

Syllable and Rime Patterns for Teaching Reading: Analysis of a Frequency-Based Vocabulary of 17,602 Words

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A frequency-based vocabulary of 17,602 words was compiled and analyzed in order to group words with recurring syllable and rime patterns for teaching reading. The role of the rime unit (e.g., ite in kite and invite) in determining vowel pronunciation was central to the analysis because of the difficulty that the ambiguity of English vowel spelling presents to children who do not learn to read words easily. Vowel pronunciation in each orthographic rime was examined, both for its consistency in all words in which the rime occurs and for regularity, defined as conformity to the most frequent pronunciation for each vowel spelling in each of six orthographic syllable types.

Of the 824 different orthographic rimes, 616 occur in rime families as the building blocks of almost all the 43,041 syllables of the words. These rimes account for a striking amount of patterning in the orthography: 436 are both regular and consistent in pronunciation (except where a single exception word occurs); another 55 are consistent but not regular. Of the remaining 125, only 86 have less than a 90 percent level of consistency. The high order of congruence of orthographic and phonological rimes suggests their usefulness as units for teaching reading.

This paper reports on a study (Stanback 1991) that compiled and analyzed a large frequency-based vocabulary in order to group words by syllable patterns for teaching reading, especially to dyslexic students, who do not learn to read words adequately without explicit

Annals of Dyslexia, Vol. 42, 1992.
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ISSN 0736-9387

teaching. The principal focus was on grouping words around the rime (i.e., that part of the syllable that begins with the vowel, e.g., *ite* in *kite* and *invite*). Analysis was carried out that examined vowel pronunciation in each orthographic rime, both for its consistency in all words in which the rime occurs and for regularity according to six orthographic syllable types: closed, open, silent *e*, vowel-*r*, vowel team, and consonant-*le* and *-re*. The six syllable types are a schema developed by Orton-Gillingham teachers to help older dyslexic students decode the vowels of multisyllabic words (Steere, Peck, and Kahn 1971).

Words were also grouped by common beginning and ending syllables uniform in pronunciation (e.g., *pre-* in *pretend* and *-cian* in *musician*), some of them spanning more than one syllable (e.g., *para-* in *parachute* and *-ity* in *dignity*). In addition, words were grouped around certain difficult letter-sound correspondences (e.g., soft *c* and *g*). For each pattern—rime families, beginning syllables, ending syllables, and difficult consonants and vowels—words were ordered first by number of syllables and then by word frequency, providing a source from which words can be selected for teaching a particular pattern. The analysis, reported on here, was limited to rime patterns.

The role of the rime unit in determining vowel pronunciation was central to the analysis because of the difficulty that the ambiguity of English vowel spelling presents to children who do not learn to read easily. Although consonants usually relate to sound in simple one-to-one fashion, vowels in almost all cases correspond to more than one sound. In decoding a word, getting the vowel sound right depends on taking into account the letters that follow the vowel, not those that precede it, with only one minor exception (Venezky 1970). According to Venezky, "A person who attempts to scan left to right, pronouncing as he goes, could not correctly read most English words" (p. 129). This can be illustrated for the pronunciation of *a* in *cap*, *cape*, *car*, *call* and *care*, where the entire rime unit—the vowel together with what follows in the syllable—cues vowel pronunciation. An important characteristic of rimes is that they are often repeated in various words, with the same pronunciation. This is illustrated by the word groups below:

<i>cap</i>	<i>cape</i>	<i>car</i>	<i>call</i>	<i>care</i>
<i>clap</i>	<i>tape</i>	<i>far</i>	<i>ball</i>	<i>dare</i>
<i>strap</i>	<i>shape</i>	<i>star</i>	<i>tall</i>	<i>stare</i>
<i>nap kin</i>	<i>es cape</i>	<i>ci gar</i>	<i>in stall</i>	<i>be ware</i>

Rimes are thus productive in English word formation, in that a single rime often combines with different onsets (i.e., the initial consonant or consonants in the syllable) to form the syllables of many words. A

grasp of this structural property of English orthography, a spelling system that departs so far from a one-to-one representation of vowels, should be important in learning to read. Generalizations that predict vowel pronunciation by syllable type are an attempt to capture at a higher level of abstraction this structural characteristic of the orthography in representing vowels. For example, *i* in *spin* (a closed syllable) is pronounced as short; *i* in *spine* (a silent *e* syllable) is long; *i* in the first syllable of *spider* (an open syllable) is also long. Vowel sounds predicted by syllable type are those generally considered to be regular.

In recent years, there has been considerable interest in the possible advantages of making use of onsets and rimes in reading instruction (e.g., Adams 1990; Bradley 1987; Goswami and Bryant 1990; Treiman 1991). This interest stems from the substantial evidence that the onsets and rimes of spoken syllables are natural phonological units for children. Sensitivity to rhyme develops very early, as evidenced by young children's fascination with nursery rhymes (Bryant et al. 1989; MacLean, Bryant, and Bradley 1987); and a predictive link has been found between the ability to detect rhyme and the acquisition of reading skill (Bryant and Bradley 1985; Ellis and Large 1987). Studies have shown that it is relatively easy for five- to seven-year-olds to detect onsets and rimes in spoken syllables, while identifying phonemes that are a part of these units is a more difficult skill that may develop only in conjunction with learning to read and spell (Kirtley et al. 1989; Treiman and Zukowski 1991). Other research has found that in playing games that require segmenting and manipulating parts of syllables, eight-year-olds are more successful with tasks that keep onsets and rimes intact than with those that break apart these units (Treiman 1985).

