

The Development of Spelling Skill

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Topics in Language Disorders, 20, 1-18. 2000.

Abstract

This article reviews the literature on spelling development in alphabetic scripts. Once children begin to learn that the function of alphabetic writing is to represent the sounds of language, they go through the process of learning sound-spelling correspondences in increasingly fine detail, from syllables to phonemes. This process is rooted in the development of phonological representations of words. Continued experience with print allows children to learn about more complex orthographic and morphological conventions of the language. Research and practice must take into account the complexities of phonological, orthographic, and morphological knowledge as they relate to spelling development.

Key Words: Spelling Development; Phonological Structure; Orthography; Morphology

Views of spelling development in English have been influenced by our notions about the nature of the writing system and by prevailing theories of learning. Until the 1960's, the English writing system was seen as complex and illogical, leading to the idea that spelling is a form of rote memorization or serial learning. However, as language researchers began to point to regularities in spoken and printed English (e.g., Chomsky & Halle, 1968; Venezky, 1970) and as cognitive psychologists began to view people as active learners, views of spelling development changed. It became apparent that children have the ability to actively search for meaning and structure in written language. The idea emerged that, although the sound-spelling correspondences of English are not completely regular, children use their knowledge of these correspondences in addition to rote visual memorization. Indeed, as will become apparent, spelling is to a large extent a creative process of symbolizing the linguistic structure of spoken words.

The primary goal of this article is to review the literature on spelling development in alphabetic scripts. Our focus will be on the acquisition of spelling skill in English, but we will also consider work done in other languages (particularly cross-language investigations of children's earliest attempts to understand the writing system). We will see that, although children distinguish writing and drawing from an early age, their first inclination is to represent the written forms of words in terms of their semantic attributes. Once children begin to learn that the function of alphabetic writing is to represent the sounds of language, they go through the process of learning sound-spelling correspondences in increasingly fine detail, from syllables to phonemes. In addition, experience with print allows children to learn about more and more complex orthographic and morphological conventions of the language.

Where appropriate, we will evaluate the research findings as they relate to theories of spelling development. The most widely accepted approach is that of *stage theories* (e.g., Ehri, 1986; Gentry, 1982; Henderson, 1985). According to these theories, children begin by using their knowledge of letter names and their knowledge of phonology to spell words. During later stages, additional sources of information come into play, including knowledge of orthographic

patterns and morphological relationships among words. These latter types of knowledge are said to be unavailable to beginning spellers. Stage theories give a rough overall picture of spelling development. However, they do not fully capture the complexities of phonological, orthographic, and morphological representations as they relate to spelling. A more fruitful understanding of spelling development may stem from the emerging view that, from the onset of their experiences with print, children use multiple strategies and different types of knowledge when engaged in spelling tasks (Treiman & Cassar, 1997; Varnhagen, McCallum, & Burstow, 1997; Rittle-Johnson & Siegler, 1999). It may be more accurate to depict spelling development as consisting of the predominant use of a particular process or strategy at different points in time, but not to the complete exclusion of others.

THE PRECURSORS OF ALPHABETIC WRITING

Even before they learn to read, children see words on street signs, cereal boxes, newspapers, and so on. As a result of this exposure, children begin to learn about the salient characteristics of writing from an early age. Preschoolers may “write” by making marks with a crayon or pencil, even before they know the conventional letters. Their writing, unconventional as it is, differs noticeably from their drawing.

Lavine (1977) tested children’s ability to differentiate between writing and drawing by asking them to sort cards containing various kinds of graphic displays. The children in this study were United States preschoolers aged 3, 4, and 5 years. Lavine asked the children to put those cards that had writing on them into a play mailbox and those that did not have writing on them into another container. Even the 3-year-olds accurately discriminated writing from pictures. These young children considered linearly arranged displays as writing more often than nonlinear displays. In addition, displays that included a variety of symbols were more likely to be labeled as writing than those in which the same symbol was repeated several times. As long as the units in a display looked similar to letters, the 3- and 4-year-olds accepted them as writing. It was not

until age 5 that children showed signs of differentiating Roman letters from similar-looking symbols that were not real letters.

