 also 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) 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 here 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; thus we were able to follow individual children's performance on syllabic /r/ across the school year.

In Experiment 1, we examined a second linguistic pattern that is of interest, both 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 along with an *e* at the end of the word. Previous studies in both traditions have shown that young children often use 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* for 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 spellings to spellings with a final *e*? According to existing stage theories, letter-name spellings predominate during the semiphonetic stage (for the vowels that children represent at all) and 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 a 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 spellings for words with /e/ (e.g., *bake*) than 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 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 transitional stage, children should spell syllabic /r/ with a vowel letter followed by an *r* (e.g., SER for *sir*), and they should 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 ways predicted by existing stage theories.

## EXPERIMENT 1

### METHOD

#### *Participants*

The participants were 35 first graders (21 boys, 14 girls), all of whom were native speakers of English. Their mean age was 6;6 (range 5;6–6;9) at the beginning of the fall test. 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 for one class ran from late October to mid-November and the spring test ran from late March to late April. For the other class, the fall test ran from mid-November to mid-December (5 children finished this phase in early January) and the spring test ran from May to the first week of June. As measured by the spelling subtest of the Wide Range Achievement Test–Third Edition (WRAT-3) (Jastak & Wilkinson, 1993), the children's average spelling level at the time of the fall test was first grade, with a range from kindergarten to third grade. At the spring test, the average spelling level was second grade, with a range from first grade to fourth grade. 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 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 10 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, 6 words had a final syllabic /r/ and 6 words had a medial syllabic /r/. For each type of syllabic /r/ word, there was a set of control words that were similar to

Table 1. *Sample stimuli and their characteristics: Experiment 1*

Type	Examples	<i>n</i>	Number of letters	Frequency <sup>a</sup>	Grade level <sup>b</sup>
Final syllabic /r/	<i>sir, stir</i>	6	3.67	505.8	4.2
Final control	<i>kit, skip</i>	6	3.67	382.2	4.2
Medial syllabic /r/	<i>burn, dirt</i>	6	4.00	504.0	3.8
Medial control	<i>pump, sink</i>	6	4.00	465.2	3.8
Letter-name vowel	<i>mate, mule</i>	12	4.00	335.9	3.9

<sup>a</sup>Average raw frequencies (out of 17,274,580 tokens) from Zeno, Ivens, Millard, and Duvvuri (1995).

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

the syllabic /r/ words in length and grade level. 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 3 words for each of the vowels /e/, /ai/, /o/, and /yu/. The conventional spellings in these words were *a* + final *e*, *i* + 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 1 provides a complete list of the stimuli.

### Procedure

The fall test was spread over three sessions. The first session, carried out with groups of two or three children, included 24 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, the spelling subtest of the WRAT-3 was individually administered. The spring test was also done in groups of two or three children. All 36 spelling words were given in the first session; the second session included the spelling subtest of the WRAT-3 and a task that is not reported here.

For the experimental spelling test, each word was presented a minimum of three times. The experimenter pronounced the word, 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 spelled the word with a pencil on a 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

Table 2. Mean (and standard deviation) proportions of spellings that contained a vowel letter in any position: Experiment 1

Stimulus type	Fall		Spring	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Final syllabic /r/	.48	.39	.84	.21
Final control	.87	.28	.99	.06
Medial syllabic /r/	.47	.43	.73	.36
Medial control	.90	.24	1.00	.00

to discern that particular letter. This comment usually prompted the child to state the correct letter or to 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 whether the children in this study, like those in the studies cited earlier, would spell syllabic /r/ words (e.g., *sir*) differently from control words (e.g., *sip*). Also, since some previous studies reported errors such as *SRI* and *SRE* for *sir* but others did not, we wanted to determine whether such vowel-consonant reversals would be 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 determined whether the spelling included one or more vowel letters, correct or not, in any position.<sup>1</sup> 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 syllabic /r/ words than 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 these conclusions came from ANOVAs using the factors of time (fall vs. spring), position (final vs. medial), and stimulus type (syllabic /r/ vs. control). In this and the following ANOVAs, data were analyzed by subjects (*F1*) and by items (*F2*). There was a main effect of stimulus type,  $F1(1, 34) = 59.50$ ;  $F2(1, 20) = 203.57$ ,  $p < .001$ , 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,  $F1(1, 34) = 31.98$ ;  $F2(1, 20) = 512.85$ ,  $p < .001$ , for both. A significant interaction between time and stimulus type was also found,  $F1(1, 34) = 6.71$ ,  $p = .014$ ;  $F2(1, 20) = 122.45$ ,  $p < .001$ . This interaction reflects the larger increase in vowel inclusion for syllabic /r/ words than control words from the fall to the spring, control words being close to ceiling in the fall.