There is also evidence which suggests that the onsets and rimes of printed words are natural units for children, which they demonstrate when they use analogy to predict the pronunciation of an unknown word based on a known word with the same spelling of the rime. Goswami (1986) found that five- to seven-year-olds who were given a clue word such as *beak* were more successful in reading words with the same rime (e.g., *peak*) than words with the same initial consonant-vowel segment (e.g., *bean*) or with only letters in common with the clue word (e.g., *bank*).

The importance of the rime in making analogies was confirmed in a study of first- and third-graders' reading of nonwords (Treiman, Goswami, and Bruck 1990). Nonwords with common rimes that occur in a number of real words (e.g., *tain*, cf. *rain*, *main*, *train*) were read more accurately than those with rimes that occur in few or no real words (e.g., *taich*). Even the poor third-grade readers and the lowest scoring first-graders performed better on the nonwords with common rimes. Brown and Watson (1991) found a similar facilitating effect of spelling-

to-sound friends (i.e., words with the same orthographic rime pronounced in the same way) in the word reading of dyslexics as well as normals.

The Treiman, Goswami, and Bruck (1990) study examined children's performance only on nonwords with rimes that were consistent in pronunciation in various words that might be familiar to children. The nonwords were also regular in terms of their grapheme-phoneme correspondences. For example, *ai* in the nonword *tain* is most frequently pronounced as long *a* (i.e., with its regular sound), whatever the rime in which it occurs (e.g., *rain*, *wait*, *tail*). Rimes, however, may differ in regularity or consistency. For example, some rimes are consistent but not regular (e.g., *old* as in *gold*, *told*, *sold*; *ight* as in *right*, *bright*, *light*). Others are inconsistent in pronunciation (e.g., *ove* in *stove*, *love*, and *move*).

Glushko (1979) demonstrated that the ease with which a word or nonword is read is influenced by the consistency of its orthographic neighborhood (i.e., words with the same spelling of the rime). A consistent neighborhood is one in which the rime has the same pronunciation in various words; an inconsistent neighborhood is one in which pronunciation varies. Based on his research findings, Glushko proposed that the classification of words as regular or irregular should be supplemented by a classification according to consistency. Following Glushko's insight, other research has examined children's reading of a number of different word types (e.g., Backman et al. 1984; Seidenberg et al. 1986; Zinna, Liberman, and Shankweiler 1986). A general finding is that younger and less-skilled older readers have special difficulty reading words with rimes that have more than one pronunciation.

The analysis of the present study is a way of looking at orthographic neighborhoods. Rimes for each of the six syllable types separately were classified according to both regularity and consistency in order to identify those rimes that should be relatively easy (or difficult) to learn. Analysis was also carried out to determine the relationship of regularity and consistency.

The benefits of making use of onsets and rimes in teaching reading are usually described in terms of learning to read rhyming monosyllabic words in early reading instruction. These units, however, are useful in learning to read multisyllabic words as well. For this reason, a vocabulary that included multisyllabic as well as monosyllabic words was analyzed. In practice, rimes can serve as a bridge to multisyllabic words. If a remedial student can read and spell, for example, the one-syllable "*ire* in *fire*" words, learning words of more than one syllable with *ire* (e.g., *in spire*, *en tire ly*, *re quire ment*), may be relatively easy. It can be encouraging and motivating for remedial students to move beyond monosyllabic "first-grade words."

Method

For the analysis a 17,602 word vocabulary was assembled by using the computer to merge two lists: that used by Hanna et al. (1966) in their study of phoneme-grapheme correspondence in spelling, and the *Word Frequency Book* list (Carroll, Davies, and Richman 1971), with frequency data taken from the latter source.¹ Words of the new, consolidated list were divided into syllables and coded for pronunciation, using, with some modifications, the Hanna et al. coding. Each of the 43,041 syllables of the words was then segmented into the units, onset and rime.

What scheme to use in syllabifying the words was a perplexing problem. Linguists do not agree on syllable boundaries, and dictionary divisions are often unsuitable for teaching reading. The most serious problem with using dictionary divisions for teaching decoding is that dictionaries typically divide words according to the nature of the vowel (e.g., *ra-dar*, *rad-ish*) only where morpheme borders are not in conflict with this scheme. Where they are in conflict, morpheme borders usually override (e.g., *skat-er*, *rag-ing*). Dividing at morpheme boundaries can be useful in teaching the meaning of suffixes, for example, *er* in *skater* as "one who" (*skates*); but for decoding to sound, the division *ska-ter* is preferred because it provides a visual cue for the long vowel at the end of the first syllable. Dividing according to the nature of the vowel keeps intact rimes that are congruent in spelling and pronunciation (e.g., *ad* in *rad-ish*, *shad-ow*; *a* in *ra-dar*, *sha-dy*). There are also problems with using the dictionary pronunciation key in dividing words. In the Hanna et al. (1966) study, words were divided according to their pronunciation, which resulted in some strange divisions (e.g., *a-count*, *a-cquaint*, and *a-dditi-on*).

The decision was made to use Kenyon's (1955) rules in Webster's Second. A number of changes were made, however, primarily to increase the consistency of dividing according to the nature of the vowel.

¹The *Word Frequency Book* list (Carroll, Davies, and Richman 1971—the WFB list) provides more recent frequency information than the Hanna et al. list. The WFB list, however, sampled school reading material only through grade 9, while the Hanna et al. list was drawn largely from Part I of the Thorndike-Lorge list, which surveyed adults' as well as children's material. Hanna et al. edited and selectively updated the Thorndike-Lorge list in order to provide a representative core vocabulary for an educated adult.