Tolchinsky-Landsmann and Levin (1985) provided further support for the idea that children distinguish between writing and drawing from an early age. These investigators asked middle-class Israeli children aged 3, 4, and 5 years to both write and draw utterances such as *a house* and *a red flower*. By the time the children were 4, adults could easily tell which of the children's productions were meant as writing and which were meant as drawing. The 4-year-olds' writings generally consisted of linearly arranged strings of units separated by blanks. The writings tended to be smaller than the drawings. When writing, 3-year-olds either used characters of unidentifiable origin, mostly undifferentiated into units, or nonletters that bore some resemblance to Hebrew letters. Four-year-olds used a combination of real Hebrew letters, digits, and letters of the Roman alphabet, which these children had probably seen in addition to Hebrew letters. It was not until age 5 that children predominantly used real Hebrew letters in their writing. Still, these letters were often not the ones found in the conventional spelling of the utterance. The majority of 5-year-olds wrote in the direction that is standard for Hebrew, from right to left.

Although children as young as 3 or 4 know that writing looks different than drawing, they do not yet understand that the function of alphabetic writing is to represent the sounds of language. Instead, young children seem to believe that the written forms of words reflect their meanings. Children think that variations in the written forms of objects' names should correspond to differences in the properties of the objects themselves in much the same way that variations among pictures mirror variations among objects. For example, a 4-year-old Argentinian child, Gustavo (Ferreiro & Teberosky, 1982), wrote the word *pato* (duck), using a wavy line. The researchers then asked him to write *oso* (bear). They asked the child whether the word for bear would be longer or shorter than the word for duck. Gustavo replied the word for bear would be bigger. Because bears are bigger than ducks, Gustavo reasoned, the word for bear must be longer than the word for duck.

Further evidence for the primacy of meaning in early writing, according to Ferreiro and Teberosky (1982), is that young children expect nouns to be represented in print but do not understand that verbs can also be represented. Support for this suggestion comes from the findings of Tolchinsky-Landsmann and Levin (1987) with Israeli children. These researchers asked 4, 5, and 6 year olds to write words, phrases, and sentences. When a noun was added to a phrase or sentence, children were apt to write an additional character. They were less likely to add a character when a verb was added. For example, five-year-old Yafit used one character to write words that corresponded to single objects, such as *wave* and *wheel*. She used a single sign to write *Tali* (a girl's name), two signs to write the phrase *Tali and Eran* (the names of a girl and a boy), and three signs to write the sentence *Tali and Eran are building a tower*. When asked to read what she had written, Yafit divided the spoken sentence into three units, *Tali / and Eran / are building a tower*. She pointed successively to each of the three signs she had written while saying each unit. Thus, the number of units in Yafit's writing corresponded to the number of people or objects referred to in the sentence. Yafit used a single character to write *a girl*, *a girl is dancing*, and *a girl is dancing and singing*. Only nouns, she seemed to believe, deserved representation in print.

As children progress, they discover that writing represents the spoken form of language. All of the words in a spoken utterance are symbolized, not just the nouns. This realization may come about as children observe that the number of separate units in a written sentence is typically greater than the number of objects referred to in the sentence. Moreover, the physical features of a word and of the letters it contains do not necessarily correspond to the physical features of the corresponding object. For example, the written word *Dad* has fewer letters than the written word *Gustavo*, even though Dad is bigger and older than the 4-year-old Gustavo.

Ferreiro and Teberosky (1982) proposed that children initially believe that the correspondence between writing and speech is at the level of the syllable. Only later do children learn that, for English and other alphabetic systems, the link between print and speech is primarily at the level of individual sounds or phonemes. Five-year-old Bobby, whose writing is

reproduced in Figure 1, appears to understand that writing symbolizes the words of a spoken utterance. For the most part, he seems to relate print and speech at the syllabic level, using letters to represent syllables. Thus, he writes the monosyllabic words *should* and *be* with one letter each—“c” for *should* and “b” for *be* (henceforth, children’s complete spellings of words will be placed in quotations). The use of “b” for *be* reflects the letter’s name; the use of “c” for *should* may reflect the similarity between the first sound in the name of the letter c, /s/, and the first sound in the spoken form of *should*. Bobby’s spellings of *why* as “ye” and *I* as “ie” reflect a syllabic hypothesis overlaid with the effects of experience. Bobby’s older brother had told him that, when a letter says its name, an *e* should be added to the end of the word. Thus, Bobby included an *e* after his *y* spelling of *why* and his *i* spelling of *I*. The syllabic hypothesis also shows through in Bobby’s two-letter spelling of *enough*. He uses *n* to symbolize the first syllable of this word and *f* to symbolize the second syllable. Again, Bobby’s choices of letters are influenced by his knowledge of letter names.