Table 3. Mean (and standard deviation) proportions of spellings that contained the correct postvocalic consonant letter: Experiment 1

Stimulus type	Fall		Spring	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Final syllabic /r/	.95	.18	.99	.06
Final control	.96	.19	.95	.13
Medial syllabic /r/	.82	.31	.94	.17
Medial control	.46	.31	.81	.27

Finally, an interaction between time and position emerged,  $F(1, 34) = 5.93$ ,  $p = .02$ ;  $F(1, 20) = 11.19$ ,  $p = .003$ . This interaction reflects a greater improvement from fall to spring for final-position words (24%) than 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 (i.e., 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.

ANOVAs 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. In addition, 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. For the spellings that included one or more vowel letters and the correct postvocalic consonant letter, we calculated the proportion of words in which the vowel(s) and the consonant were 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 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 control words. Statistical analyses confirmed the main

Table 4. Mean (and standard deviation) proportions of spellings that contained a vowel letter and the correct postvocalic consonant letter in the correct order: Experiment 1

Stimulus type	Fall		Spring	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Final syllabic /r/	.55	.46	.69	.36
Final control	.95	.14	.96	.18
Medial syllabic /r/	.48	.49	.68	.37
Medial control	.97	.12	.99	.04

Table 5. Proportions of vowel letters used in syllabic /r/ spellings: Experiments 1 and 2

V letters(s)	Experiment 1, Fall	Experiment 1, Spring	Experiment 2
<i>a</i>	.12	.01	.01
<i>e</i>	.39	.45	.75
<i>i</i>	.04	.03	.03
<i>o</i>	.05	.02	.01
<i>u</i>	.27	.32	.15
Other	.13	.17	.05

effect of stimulus type,  $F1(1, 18) = 26.26$ ;  $F2(1, 20) = 77.77$ ,  $p < .001$ , 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/:  $F2(1, 20) = 6.83$ ,  $p = .017$ , for the interaction of time and stimulus type;  $F2(1, 20) = 9.42$ ,  $p = .006$ , 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 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 (e.g., Read, 1975; Treiman, 1993) have documented that children often fail to include a vowel in their spelling of syllabic /r/, but seldom have 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 stage theories, such spellings are thought to occur during the precommunicative and semiphonetic stages. Spellings in the letter-name category contained one instance of the correct vowel letter but no final *e*: for example, MUL and MULL for *mule*. Such spellings are thought to characterize the phonetic stage. At the next level of sophistication, transitional spellings were those in which two or more letters were used to symbolize the vowel, as in MEUL, MUUOL, or MYOOL for *mule*. These spellings are thought to occur during the transitional stage. 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.<sup>2</sup>

Table 6 shows, for each vowel, the mean proportion 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 (i.e., the letter-name vowel + final *e*) increased. Transitional spellings were infrequent at both test periods, except in the case of the vowel /yu/.

ANOVAs using the factors of time (fall vs. 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,  $F(1, 34) = 14.52$ ;  $F(1, 8) = 48.49$ ,  $p < .001$ , for both. Primitive spellings decreased in frequency from the fall to the spring.