The list compiled for this study includes three groups of words: (1) 14,424 words that appear on both the Hanna et al. and WFB lists; (2) 1,947 words of a specified minimum frequency that appear only on the WFB list; and (3) 1,231 of the 2,704 words that appear only on the Hanna et al. list and were judged by four independent raters (high school teachers in a suburban school for children with learning disabilities) to be important for high school students to be able to read. For details on compiling the list and assigning word frequencies, see Stanback (1991).

For example, *rag-ing*, *un-ion*, *pe-cul-iar* and *pas-try* were redivided as *rag-ing*, *u-nion*, *pe-cu-liar* and *pa-stry*.

In coding the words phonemically the consonant phonemes of the Hanna et al. (1966) coding were reduced from 31 to 28 and the vowel phonemes from 22 to 19, in line with Orton's (1937) admonition to keep down the number of sounds to be learned. A major change was the treatment of reduced vowels in unstressed syllables. Where possible without undue distortion of the word, the single vowel spellings in unstressed syllables were coded, not as schwa, but as half-long or half-short. For example, *o* in *observe* was coded as half-short and *o* in *protect* as half-long. This made it possible to separate words with the clearest, full vowel sounds from words in which the vowel is reduced. In presenting the rime families, the *ob* (*job*) family, for example, precedes the *ob* (*observe*) family, but the vowel sound can be considered the same for teaching. In other cases it was clearly necessary to code vowels as schwa (e.g., *a* in *ago*).

Although stress plays an important role in the pronunciation of vowels in English, this correlate of vowel pronunciation was not used in the analysis because in decoding an unknown word, children cannot use stress in a simple, straightforward way to determine vowel pronunciation. If, however, the correct vowel sounds are assigned, the right stress naturally follows if the word is known in speech. For example, if the child misreads *deny* as "denny" and follows the suggestion to try the long sound of *y*, the word *deny* will usually be pronounced with the proper stress.

Dividing the syllables into onsets and rimes was in almost all cases simply a matter of dividing before the first vowel in the syllable. Vowel letters, when they function as consonants, were considered part of the onset, for example, *u* as "w" in *queen* and *persuade*, which were segmented *qu-een* and *p-er su-ade*; *i* as "y" in *on i-on*; *e* and *i* in the palatalized suffixes, as in, for example, the combinations *ti* or *ce* as "sh" in *n-a ti-on* and *o ce-an*; *e* and *i* after an initial soft *g* in ending syllables as in *r-e gi-on* and *g-or ge-ous*. A silent *u* following an initial consonant was considered part of the onset, whether or not it could be rationalized as a marker of hard *c* and *g* (*gu-ess*, *gu-ild*, *b-is cu-it* but also *gu-ard*, *bu-ild*).

All orthographic rimes were classified according to the six syllable types, using the conventional terminology "syllable types." It should be noted, however, that it is the rime—the vowel and what follows—that defines the syllable type. The initial consonant(s) plays no part in the classification. The syllable types are defined in terms of their spelling as follows: (a) A closed syllable is one that ends in a consonant or consonants after a single vowel. (b) An open syllable is one that ends in a single vowel (not silent *e*). (c) A silent *e* syllable is one in which a single vowel is followed by a single consonant plus a final silent *e*. (d) A

vowel-*r* syllable is one in which a vowel is followed by *r*. (e) A vowel team syllable is one in which a combination of two (and occasionally three) vowel letters spells the vowel sound. (f) A consonant-*le* or -*re* syllable is one that ends in *le* or *re* after a consonant. Examples are shown below.

Type of Syllable	Example
Closed	<i>cab</i> in
Open	<i>pa</i> per
Silent <i>e</i>	ex <i>cite</i>
Vowel- <i>r</i>	<i>gar</i> land
Vowel team	<i>ea</i> ger
Consonant- <i>le</i> and - <i>re</i>	sim <i>ple</i> , a <i>cre</i>

The above definitions, as used in the present classification system, need clarification on several points: (a) Rimes with a single vowel followed by two sounded consonants plus a silent *e* were classified as closed (e.g., *ance* in *dance*). (b) Rimes in which a single vowel is followed by two consonants that represent a single consonant sound plus a final silent *e* were classified as silent *e* (e.g., *ache*). (c) Rimes in words from the French that follow the silent *e* pattern except that a silent *u* occurs between the consonant and the final *e* were classified as silent *e* (e.g., *ague* in *vague*). (d) The influence of a following *r* on vowel pronunciation also affects silent *e* and vowel team rimes (e.g., *ere* in *here* or *ear* in *hear*). These rimes were nevertheless classified respectively as silent *e* and vowel team. (e) In a few rimes, a vowel combination is followed by a consonant plus silent *e* (e.g., *aine* in *cocaine*). These rimes were classified as vowel team.

The above analysis—dividing the words into syllables and the syllables into onsets and rimes, coding the words phonemically, and classifying the rimes according to syllable type—provided the raw material for computer-assisted sorting and ordering of words into rime families in which words are grouped around each orthographic rime that occurs with the same pronunciation in at least two words. The reason why as few as two words were considered important enough to be grouped as a pattern can be illustrated with the words *any* and *many*. Although these are the only words on the list with the rime *an* as “en,” it is efficient to teach them together. Similarly, *could*, *would*, and *should* are an important family with only three words. While these words occur very frequently, word frequency was not the criterion for defining what constitutes a family because both higher and lower frequency words can usefully be taught in groups. The *ague* family, for example, includes only two relatively low frequency words, *vague* and *plague*.

Practicing this difficult rime in two different word contexts is reinforcing, and in effect the student gets two words for the price of one. Although some families comprise only two words, almost all families are made up of a significant number of words, some of them hundreds of words. Rimes that do not share *both* spelling and pronunciation with a rime in any other word were consigned to a list, "Words with Unique Rimes," a list that in fact contains only 436 words.