Figure 1 here

Had Bobby not attempted the word *warm*, we would have concluded that he linked writing and speech solely at the level of syllables. However, Bobby’s “wom” spelling of *warm* reveals the beginnings of the idea that letters reflect the phonemes in spoken words. Bobby seems to have segmented the spoken word *warm* into three units of sound, writing *w* for the initial /w/, *o* for the middle part of the word, and *m* for the final /m/. His failure to represent the /r/ with a separate letter is typical of beginning spellers and is discussed below. Bobby’s case forms a bridge between what we have called the precursors of alphabetic writing and the emergence of the alphabetic principle.

THE ALPHABETIC PRINCIPLE EMERGES

As children begin to learn the conventional spellings of words such as *Dad*, *Mom*, and *stop*, they observe that the number of letters in a word's spelling does not usually match the number of syllables in its spoken form. Their early experiences with print force children to go beyond the syllabic hypothesis and to relate print and speech at a more fine-grained level.

Trevor (Figure 2), a year older than Bobby, shows a stronger grasp of the alphabetic principle. Trevor uses the alphabetic principle more or less consistently instead of only sporadically. For example, the spoken word *eat* contains two phonemes, /i/ and /t/. Trevor uses *e* to symbolize the first sound of this word and *t* to symbolize the second. His choice of *e* for /i/ is probably motivated by the fact that /i/ is the name of the letter *e*. The spoken word *pop* has three sounds, /p/, /ɑ/, and /p/, and Trevor spells it with three letters—*p* for the two /p/s and *a* for the /ɑ/. Trevor seems to fall back on a syllabic strategy when he writes *like* as “l” on the second line of his October 6 journal entry. On the first line of this entry, though, he writes this same word as “lak,” with one letter for each of its three sounds.

Figure 2 here

Trevor does not always succeed in dividing words into individual phonemes and representing each phoneme with a letter or letter group. For example, he fails to spell the /l/ of *play*, writing “pa”. He does not use a separate letter to represent the /ŋ/ of *drink*. He also chooses an unconventional letter to spell the initial /d/ of this same word, resulting in the apparently odd - but, as we shall see, common - spelling “grak” for *drink*. Trevor's only unusual error is “aco” for *and*, which he produces twice.

Six-year-old Jillian (Figure 3) makes some of the same kinds of spelling errors as Trevor. For example, she omits the second consonant of the initial /st/ cluster when spelling *still* as “sile.” She fails to spell the first consonant of the final cluster when writing “plat” for *plant*. Although Jillian is a better speller than Bobby or Trevor, she too sometimes uses the names of

letters as a guide to spelling. For example, she spells the /i/ of *seeds* with *e*, the letter that has this name, rather than with the conventional *ee*.

Figure 3 here

Much of the research on children's writing has focused on children whose spellings are similar to Trevor's and Jillian's, in both naturalistic (e.g., Read, 1975; Treiman, 1993) and experimental (e.g., Bruck & Treiman, 1990; Miller & Limber, 1985; Snowling, 1994; Treiman, 1985b, 1985c, 1985d, 1991, 1994; Treiman, Berch, Tincoff, and Weatherston, 1993; Treiman, Goswami, Tincoff, & Leever, 1997; Treiman, Zukowski, & Richmond-Welty, 1995; van Bon & Uit De Haag, 1997) settings. Below we will discuss several features of early alphabetic spelling that are suggested by the results of the naturalistic and experimental research. We will focus on studies of English, where a good deal of work has been done.

Unconventional Sensitivity to the Sounds of Words

A child who misspells *plaid* as "plad" has clearly used the alphabetic principle. This child has analyzed the word into individual sounds or phonemes and has represented each phoneme - /p/, /l/, and /æ/ and /d/ - with a reasonable letter. The child's only error is in picking *a* rather than *ai* to represent the vowel. The letter *a* is in fact the most typical spelling of /æ/ in English; it is the *ai* in the conventional spelling of *plaid* that is unusual. A misspelling like "plad" for *plaid* is often called a phonetic error. Such errors are taken to indicate that a child is successfully using the alphabetic principle.