Letter-name spellings also showed a significant decrease from the fall to the spring,  $F(1, 34) = 31.81$ ;  $F(1, 8) = 94.24$ ,  $p < .001$ , for both. There was also a main effect of vowel,  $F(3, 102) = 11.11$ ,  $p < .001$ ;  $F(3, 8) = 6.81$ ,  $p = .014$ , and a significant interaction between vowel and time,  $F(3, 102) = 5.39$ ,  $p = .002$ ;  $F(3, 8) = 4.52$ ,  $p = .039$ . In the fall, there were fewer letter-name spellings of /yu/ than 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,  $F(3, 102) = 20.34$ ;  $F(3, 8) = 27.99$ ,  $p < .001$ , 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,  $F(1, 34) = 80.53$ ;  $F(1, 8) = 236.40$ ,  $p < .001$ , for both. Conventional spellings with final *e* increased from fall to the spring. A main effect of vowel also emerged,  $F(3, 102) = 6.36$ ,  $p = .001$ ;  $F(3, 8) = 10.28$ ,  $p = .004$ . There were fewer letter-name + final *e* spellings for /yu/ than the other vowels, which did not differ significantly from one another.

#### *Changes in individual children's spellings of syllabic /r/*

The analyses presented so far have examined group data, as is typically done in studies employing a narrow approach. However, it is also important to examine

Table 6. Mean (and standard deviation) proportions of spellings for letter-name stimuli: Experiment 1

Vowel	Fall						Spring									
	Primitive		Letter-name		Transitional		Correct		Primitive		Letter-name		Transitional		Correct	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
/e/	.13	.32	.51	.46	.06	.19	.30	.45	.02	.11	.12	.26	.07	.14	.79	.29
/ai/	.25	.35	.40	.40	.04	.11	.31	.41	.02	.08	.15	.26	.03	.09	.79	.33
/o/	.15	.31	.50	.36	.09	.22	.27	.37	.03	.12	.12	.26	.04	.13	.81	.31
/yu/	.28	.36	.20	.27	.34	.34	.18	.30	.03	.09	.08	.18	.25	.34	.65	.43

Table 7. *Spellings of syllabic /r/ produced by individual children: fall and spring of Experiment 1*

	Type in spring					Total
	Primitive	R	RV	VR	Correct	
Type in fall						
Primitive	1	0	1	0	0	2
R	1	7	0	10	2	20
RV	0	0	2	1	1	4
VR	0	0	1	6	1	8
Correct	0	0	0	0	1	1
Total	2	7	4	17	5	35

individual children's performances and to look at how they change across time. To examine changes from the fall to the spring, 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 are 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 are thought to typify the phonetic stage. 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 was more than one) came after the *r* rather than before it: for example, CRLA for *curl* and SIRE for *sir*. Although such spellings were not considered by existing stage theories, they were included here because the analyses reported earlier indicated that they did occur among beginning spellers. VR spellings contained one or more vowel letters and an *r*; the vowel letter(s) not only preceded the *r*, but also were incorrect: for example, SAR for *sir* and CERL for *curl*. Such spellings are thought to predominate during the transitional stage. 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*.<sup>3</sup> After classifying the children'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 here) 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 retrogressed (those in the cells below the diagonal). 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).

Table 8. *Spellings of letter-name vowels produced by individual children: fall and spring of Experiment 1*

	Type in spring			Correct	Total
	Primitive	Letter-name	Transitional		
Type in fall					
Primitive	1	2	0	2	5
Letter-name	0	3	0	16	19
Transitional	0	0	0	2	2
Correct	0	0	0	9	9
Total	1	5	0	29	35

*Changes in individual children's spellings of letter-name vowels*

We examined changes across time in the children's spellings 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 fell into the primitive category, as defined earlier; in the letter-name category if the majority of spellings used the letter-name vowel but no final *e*; in the transitional category if the majority of spellings used two or more letters to symbolize the vowel; and in the correct category if the majority of spellings contained the correct letter vowel and a final *e*.