Table I illustrates the presentation of rime families with *ine*, a silent *e* syllable. The phonemic coding made it possible to organize in separate families words in which alternate pronunciations of the same rime spelling (orthographic rime) occur. As can be seen, the *ine* as in *line* family words appear first, followed by the *ine* (*engine*) family, then the *ine* (*machine*) family. For each family, one-syllable words appear first. Two-syllable words are next, first those with the rime in the first syllable, then those with the rime in the second syllable. Then follow three-, four-, five-, and six-syllable words with *ine*, which are presented without regard for the position of the syllable in which *ine* occurs. Words for each number of syllables are ordered by their frequency.

The phonemic coding also permitted analyzing each orthographic rime both for the consistency of vowel pronunciation in all words in which it appears and for regularity according to syllable type. Regularity was defined as conformity to the most frequent pronunciation for each vowel spelling in a given syllable type (e.g., the most frequent pronunciation of *a* in closed syllables is short *a*, as in *cat*). As regards consistency, a rime was considered to be consistent if its vowel pronunciation is the same in all occurrences with only a single exception word, which was assigned to the unique list (e.g., *ought* is consistently pronounced as in *thought*, *bought*, *fought*, except in the word *drought*).

Analysis of the regularity of vowel pronunciation in each of the six syllable types identified for each vowel spelling all of its various pronunciations, which were ordered according to their frequency of occurrence as "first sound" (regular sound), "second sound," "third sound," and so forth. The interplay of regularity and consistency was examined by categorizing each orthographic rime according to the vowel sound(s) represented in the rime and by assigning the rime spellings to one of three groups according to their consistency and regularity: Group A, in which vowel pronunciation is both consistent and regular (e.g., *ack*, which is always pronounced with short *a*, as in *back*); Group B, in which vowel pronunciation is variant (e.g., *al*, which is pronounced as in *pal*, *also*, and *quality*); and Group C, in which vowel pronunciation is consistent but not regular (e.g., *alk*, as in *walk*, *talk*, *chalk*). Table II presents an example of this analysis for silent *e* syllables with *i*. The first column shows the rime spellings of Groups A, B, and

Table I
An Example of Rime Families: Silent *e* Syllables with *ine*

<i>ine</i> (line)					
1-syllable words	air. line.	36	al. ka line	4	4-syllable words
line	de cline.	26	pal. a tine	4	de ter. mined ly
fine	head. line.	26	as. i nine	3	6-syllable words
nine	waist. line.	21	con. cu bine	3	o. le o mar. ga rine
mine	pipe. line.	19	un. der mine.	3	<i>ine</i> (<i>ma chine.</i>)
pine	stream. lined.	18	nine. ti eth	2	2-syllable words
shine	al. pine	17	dis. in cined.	1	(in second syllable)
wine	clothes. line.	15	<i>ine</i> (<i>en. gine</i>)		ma chine. 874
Rhine	shore. line.	15	2-syllable words		ma rine. 78
spine	re fine.	12	(in first syllable)		rou tine. 55
vine	in cline.	9	vine. yard	7	vac. cine 43
shrine	sky. line.	9	(in second syllable)		chlo. rine 36
twine	grape. vine.	7	en. gine 583		ra vine. 26
brine	con fine.	6	doc. trine 21		sar dine. 6
thine	en twine.	6	u. rine 21		cui sine. 3
whine	out shine.	6	des. tined 19		la trine. 3
dine	qui. nine	6	fam. ine 6		mor. phine 3
swine	moon. shine.	5	san. guine 6		ben. zine 2
	bee. line.	4	jas. mine 5		pris. tine 1

Table II
 Analysis of Consistency and Regularity of Vowel Pronunciation in the Rime Spellings:
 Silent *e* Syllables with *i*

Rime Spelling	First Sound	Number of words
ibe	tribe	16
ide	ride	75
ife	life	15
ike	bike	26
ime	dime	37
ipe	pipe	13
ire	fire	57
ithe	blithe	4
ize	prize	84

Group A: Consistent and Regular

Rime Spelling	First Sound	Group B: Variant		Third sound	Number of words
		Second Sound	Number of words		
ice	nice	notice	37	police	4
ile	reptile	fertile	21	automobile	2
ine	line	engine	28	machine	30
ise	paradise	promise	3	marquise	3
ite	wise	granite	14	elite	3
ive	kite	native	200		
	hive				
Group C: Consistent but not Regular					
Rime Spelling				Third Sound	Number of words
igue				fatigue	2
ique				antique	8
Total			589		52
					303

C. The words in the second column identify rime families in which vowel pronunciation is according to the first sound. The next column gives the number of words in these rime families. Succeeding pairs of columns treat the second and third sounds. Table III illustrates for closed syllables how the information on regularity and consistency was consolidated for each of the six syllable types.

Results

Before examining the results of the analyses of regularity and consistency, two general findings should be mentioned. The first is that only 19 percent of the words of the entire list are monosyllabic; however, one-syllable words account for about three-fourths of the total frequency of all the words (Table IV). This is in accord with well-documented properties of the distribution of words according to frequency. While a relatively small number of words (mostly monosyllables) occur repeatedly, most words (especially multisyllabic words) occur infrequently. In *A Statistical Analysis of American English*, Roberts (1965) presents data, based on the Horn list of the 10,000 most frequent words, which reveal that one-syllable words account for 82 percent of the first one-thousand most frequent words (first decile), while at the tenth decile their relative frequency has dropped to 22 percent. Obviously, as the student progresses through the grades, being able to read multisyllabic words becomes increasingly important, and the necessity for being able to make use of familiar patterns in decoding the large number of multisyllabic words not often encountered in print seems apparent. The second finding is that certain types of syllables occur far more often than others (Table V). Closed syllables account for 43 percent of all syllables; closed and open syllables together, almost three-fourths. The other syllable types, although they occur relatively less often, are still found in large numbers of words.