Some of children's errors, although not phonetic in the sense just described, nevertheless accurately represent aspects of words' sounds. For example, the children studied by Read (1975), who began to write as preschoolers, sometimes spelled /d/ before /r/ as *g* or *j*, as in "gradl" for *dreidel* or "jragin" for *dragon*. Children learning to write at school have been found to make similar errors (Treiman, 1985c, 1993). Trevor (Figure 3) makes such an error when spelling

drink as “grak”. Similarly, the children in the foregoing studies sometimes symbolized /t/ before /r/ as *ch*, for example, spelling *trap* as “chrap” or *truck* as “chrac.” These errors make sense phonetically. A /d/ before /r/ is articulated with a degree of frication or turbulence that is similar to (although not as marked as) the frication that occurs in /dʒ/. Likewise, /t/ becomes similar to /tʃ/ when it occurs before /r/.

A similar tendency to represent sounds in unconventional but plausible ways is found when stop consonants occur after /s/. At the beginnings of words, voiceless and voiced stops contrast with one another. Thus, English speakers distinguish *cot*, which begins with the voiceless stop /k/, from *got*, which begins with the voiced stop /g/. In contrast, voiceless and voiced stops are not distinguished from one another when they occur after initial /s/. The English writing system assumes that stops are voiceless in this context and so *Scot* is spelled with *c* rather than *g*. In terms of certain phonetic properties, though, the second sound of *Scot* is more similar to /g/ than to /k/ (Klatt, 1975; Lotz, Abramson, Gerstman, Ingemann, & Nemser, 1960; Reeds & Wang, 1961). Correspondingly, young children sometimes symbolize stops after /s/ with letters that are appropriate for the voiced stops rather than with letters appropriate for the voiceless stops (e.g., Treiman, 1985d, 1993). For example, one first grader studied by Treiman (1993) wrote *sky* as “sgie.”

A third case in which children spell sounds in an unconventional but plausible manner involves syllabic /r/. In most varieties of American English, a word like *her* does not contain a separate vowel as it is pronounced. Rather, the /r/ takes the place of the vowel and is *often* said to be syllabic. The American children studied by Read (1975), Treiman (1993), Treiman et al. (1993), and Treiman et al. (1997) often omitted the vowels in these contexts, producing many errors such as “hr” for *her* and “brutr” for *brother*. Jillian (Figure 3) made the same sort of error when she spelled *bigger* as “bigr” and *sunflower* as “sunfliwr.” Indeed, the precocious spellers studied by Read (1975) and the kindergarteners studied by Treiman et al. (1993) omitted the *es* of words like *her* and *brother* more often than they included them. Even the first graders in the Treiman et al. (1993) study - average to above-average readers and who had surely seen common

words such as *her*, *work*, and *mother* - omitted the vowel between one-third and two-thirds of the time when spelling syllabic /r/.

Errors such as “chrap”, “sgie”, and “hr” have some important implications. These errors show that certain misspellings that are not phonetically correct in the sense of errors like “plad” for *plaid* nevertheless reveal children’s fine sensitivity to the sounds of spoken words. We would miss this sensitivity if we categorized errors such as “chrap” for *trap* as nonphonetic on the grounds that /t/ is never symbolized as *ch* in English. Thus, the division between phonetic and nonphonetic errors that forms the basis of many schemes of classifying spelling errors (e.g., Boder, 1973; Bruck & Waters, 1988; Finucci, Isaacs, Whitehouse, & Childs, 1983; Nelson, 1980) may be misleading when applied to young children.

Sound-based errors further show that, for young children, spelling is to a large extent a process of symbolizing the linguistic structure of spoken words. It is not simply a process of reproducing memorized letter sequences. If children had a general tendency to replace *t* with *ch*, we could not explain why *ch* substitutions for *t* are more common when *t* occurs before *r* (as in *trip*) than when *t* occurs in other contexts (as in *tap*).

Finally, certain spelling errors may arise because children’s implicit classifications of speech sounds sometimes differ from adults’. These errors may occur even on words like *trap*, that have consistent sound-spelling correspondences for adults. Thus, at least when regularity is defined according to an adult viewpoint, regular words are not necessarily easy for children to spell. Although the irregularity of the English writing system is often blamed for children’s difficulties in grasping the system, consistent sound-spelling correspondences would not necessarily be a cure-all during the early stages of development.

Grouping Phonemes in Words

Although beginning experiences with print force children to go beyond the syllabic hypothesis and to relate print and speech at a more fine-grained level, children’s analyses of

spoken words do not always reach the level of single phonemes. As a result, children may spell groups of phonemes with single letters.