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 our 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 test sessions, was .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 + 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

Table 9. Mean (and standard deviation) proportions of spellings for letter-name stimuli by children producing various spellings of syllabic /r/: Experiment 1

Spelling type for syllabic /r/	Spellings of letter-name stimuli									
	Primitive		Letter-name		Transitional		Correct			
	M	SD	M	SD	M	SD	M	SD		
Primitive	.58	.37	.25	.25	.10	.13	.06	.08		
R	.16	.26	.46	.31	.13	.14	.25	.34		
RV	.02	.04	.18	.26	.09	.17	.71	.32		
VR	.04	.08	.13	.19	.11	.11	.72	.32		
Correct	.00	.00	.03	.04	.07	.06	.90	.08		

Note: Results are pooled over fall and spring tests.

vowels. This was true whether the children's syllabic /r/ spellings often had the vowels in the incorrect position (dominant spelling type: RV) or whether their spellings generally had the vowels in the correct position (dominant spelling types: VR and correct). In each case, letter-name + final *e* spellings significantly outnumbered spellings that included only the letter-name vowel ( $p < .001$  for all).

As mentioned before, *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, this vowel was often a word-final *e*, as in SRE for *sir*. These children sometimes used an *e* at the end of the control words as well, as in PUF*e* for *puff* or HITE for *hint*. For the 4 children with the highest rate of final *e* in syllabic /r/ words (mean = 73%), incorrect use of final *e* occurred 29% of the time on the control words.

## DISCUSSION

The present findings provide additional information about two phenomena that have been studied in past research: children's spelling of syllabic /r/ and their 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 this 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 producing many letter-name spellings in the fall to mostly correct letter-name + final *e* spellings in the spring. For /e/, /ai/, and /o/, we found few of the transitional spellings (e.g., MAET for *mate*) postulated by stage theories (see Gentry, 1982). Only for /yu/ did we find appreciable number of spellings that fit into the transitional category. Our results thus do not show the consistency across vowels predicted by stage theories (see Gentry, 1982). They also shed doubt on the mechanism postulated as underlying transitional vowel spellings: that is, a gen-

eral tendency to “mark” long vowels by adding additional letters. 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 spelling of /yu/ as *u* does not occur very often in English. There are no preprimer words with *u* spellings of /yu/, although there are some words with letter-name spellings of /e/, /ai/, and /o/ (e.g., *a*, *I*, and *go*) (Harris & Jacobson, 1972). Children's exposure to letter-name 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 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) indicated, 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 /ai/ and /o/ words. However, we found no significant difference here. Varnhagen et al. did not report whether transitional spellings were more common for some vowels than 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 adopted a narrow approach to the study of spelling development and 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 used a final *e* for short vowels, as in PUF*e* for *puff*.

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. The spelling production task in Experiment 2 used nonsense words, in contrast to the real words used in 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 /dɹ/. In another session, the children were asked to spell /dɹ/ and other nonwords containing syllabic /r/. By gathering information about children's spelling choices, we hoped to gain insight into 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 have a degree of incipient knowledge that can be revealed more readily in a less cognitively demanding situation (e.g., a choice task) than a more demanding one (e.g., a spelling production task). For example, first graders and even kindergartners show a small, but significant, preference for nonwords like *peess* over nonwords like *ppes* (Cassar & Treiman, 1997; Treiman, 1993). Apparently, these children have begun to learn that consonant doublets may occur at the end of English words but not at the beginning. 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 spelling that was similar to that they themselves produced. Indeed, some of the children seemed to prefer the correct spellings. Cassar and Treiman used real words in their study, and so it is not clear whether these children had a general understanding about the spelling of the past tense 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 display a knowledge about vowels before they would reveal such knowledge in their own spellings.

The spelling choice task of Experiment 2 included choices with *e* (e.g., *der* vs. *dr*), *i* (e.g., *kir* vs. *kr*), and *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 would choose the vowel + *r* option for all three vowels or only for *e*, we wanted to determine whether they possessed a general rule (i.e., the spelling of syllabic /r/ must contain a vowel letter) or whether their knowledge was specific to *e*, the vowel that they used most often in their own spellings.

## EXPERIMENT 2

### METHOD

#### *Participants*

The participants were 30 children (15 boys, 15 girls), all of whom were native speakers of English. Their mean age was 6;7 (range 6;1–7;4). 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, with a range from kindergarten to third grade. The average spelling level was also first grade, with a range from kindergarten to second grade.