Regularity

The results of the analysis of regularity of vowel pronunciation according to syllable type (Tables VI and VII) show that closed syllables (and the far fewer consonant-*le* and *-re* syllables) are far more regular than the other syllable types. A second observation is that within each syllable type the degree of regularity varies among the different vowel spellings. For each vowel spelling in each syllable type, however, there is almost always one vowel sound that predominates (first sound), and that sound is, with a limited number of exceptions, as predicted by syl-

lable type. Following is a discussion of the findings for each of the different syllable types.

Closed syllables. The vowel sounds in closed syllables are the regular short sounds as predicted by syllable type in about 95 percent of occurrences. As we shall see, this high degree of regularity is manifested in the large number of rime spellings that are consistent (or nearly so) in vowel pronunciation according to the first sound. Alternate vowel sounds do occur, however, in substantial numbers of words, and the analysis by rime spelling can help locate the trouble spots and organize words for teaching.

Open syllables. An open syllable, by definition, is one that ends in a single vowel; therefore, for each vowel there is only one rime spelling (e.g., the rime spelling for *a* in open syllables is *a*, for *e* it is *e*). All are variant in pronunciation. As can be seen in Table VI, the first sound is long, as predicted by syllable type, for *e*, *o*, and *u* in over 90 percent of occurrences; but for *a*, the first sound is as in *about*, for *i* as in *pigeon*, and for *y* as in *body*. For *a* and *y* these sounds occur only in unstressed syllables, and words can be selected to familiarize students with these patterns (e.g., *a* in *about*, *around*, *ago*; *tuna*, *soda*, *opera*). The first sound of *i* (as in *pigeon*) occurs in both stressed and unstressed syllables, and this pattern is extensive in multisyllabic words. In fact, only in two-syllable words is the long sound of *i* frequent (e.g., *ti ger*, *spi der*). Students should be aware of the special case of *i* in the open syllables of multisyllabic words (e.g., *con di tion*, *po si tion*; *mag ni fy*, *for ti fy*).

The generalization that in an open syllable the vowel sound is long clearly needs qualifying. There are, however, large numbers of words in which it does hold true, and it is useful for students to know that the vowel at the end of a syllable may say its name. Because monosyllabic words account for only 37 of the 12,000-plus occurrences of open syllables, students must learn to decode open syllables largely in the context of words of more than one syllable. Practice reading and spelling families of words with long open vowels can be helpful (e.g., *mu sic*, *pu pil*, *hu man*, *fu el*, *fu ner al*, *stu di o*).

Silent e syllables. In silent *e* syllables the first sound is the long sound for all six vowel spellings; however, the percentages of occurrence are relatively low except for *y*, which is consistently long in the 14 words in which it occurs (e.g., *type*, *rhyme*). Much of the variation from the expected long sound is accounted for by certain rimes that occur in unstressed final syllables (e.g., *age* in *message*, *ate* in *climate*, *ive* in *native*, and *ure* in *picture*). The amount of regularity by syllable type can be significantly improved by teaching, for example, the *age* (*page*) family words as exemplars of the silent *e* rule and the *age* (*message*) words separately.

Table III
 Regularity and Consistency of Vowel Pronunciation in the Rime Spellings: Closed Syllables

	Number of rime spellings	Number of rime families and occurrences of vowel pronunciation ^a				Other	Total
		as in cat	as in also	as in wash	as in wash		
with <i>a</i>	Group A	35	—	—	—	—	42(1,533)
	B	10	10(2,709)	1(45)	10(75)	3(25)	24(2,854)
	C	11	—	5(72)	4(19)	2(29)	11(120)
Total	56	52(4,242) 94.1%	6(117) 2.6%	14(94) 2.1%	5(54) 1.2%	77(4,507) 100%	
with <i>e</i>	Group A	52	as in web	as in ballet	as in oases	Other	Total
	B	3	56(2,820)	—	—	—	56(2,820)
	C	—	4(1,511)	1(11)	1(9)	2(10)	8(1,541)
Total	55	60(4,331) 99.3%	—	—	—	—	64(4,361) 100%
with <i>i</i>	Group A	46	as in crib	as in high	—	—	Total
	B	4	47(3,568)	—	—	—	47(3,568)
	C	4	5(557)	4(43)	4(120)	4(120)	9(600)
Total	54	52(4,125) 96.2%	8(163) 3.8%	—	—	60(4,288) 100%	

with <i>o</i>	Group A	23	as in rod	26(834)	as in old	—	as in front	—	Other	—	Total	26(834)
	B	10		11(2,342)	8(73)	5(105)	—	4(23)	—	—	28(2,543)	
	C	5		—	3(62)	2(7)	—	—	—	—	5(69)	
	Total	38		37(3,176) 92.2%	11(135) 3.9%	7(112) 3.3%	—	4(23) 0.7%	—	—	59(3,446) 100%	
with <i>u</i>	Group A	41	as in club	42(1,169)	as in push	—	as in busy*	—	Other	—	Total	42(1,169)
	B	5		6(363)	4(169)	1(7)	—	—	—	—	11(539)	
	C	1		—	—	—	—	1(3)	—	—	1(3)	
	Total	47		48(1,532) 89.5%	4(169) 9.9%	1(7) 0.4%	—	1(3) 0.2%	—	—	54(1,711) 100%	
with <i>y</i>	Group A	14	as in gym	16(135)							Total	16(135)
	B	—		—							—	
	C	—		—							—	
	Total	14		16(135) 100.0%							16(135) 100%	
All vowels	Group A	All rime spellings	211	First Sound	229(10,059)	Second Sound	Third Sound	Other	—	Total	229(10,059)	
	B		32		36(7,482)	18(341)	17(196)	9(58)	—	80(8,077)		
	C		21		—	12(254)	6(26)	3(32)	—	21(312)		
	Total		264		264(17,541) 95.1%	30(595) 3.2%	23(222) 1.2%	12(90) .5%	—	330(18,448) 100%		

Note. The number of occurrences is shown in parentheses. All occurrences for words marked with an asterisk are forms of the word given.