One example of this grouping phenomenon involves final consonant clusters. Children sometimes fail to spell the first consonant of these clusters. For example, Trevor did not represent the /ŋ/ of *drink*, writing “grak” (Figure 2). These omissions occur for a variety of phonemes, including nasals like the /ŋ/ of *drink* and the liquids /r/ and /l/ as in *horse* and *old* (Read, 1975, 1986; Snowling, 1994; Treiman, 1993; Treiman et al., 1995; van Bon & Uit De Haag, 1997). Children may produce errors like “hos” for *horse* because they consider *horse* to contain three units of sound - initial /h/ followed by /or/ followed by /s/. For children, /o/ and /r/ form a single vowel unit rather than a sequence of two phonemes. Converging evidence for this notion comes from phonemic awareness tasks, which tap the child's ability to perceive and/or manipulate speech units. First graders who were asked to pronounce the individual sounds of syllables while putting down one token for each sound often used three tokens for a nonword such as *morl*, saying that its three sounds were /m/, /or/, and /l/ (Treiman et al., 1995; see also van Bon & Uit De Haag, 1997).

Another case in which children seem to group together what for adults are separate phonemes is that of initial consonant clusters. Young children sometimes fail to spell the second and third consonants of these clusters. For example, Trevor spelled *play* as “pa” (Figure 2) and another first grader spelled *street* as “set” (Treiman, 1993; see also Bruck & Treiman, 1990; Miller & Limber, 1985; Sprenger-Charolles & Siegel, 1997; Treiman, 1985b, 1991). Children may consider the spoken word *play* to contain the initial consonant unit /pl/ followed by the vowel /e/. They may symbolize the cluster with a single letter rather than analyzing it into two phonemes and symbolizing each phoneme with a separate letter. This idea is consistent with the phonological awareness literature which has also shown that syllable-initial consonant clusters, or onsets, form cohesive units for both children and adults (Bowey & Francis, 1991; Fowler, Treiman, & Gross, 1993; Kirtley, Bryant, Maclean, & Bradley, 1989; Treiman, 1985a, 1989, 1992).

A final example of children's tendency to group sounds is their use of a consonant letter to represent all of the phonemes in the letter's name. Examples include “frmmr” for *farmer*, “lefit” for *elephant*, and Jillian's “bamblbs” for *bumblebees* (Figure 3). The first *r* of “frmmr” apparently stands for both /ɑ/ and /r/, which together constitute the name of the letter *r*. In “lefit,” *l* represents the /ɛl/, the name of the letter *l*. In “bamblbs,” the last *b* seems to symbolize both /b/ and /i/. Several researchers have observed such letter-name spellings among young children (Chomsky, 1979; Ehri, 1986; Gentry, 1982; Read, 1975; Treiman, 1993, 1994). The errors appear to be more common for some consonants than for others (Treiman, 1993, 1994). For example, letter-name spellings of *r* and *l* (e.g., “frmmr” and “lefit”) are more frequent than letter-name spellings of *b* (e.g., “bamblbs”) and *s* (“ms” for *mess*). Children most often group /ɑr/ and /ɛl/ - the two English letters whose names consist of a vowel phoneme followed by a liquid phoneme. Because of the close bond between vowels and following liquids (Derwing & Neary, 1990, 1991; Treiman, 1984; Treiman et al., 1995), children sometimes use a familiar letter-name spelling for a vowel-liquid sequence, such as *r* for /ɑr/.

Misspellings such as “hos” for *horse*, “pa” for *play*, and “frmmr” for *farmer* suggest that children do not suddenly grasp the idea that print represents the level of phonemes. For some period of time, normally developing children may be unable to carry out full phonemic analyses of spoken words. During this time, children symbolize speech at a level that is intermediate between syllables and phonemes rather than dividing words into individual phonemes and representing each phoneme with a letter.

Implications for models of spelling development

In general, children's sound-based errors are consistent with stage theories of spelling development. However, stage theories do not account for the complexities of phonological representations as they relate to spelling development.

For example, Gentry (1982) postulated a well-defined phase of spelling development during which children produce letter-name spellings for all letters, whenever possible. In

contrast, Treiman's (1993, 1994) approach, as outlined above, emphasizes that letter-name spellings are more common for some letters than others because of the phonological properties of the letters' names. Treiman (1994) proposed that there are at least three phases in the use of letter names in spelling development. The first phase is characteristic of preschoolers who are as yet unable to segment spoken syllables into smaller units. Thus, a young child may notice that /kɑr/ sounds similar to the familiar sequence /ɑr/. Because the syllable /kɑr/ sounds similar to /ɑr/, the child may spell the syllable as "r" if he or she knows that /ɑr/ is the name of the letter *r*. This interpretation is consistent with suggestions that children are sensitive to syllable units in their earliest attempts at writing. That is, they tend to represent each syllable of a spoken word with a single symbol (Ferreiro & Teberosky, 1982; Tolchinsky-Landsman & Levin, 1987).