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. There were 9 nonwords that had a single consonant followed by syllabic /r/, as in /dɹ/, and 9 nonwords that had an initial two-consonant cluster followed by syllabic /r/, as in /flɹ/. The remaining 9 words involved a single initial consonant, syllabic /r/, and a single final consonant, as in /gɹp/. Appendix 2 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 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, Ivens, Millard, & Duvvuri, 1995) that they probably functioned as nonwords for the children and were considered as such by us. 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 an *r*. We used the vowels *e*, *i*, and *u*; each vowel occurred 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 and in English as a whole (Venezky, 1970). In the R choice, the syllabic /r/ was spelled with only an *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 not, including characters that were not real letters (e.g., *moz* vs. *8b\$*). The test stimuli are shown in Appendix 2.

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 printed 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 children repeated it. The experimenter never needed to repeat an item more than twice. 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 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 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 for Experiment 1; they attended the same school and were taught by the same teachers. Comparing the spelling results for Experiment 2 to those observed in the fall for 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 for Experiment 1. There was 1 child who produced

Table 10. Mean (and standard deviation) proportions of VR choices in choice test: Experiment 2

	<i>e</i>		<i>i</i>		<i>u</i>	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
VR < .50 in spelling test ( <i>n</i> = 20)	.32 <sup>a,b</sup>	.29	.26 <sup>a,b</sup>	.31	.29 <sup>a,b</sup>	.30
VR > .50 in spelling test ( <i>n</i> = 10)	.62 <sup>b</sup>	.35	.27 <sup>b</sup>	.37	.31 <sup>b</sup>	.38
All children ( <i>n</i> = 30)	.42	.34	.26 <sup>a,b</sup>	.32	.30 <sup>a,b</sup>	.32

<sup>a</sup>*p* < .05 by subjects when compared to chance performance (.50) by two-tailed *t* test.

<sup>b</sup>*p* < .05 by items when compared to chance performance (.50) by two-tailed *t* test.

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, and 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 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 those children who often did use 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–.37) for children in the former group and .97 (*SD* = .09, range .70–1.00) for children in the latter group. As Table 10 shows, children who did not usually use a vowel in their own productions generally chose spellings without a vowel as better than spellings with a vowel. Children who often did use 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 these results came from ANOVAs using the factors of group (low VR proportion vs. high VR proportion) and letter (*e*, *i*, or *u*). The main effect of letter,  $F(2, 56) = 15.72$ ;  $F(2, 24) = 15.11$ ,  $p < .001$ , for both, and the interaction between letter and group,  $F(2, 56) = 8.58$ ,  $p = .001$ ;  $F(2, 24) = 11.70$ ,  $p < .001$ , 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 from random guessing. For children who

generally included a vowel in their spellings of syllabic /r/, there was a significant effect of vowel letter,  $F(2, 18) = 9.80, p = .001$ ;  $F(2, 24) = 28.50, p < .001$ . Although the results for this group were 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 additional information about children's knowledge of the spelling of syllabic /r/. One question was whether children's choice of vowel + r spellings or single *r* spellings would mirror their own productions. In one scenario, children with some incipient knowledge of syllabic /r/ may be able to reveal this knowledge in a simple situation (e.g., choosing a correct spelling) before they can reveal it in a more taxing situation (e.g., producing a complete spelling). In a second scenario, children's performance in the spelling choice task should be consistent with their performance in the spelling production task. The 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 reveal a knowledge about the spelling of syllabic /r/ more easily in a choice task than 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 often did include a vowel in their own spellings of syllabic /r/, the results again pointed to a 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 (i.e., *e*). When they were presented with spellings containing vowels that they themselves did not use (*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, was 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. This outcome is quite striking. It suggests that single *r* spellings of syllabic /r/ remain compelling for children and are difficult to reject when seen.