*The number of rime families for Group A may be slightly larger than the number of rime spellings because variation in pronunciation of the final consonant breaks out separate families in a number of cases.

Table IV
Analysis of Words by Number of Syllables

Number of Syllables	Number of words	Percent Distribution	Total Word Frequency ^a	Percent Distribution
1	3,330	18.9	3,163,023	76.3
2	6,685	38.0	693,555	16.7
3	4,540	25.8	209,630	5.1
4	2,258	12.8	64,265	1.6
5	682	3.9	14,205	.3
6	101	.6	1,204	<.05
7	6	<.05	80	<.05
Total	17,602	100.0	4,145,962	100.0

^aSum of the frequencies of the words, based on raw frequencies in the *Word Frequency Book* (Carroll, Davies, and Richman, 1971).

Table V
Analysis of Occurrence of Syllables Types

Type of Syllable	Number of Occurrences	Percent Distribution
Closed	18,644	43.3
Open	12,419	28.9
Silent <i>e</i>	2,876	6.7
Vowel- <i>r</i>	4,397	10.2
Vowel Team	4,092	9.5
Consonant- <i>le</i> and <i>-re</i>	613	1.4
Total	43,041	100.0

Note. A word may contain more than one of a given syllable type and may therefore be counted more than once, e.g., the word *magnet* contains 2 closed syllables and accordingly is counted twice under closed syllables.

Table VI
 Analysis of Regularity of Vowel Pronunciation in Five of the Six Syllable Types

Closed	e		i		o		u		y		Total	
	as in:	% occ.	as in:	% occ.	as in:	% occ.	as in:	% occ.	as in:	% occ.		
1st Sound	cat	94.1	web	99.3	crib	96.2	rod	92.2	club	89.5	gym	95.1
2nd Sound	also	2.6	ballet	0.3	high	3.8	old	3.9	push	9.9	—	3.2
Other		3.4		0.4		—		3.9		0.6		1.7
		n = 4,507		n = 4,361		n = 4,288		n = 3,446		n = 1,711		n = 135
1st Sound	about	55.3	even	93.4	pigeon	82.7	go	98.1	music	99.3	body	83.0
2nd Sound	paper	40.9	com-	4.5	lion	16.3	who	1.2	corduroy	0.7	my	15.5
Other		3.8	edy									1.5
		n = 2,702		n = 1,900		n = 3,024		n = 1,686		n = 946		n = 2,158
1st Sound	cake	69.6	scene	75.5	bike	62.4	globe	81.3	cube	68.8	type	69.2
2nd Sound	surface	22.9	where	27.9	notice	32.1	come	12.5	picture	31.2	—	25.2
Other		7.5		4.5		5.5		6.2		—		5.6
		n = 1,000		n = 121		n = 944		n = 455		n = 295		n = 14
1st Sound	car	56.2	her	93.4	stir	70.4	orbit	61.7	fur	98.8	pyramid	78.9
2nd Sound	sugar	20.0	merry	6.6	miracle	29.3	major	31.9	bury*	1.2	myrtle	15.0
Other		23.9		—		—		6.4		—		6.1
		n = 872		n = 2,171		n = 157		n = 887		n = 248		n = 12
Cons. -le and -re	le		re									
		as in:		as in:								
1st Sound	people	100	acre	100								100
2nd Sound	—	—	—	—								—
Other	—	—	—	—								—
		n = 605		n = 8								—

Note. The pronunciation of a vowel spelling indicated by a word marked with an asterisk occurs only in forms of the word given (e.g., *ur* in *bury*, *buried* and *burial*).

Level 2 (less than 90% occurrence of the first sound)					
<u>Vowel</u>	<u>Occurrences</u>	<u>1st sound as in:</u>	<u>2nd sound as in:</u>	<u>3rd sound as in:</u>	<u>Other</u>
ae	11	<i>aesthetic</i> 54.5%	<i>algae</i> 45.5%		
ai	309	<i>rain</i> 73.5%	<i>hair</i> 18.1%	<i>captain</i> 8.4%	
ea	574	<i>sea</i> 63.1%	<i>deaf</i> 25.6%	<i>search</i> 5.4%	<i>break</i> (3.1%); <i>heart</i> (2.8%)
ei	64	<i>vein</i> 46.9%	<i>either</i> 25.0%	<i>forfeit</i> 10.9%	<i>geiger</i> (9.4%); <i>heir</i> (7.8%)
eo	5	<i>leopard</i> 60.0%	<i>people</i> 40.0%		
eu	35	<i>neutral</i> 74.3%	<i>chauffeur</i> 25.7%		
ey	67	<i>money</i> 76.1%	<i>they</i> 23.9%		
ie	300	<i>piece</i> 75.7%	<i>pie</i> 22.3%	<i>friend*</i> 2.0%	
oe	22	<i>toe</i> 54.5%	<i>shoe</i> 22.7%	<i>amoeba</i> 22.7%	
oo	334	<i>zoo</i> 59.9%	<i>book</i> 34.4%	<i>door</i> 3.6%	<i>blood</i> (2.1%)
ou	764	<i>ouch</i> 37.0%	<i>famous^a</i> 41.6%	<i>coupon</i> 6.4%	<i>couple</i> (4.2%); <i>soul</i> (5.4)% ^b
ow	254	<i>show</i> 50.0%	<i>cow</i> 48.4%	<i>knowledge</i> 1.6%	
eau	13	<i>beauty*</i> 53.8%	<i>plateau</i> 46.2%		

Note. All occurrences for words marked with an asterisk are forms of the word given.