As phonological awareness develops, the child becomes able to analyze /kɑr/ as a sequence of /k/ followed by /ɑr/. The child symbolizes /k/ as *c* or *k*, using knowledge of phoneme-grapheme correspondences, and /ɑr/ as *r*, using the well-practiced link between /ɑr/ and its name. During this second phase, "cr" or "kr" spellings predominate. Some "cre" or "kre" spellings may occur too if the child has had enough experience with print to know that English words generally contain a vowel.

As phonological analysis abilities develop further (and exposure to print increases), children become able to analyze /ɑr/ into /ɑ/ and /r/, in spite of the strong bond between the two phonemes and the familiar link from /ɑr/ to *r*. During this third phase, children come to symbolize the vowel of /kɑr/ with a separate letter, ordered correctly in relation to the two consonants. Although they may not yet produce the conventional "car," they use some vowel grapheme in the middle of their spelling.

The critical feature of the developmental model of letter-name spelling proposed by Treiman (1994) is that children's movement through the three phases differs according to the phonological properties of a letter's name. As mentioned, the bond between the phonemes in a letter's name is stronger for some consonant letters, such as *r*, than for others, such as *b*. Thus, it is harder for children to separate the /ɑ/ and /r/ of /kɑr/ than the /b/ and /i/ of /bit/.

Consequently, a child may produce incorrect “cr” spellings of /kɑr/ while also producing more accurate “bet” or “beet” spellings of /bit/ (Treiman, 1993, 1994). This latter finding presents a problem for stage notions of spelling development, which posit consistent spelling patterns within a stage of development. That is, according to stage theory, a child at the letter-name stage ought to produce both “cr” and “bt” spellings at the same point in time.

Throughout this section, we have drawn parallels between developmental patterns in spelling and those in phonological awareness tasks. Both early spelling and phonological awareness appear to proceed from syllables to units intermediate between syllables and phonemes to phonemes. The connection between spelling and phonological awareness arises because performance on both types of tasks reflects the underlying nature of phonological representations. Analyzing spelling performance on the basis of the particular phonological attributes of the stimuli, and relating this to what is known about the development of those particular phonological representations, yields a clearer and more detailed picture than that afforded by stage notions of development. Indeed, as seen above, such analyses have the potential to challenge stage theory's core assumption of consistent spelling patterns within a stage of development (see Varnhagen, McCallum, & Burstow, 1997, for a similar view).

TOWARD MORE SOPHISTICATED SPELLING

As children progress, their knowledge of the spelling system grows and deepens. Proficient writers possess a good deal of information about orthography, including knowledge about the spacing of words, the orientation of writing, acceptable and unacceptable letter sequences, and the variety of ways in which certain phonemes may be represented, depending on such factors as their position in a word. They also learn about morphological relations among words and how they are indicated in print.

Learning to Classify Sounds According to Conventional Orthography

As children learn to read, they see how sounds are classified by the conventional writing system. For example, as outlined in the previous section, young children may perceive the *dr* of *drag* as a type of /dʒ/ and spell it accordingly. This classification changes as a function of experience with print. The change does not happen overnight as a result of learning to read a few *dr* and *tr* words. For example, one first grader tested by Treiman (1985c) read the word *tray* correctly but spelled /dr/ and /tr/ in a nonstandard manner on every possible occasion. By second grade, though, children make only a few unconventional spellings of /dr/ and /tr/ (Treiman, 1985c). The case of syllabic /r/ provides another example of how experience with conventional print changes children's ideas about sounds. As children progress from kindergarten to first grade to second grade, they are increasingly likely to include a vowel in their spellings of words such as *sir* and *work* (Treiman et al., 1993). By second grade, most children include a vowel in such words. They also use a vowel when spelling similar nonwords, showing that they have learned something beyond the conventional spellings of specific real words.