The findings also 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 an *r* or that the spellings of all English syllables should contain a vowel letter. Instead, their knowledge was limited: for them, syllabic /r/ was spelled with an *e* followed by an *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 spellings of real words in Experiment 1. Treiman et. al. (1993) also compared the spelling of

real words with syllabic /r/ and nonwords with syllabic /r/ among the same children; similar patterns of performance were observed. Apparently, the phonological processes that play a role in the spelling of nonwords are also important in the spelling of real words. One difference between the results for nonwords and the results for real words was that the preference for *e* in the spellings of syllabic /r/ was greater for nonwords. Children may have been inclined to use *ur* and *ir* for the real words of Experiment 1 because they remembered the 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 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 changes in performance across time. Studies that have adopted a broader approach, while they have led to influential theories of spelling development, sometimes have 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 together the two approaches 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; Experiment 2 served 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 characterized 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 correctly place the vowel relative to the *r*. At least some children put the vowel after the *r* rather than before it, as in *SRE* for *sir*. Some children were quite consistent in this error; one child in Experiment 2 used an *r* followed by a vowel on all 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 in 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 fully explain errors such as BRNE for *burn* and SRE for *sir*. Unstressed syllabic /r/ is usually spelled with an *e* followed by an *r*. *Re* spellings (as in *acre*) are quite uncommon, occurring less than .5% of the time in the preprimer through fourth-grade words in Harris and Jacobson (1972). A closer examination of the reversal errors in Experiments 1 and 2 revealed that many of them (53% in Experiment 1 and 49% in Experiment 2) did include a word-final *e*.

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 *e*, 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 *e* in 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 the silent *e* and the 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 others in which children's spellings do not represent the phonological structure of words or represent only some of the sound units that they 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 reason for their occurrence.

In the second phase 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, based on the view that each letter corresponds to a 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 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 of 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 PUF*e* 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 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 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 noncontiguous sequences (as with an *o* followed by a 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 our three phases 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 predicted by stage theories. The children in

Experiment 1 did not produce consistent spellings for letter-name vowels; they were more likely to produce multiple-letter or transitional spellings for /yu/ than other vowels. This difference, we propose, reflects the conventional spellings to which the 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 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 spellings 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, which examines only 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 of the broad approach. Such a combined approach, which characterizes the study of Nunes et al. (1997), has much potential to illuminate the course of spelling development.

## APPENDIX 1

### *Stimuli for experimental spelling task: Experiment 1*

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Final syllabic /r/	<i>sir, stir, blur, fur, purr, spur</i>
Final control	<i>kit, skip, club, dug, puff, spun</i>
Medial syllabic /r/	<i>burn, dirt, firm, curb, curl, surf</i>
Medial control	<i>pump, sink, hint, dump, bunk, dust</i>
Letter name, <i>a</i>	<i>mate, tame, cane</i>
Letter name, <i>i</i>	<i>ripe, pine, lime</i>
Letter name, <i>o</i>	<i>vote, code, cone</i>
Letter name, <i>u</i>	<i>mule, cute, cube</i>

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APPENDIX 2

*Stimuli for spelling test and choice test:  
Experiment 2*

Pronunciation	VR choice	R choice
/dɪ/	der	dr
/dʒɪ/	jer	jr
/nɪ/	ner	nr
/kɪ/	kir	kr
/vɪ/	vir	vr
/zɪ/	zir	zr
/lɪ/	lur	lr
/mɪ/	mur	mr
/tɪ/	tur	tr
/flɪ/	fler	flr
/klɪ/	kler	klr
/snɪ/	sner	snr
/dwɪ/	dwir	dwr
/plɪ/	plir	plr
/twɪ/	twir	twr
/glɪ/	glur	glr
/swɪ/	swur	swr
/gɪp/	gerp	grp
/bɪl/	berl	brl
/vɪk/	verk	vrk
/fɪt/	firt	frt
/lɪg/	lirg	lrg
/mɪd/	mird	mrđ
/dɪf/	durf	drf
/dʒɪb/	jurb	jrđ
/zɪn/	zurn	zrn

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NOTES

1. The letters *w* and *y* were counted as vowel letters in this and subsequent analyses.
2. The categorization was primarily based on the spelling of the vowel. A spelling could be placed in the letter name, transitional, 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 that differed

only in 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.

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