^aAlthough *ou* pronounced as in *famous* accounts for the largest number of occurrences, it occurs only in the rime spelling *ous* and for this reason was not designated as the first sound.

^bThe percentages of occurrences for the 6th, 7th, and 8th sounds of *ou*, as in *journey*, *thought*, and *could* are 2.7%, 2.2%, and .4% respectively.

There is a pattern of shifts among three alternate pronunciations for silent *e* syllables with *i* that is captured by six variant rime spellings that warrant special attention:

<i>ice</i> as in <i>nice</i>	<i>notice</i>	<i>police</i>
<i>ile</i> as in <i>reptile</i>	<i>fertile</i>	<i>automobile</i>
<i>ine</i> as in <i>line</i>	<i>engine</i>	<i>machine</i>
<i>ise</i> as in <i>paradise</i>	<i>promise</i>	
<i>ise</i> as in <i>wise</i>		<i>marquise</i>
<i>ite</i> as in <i>kite</i>	<i>granite</i>	<i>elite</i>
<i>ive</i> as in <i>hive</i>	<i>native</i>	

Vowel-r syllables. In vowel-*r* syllables the percentage of occurrences accounted for by the first sound varies widely. Two factors explain most of the variability. The first is the occurrence of several rimes with vowel-*r* in unstressed final syllables (e.g., *ar* in *sugar*, *ard* in *backward* and *or* in *major*). The second factor is a shift to the short vowel sound with *ar*, *er*, and *ir* when followed by a syllable beginning with *r* or a vowel (e.g., *carpet* versus *carrot*, *carol*). The variation in pronunciation characteristic of vowel-*r* in multisyllabic words suggests that the usual practice of teaching *ar* as in *car*, *or* as in *for* and the three “er’s”: *er*, *ur* and *ir*, though a useful first step in decoding vowel-*r* syllables, does not suffice for multisyllabic words.

Vowel team syllables. There are 28 vowel teams, 25 of them two-letter combinations and three of them three-letter combinations, the latter occurring in a few words from the French (e.g., *eau* in *beauty* and *plateau*). Vowel team syllables have little in common except that more than one letter spells the vowel sounds, which run the gamut of English vowel phonemes. The vowel teams may spell the long sounds (e.g., *oa* in *road* or *ai* in *rain*), or alternately the long and short sounds (e.g., *ea* in *sea* and *head*), or various other sounds (e.g., *oy* in *joy* or *ou* in *ouch*). They vary widely in the regularity with which they correspond to a single sound. Table VII shows that the vowel teams fall into two distinct groups: Level 1 vowel teams, in which the first sound accounts for more than 90 percent of occurrences; and Level 2, in which the share of occurrences of the first sound is considerably lower. For nine of the Level 2 vowel teams, alternate pronunciations are confined almost entirely to two sounds (e.g., the vowel team *ow*, as in *cow* and *low*). For the remaining four, however, there are substantial occurrences among three or more sounds. The most variant of all the vowel teams is *ou*, for which the occurrences of five sounds must be combined to reach the 90 percent level. The rime families can help in specifying the vowel sounds of the variant vowel teams. For example, the most frequent (regular) sound of *ea* is as in *sea*; but for the rime spelling *ead*, the most frequent sound is as in *head*, *bread*, *thread*, and so forth.

Consonant-le and -re syllables. Consonant-*le* syllables occur in 605 words and consonant-*re* syllables in only eight words. These syllables are entirely consistent in pronunciation in all occurrences and are not difficult to learn. There are only nine syllables with *le*: *ble*, *cle*, *dle*, *fle*, *gle*, *kle*, *ple*, *tle*, and *zle*, and they can be taught as whole rhyming syllables with words grouped around each syllable (e.g., *babble*, *bubble*, *table*, *fable*, *stumble*, *fumble*). Only *tle* when it follows *s* may give trouble and require special teaching (e.g., *whistle*, *castle*, *rustle*).

Taken as a whole, the evidence regarding regularity implies a degree of overall consistency of vowel pronunciation in individual rime spellings (i.e., in the consistency of the orthographic neighborhood) but does not provide information on the extent of this consistency, which will now be examined.

Consistency

The overall consistency of pronunciation in the rime spellings is shown in Table VIII. There were found to be 824 different rime spellings that occur in the 43,041 syllables of the words, of which 208 occur in only one word each and consequently appear on the list, Words with Unique Rimes. Excluding rimes with unique spellings, the remaining 616 recur as the essential core of all other syllables. Because some rime spellings have more than one pronunciation, the 616 rime spellings account for 817 rime families. Of these 616 rime spellings, 491 are consistent in vowel pronunciation and 125 are variant in vowel pronunciation. (This overstates consistency slightly because words with a unique pronunciation of a rime spelling were consigned to the unique list.) There is very little variation in pronunciation of the final consonants, and, in general, these variations are not a serious problem for decoding, except for soft *c* and *g*, which often require special teaching. More than

Table VIII
Consistency of Pronunciation in the Rime Spellings

Classification	Number of rime	
	spellings	families
Total	824	—
Occur in one word (unique)	208	—
Occur in rime families, of which:	616	817
Consistent in vowel pronunciation ^a	(491)	(516)
Variant in vowel pronunciation ^b	(125)	(301)

^aTwenty-five of these rime spellings are variant in consonant pronunciation and occur in two rime families. For example, the rime spelling *as* occurs in the rime families *as* (*gas*) and *as* (*has*).