Older children's and adults' thinking about sounds is thus colored by their knowledge of spellings. Literate people find it difficult to think about sounds as divorced from letters (Treiman & Cassar, 1997). Indeed, teachers must be aware of this fact during literacy instruction. It would be tempting, for example, to include *sugar* among the words that start with /s/ when it is in fact a word that starts with /ʃ/. Orthography, originally learned as a representation of speech, takes on a life of its own. Once learned, it influences our views about language itself (Derwing, 1992; Fowler, 1991).

Learning Orthographic Patterns

As mentioned earlier, children in a literate society have a good deal of experience with print even before they learn to read and write. As a result of this experience, prereaders learn about the salient visual characteristics of print, such as the fact that it consists of strings of units

arranged in a linear pattern. With time, children focus more and more on the letters within printed words and on how they are arranged.

The words of English, or of any other language, are not random strings of letters. Instead, the letters are arranged in certain patterns. For example, *ck* may occur in the middles and at the ends of English words, as in *packet* and *pack*. This *digraph* (or two-letter sequence) does not occur at the beginnings of words. The ban against initial *ck* does not reflect a ban against the initial /k/ sound; many words begin with /k/ spelled as *k* or *c*. Rather, the nonoccurrence of initial *ck* is an orthographic feature of English. Other orthographic patterns involve *doublets*, or two-letter spellings in which the two letters are identical. Certain letters may occur as doublets, such as the double *e* of *peel* and the double *l* of *ill*. Other letters, such as *v* and *i*, rarely double. Doublets typically occur in the middles and at the ends of words, as in *supper* and *inn*; they rarely occur at the beginnings of words. Venezky (1970) has described a number of such orthographic patterns.

Do beginning spellers appreciate these orthographic patterns? The results of several early research studies suggested that they do. Rosinski and Wheeler (1972) presented first, third, and fifth graders (tested near the beginning of the school year) with pairs of nonwords such as *tup-nda* and *dink-xogl*. Within each pair, one nonword was orthographically regular and pronounceable and the other was orthographically irregular and unpronounceable. The children were instructed to point to the item in each pair that was more like a real word. The first graders performed at chance levels, whereas the third and fifth graders performed significantly above chance. In a similar study, Niles, Grunder, and Wimmer (1977) used pairs such as *asateditol-jhbwstt*. First- through sixth-graders (tested near the end of the school year) were able to pick the correct item at better than chance levels, whereas kindergarteners performed at the level of chance. However, a problem with these early studies is that orthographic regularity and pronounceability were confounded in the nonword pairs. Thus, the children could have been using one or both of the features as a basis for their decisions.

Treiman (1993) attempted to get around the confounding effects of pronounceability in testing children's knowledge of orthographic constraints. Her orthographic constraints test included 16 pairs of nonwords. Each pair tested a constraint or regularity of the English writing system. One nonword in a pair conformed to the regular pattern while the other word did not. However, both nonwords were pronounceable. For example, one pair was *ckun* and *nuck*. Children were asked to choose which item looked more like a real word. If children make their judgments on the basis of sound only, both items would be equally likely to be chosen. However, if children consider orthographic acceptability in making their judgments, the item that conforms to the orthographic constraint should be chosen more often. Treiman found that middle-class kindergartners, first graders, and second graders (tested toward the end of the school year) all chose the conforming item significantly more than 50% of the time. The above-chance performance of even kindergartners and first graders supports the idea that knowledge of orthography begins to emerge from an early age.

The tests used by Niles, Grunder, and Wimmer (1977), Rosinski and Wheeler (1972), and Treiman (1993) contained a variety of nonword pairs. Knowledge of no one constraint was explored in detail. Cassar and Treiman (1997) conducted a series of experiments to investigate children's knowledge of double letters. We focus here on their analysis of three orthographic conventions concerning double consonants. First, consonant doublets may occur in the middle or at the end of a word but not at the beginning. Second, only certain consonants may double. Finally, medial doublets normally follow short vowels in words of more than one syllable, as in *latter*, whereas single consonants normally follow long vowels, as in *later*. Cassar and Treiman designed pairs of nonwords to test children's knowledge of these conventions. For example, in pairs testing knowledge of position, one nonword contained an initial doublet and the other nonword contained a final doublet. An example is *nnus* and *nuss*. If children know where consonants doublets may occur, they should judge that *nuss* is more likely to be a word than *nnus*. Similarly, in pairs testing knowledge of allowable doublets, children should judge that *noss* is more likely to be a word than *novv*. In pairs examining the phonetic environment for

doubling, one nonword contained a medial single consonant, as in *salip*, and the other contained a medial doublet, as in *sallip*. Cassar and Treiman asked whether children listening to pronunciations for the nonwords chose *salip* for a pronunciation with /e/ in the first syllable and *sallip* for a pronunciation with /æ/.