^bNine of these rime spellings are also variant in consonant pronunciation.

two-thirds of them involve alternation of voiced and voiceless forms of *s* and *th*, as in *base* and *phase* or as in *method* and *gather*, a negligible matter for decoding.

The Relationship of Regularity and Consistency

Analysis of the interplay of regularity and consistency is summed up for all the syllable types combined in Table IX. Of the 616 rime spellings that appear in rime families, 436 (or close to three-fourths) are in Group A. The rimes of this group are both regular and consistent and can be read by one-to-one grapheme-phoneme translation without any ambiguity. They are ideal for making analogies based on the rime because of their consistency. For example, if the Group A rime spelling *ab* is known as "ab" in *cab*, its pronunciation in *slab*—or any other word with this rime spelling—can be determined with certainty. The coincidence of regularity and consistency of orthographic neighborhood in this group of rimes is therefore reinforcing and should contribute to the ease with which they can be learned. Most of the rime spellings are in Group A, which demonstrates the close relationship between regularity and consistency.

Group C accounts for another 55 rime spellings. Although they are not regular in that the vowel sound is not the first sound according to syllable type, the consistency of their orthographic neighborhoods makes Group C rimes also ideal for the use of analogy. Thus if *alk* as "alk" in *walk* or *talk* is known, its pronunciation in *balk* or *stalk* can be determined with certainty on the basis of the rime unit taken as a whole.

Group B, the variant group, contains 125 rime spellings. Thirty-nine of these have a level of consistency of vowel pronunciation of 90

Table IX
Summary of Regularity and Consistency in the Rime Spellings

	Group A	Group C	Group B			Total
	100%	100%	90-99%	70-89%	<70%	
<u>Syllable type</u>						
Closed	211	21	20	6	6	264
Open	—	—	4	1	1	6
Silent <i>e</i>	48	4	4	8	8	72
Vowel- <i>r</i>	43	2	4	7	6	62
Vowel team	132	28	7	18	25	210
Consonant- <i>le</i> & <i>-re</i>	2	—	—	—	—	2
All types	436	55	39	40	46	616

Note. Group A rime spellings are consistent and regular in vowel pronunciation. Group B rime spellings are variant. Group C rime spellings are consistent but not regular.

percent or above. (In all but one of these rime spellings, the first sound is the regular sound.) For example, *at* is pronounced as in *cat* in 265 words and as in *what* in only six words. The remaining 86 rime spellings of Group B are the only ones that have less than a 90 percent level of consistency and can be regarded as significantly variant.

Discussion

The analysis reveals a high order of congruence of orthographic and phonological rimes. Rimes with the same spelling are usually pronounced in the same way. The structure of the orthography thus suggests that rimes should be useful in learning to read, and the results of the study provide evidence that supports the view of some researchers that onsets and rimes should be important in reading instruction.

The usefulness of the rime unit in making analogies between known and unknown words depends, of course, on the consistency with which these units are pronounced in various words. If all rimes were as variant as the notorious *ough*, pronounced as in *though*, *through*, *bough*, *tough*, and *cough*, there would be little advantage in focusing on rimes in teaching reading. As the results of the analysis show, however, this degree of inconsistency is atypical of rimes. By contrast with *ough*, the rime *ought* is quite consistent in pronunciation in a substantial group of words that provide a useful family for teaching because vowel pronunciation is clearly specified by the rime unit as a whole.

An analogy is based on an inference that two or more words with similar spelling will be similar in pronunciation. For example, if the word *antique* is known, then the pronunciation of the unknown word *pique* can be inferred because of the common spelling of the rime *ique*. Making an analogy depends on familiarity with both the spelling of the rime *ique* and its pronunciation as "eek" in the known word. Dyslexics may not spontaneously make analogies unless their attention is directed to words with common rimes and they are provided with oral reading and especially spelling practice in learning rimes. If spelling practice is not neglected, rime families are useful for teaching dyslexics the regular patterns as well as for organizing some of the irregularities.

The large amount of overlap of regularity and consistency found in the analysis suggests that both are tapping fundamental structural characteristics of the orthography as it relates to sound. Generalizations that predict vowel pronunciation by syllable type, especially for the first three syllable types, can be helpful to some students, but other students have difficulty dealing with linguistic generalizations. Learning rimes is more concrete. For example, *ap* is always "ap" in *cap*, *tap*,

and *rapid*; and *ape* is always "ape" in *cape*, *tape*, and *escape*. Learning to read and spell rime families that exemplify contrasting patterns can provide the raw material for forming generalizations about the way the vowels are usually pronounced in the various syllable types.

Making use of onsets and rimes in teaching reading does not contradict the practice followed in the Orton-Gillingham approach to the remedial training of dyslexics in which the individual letter-sound correspondences are taught first, from both the reading and spelling directions. This emphasis on building strong associations between written letters and corresponding sounds may be crucial to the child's grasp of the alphabetic principle. At the same time, evidence from this study suggests that taking advantage of common rime patterns that recur in both multisyllabic and monosyllabic words should be an effective way of enlarging a child's reading vocabulary.

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