Overall, the results revealed a developmental trend in the acquisition of these types of knowledge. Knowledge of position was present at kindergarten, whereas knowledge of allowable consonant doublets emerged in first grade. Not until sixth grade and above did children show clear knowledge of the correspondence between short vowels and spellings with medial doublets. These latter results agree with stage theories of spelling development (e.g., Henderson, 1985). However, the results of the tests of position and allowable doublet knowledge suggest that at least some types of orthographic knowledge emerge much earlier in the course of spelling acquisition.

If children have some implicit knowledge about the kinds of letter sequences that may occur in English words, as the findings just reviewed suggest, then they may use this knowledge in their own spellings. Children should make spelling errors that follow the orthographic patterns of English more often than spelling patterns that deviate from these patterns. For example, children may misspell *cake* as "kack," following the pattern that *ck* may occur at the ends of English words. Children should be unlikely to misspell this word as "ckak," for this spelling violates the constraints of English. Looking at the classroom writings of first graders, Treiman (1993) examined the degree to which the errors honored the orthographic patterns of English. For each pattern that was investigated, the first graders usually, although not always, followed the pattern. Consider the results for *ck*. The children used this digraph 38 times when it was not a part of a word's correct spelling. They used the digraph at the beginning of a word only twice. The digraph occurred in the middle of a word 11 times, as in "mrckut" for *market*, and at the end of a word 25 times, as in "bick" for *bike*. Apparently, the children had begun to pick up the restriction against initial *ck*. This restriction, like the other orthographic patterns

studied, was not formally taught at school. The children probably discovered the pattern on their own from seeing words such as *sick* and *package* but not words like *ckan*.

In Treiman's (1993) study, compliance with the orthographic constraints tended to be greater during the second half of first grade than during the first half. Even during the first half of first grade, though, the children showed some knowledge of the patterns. Thus, children begin learning about the letter patterns within printed words from an early age. This learning may even start before children are able to read and spell words on their own. Once children begin to write, they tend to honor some of the orthographic patterns that they have observed.

Learning Morphology

The English writing system is typically considered to be an alphabetic, albeit irregular, system. For words that contain more than one unit of meaning, however, English often deviates systematically from the alphabetic principle. The spelling of a word that contains more than one meaningful unit often reflects meaning rather than sound. For example, one would expect *health* to be spelled as *helth* based on the sounds that it contains. The conventional spelling, though, indicates the similarity in meaning between *health* and *heal*. As another example, *jumped* and *hemmed* end with different sounds - /t/ for jumped and /d/ for hemmed. The final sounds of the two words, although different, both represent the past tense marker, and as such are both marked with final *ed*.

It takes some time for children to learn about the way in which morphology is reflected in spelling (Carlisle, 1988; Ehri, 1986; Gentry, 1982; Henderson, 1985; Templeton, 1992; Waters, Bruck, & Malus-Abramowitz, 1988). Indeed, poor adult spellers may never fully master this aspect of English spelling (Fischer, Shankweiler, & Liberman, 1985). For example, the third-through sixth-graders tested by Waters, Bruck, and Malus-Abramowitz (1988) had difficulty spelling words like *sign*. The correct spelling of this word can be predicted if one relates it to *signal*, which has the same root; the word is unlikely to be spelled correctly otherwise. Sterling

(1983) found similar errors among 12-year-olds. For example, one child apparently did not divide *closely* into the stem *close* plus the suffix *ly*, writing the word as “closlay.”

Children’s spelling errors on words such as *sign* and *closely* may arise, in part, because they do not yet know that *sign* is related to *signal* or that *closely* is related to *close*. A word such as *signal* may not even be in a young child’s vocabulary; if present, the child may not relate the word to *sign*. In addition, children may not have mastered the often complex rules by which suffixes and prefixes are added to spoken words (Carlisle, 1988). For example, the changes that take place between *magic* and *magician* or between *original* and *originality* involve variations in pronunciation and stress.

However, not all morphological relations are this complex. With simple suffixes and relatively common words, even young children have some ability to represent meaning relationships among words in their spelling. Treiman, Cassar, and Zukowski (1994) examined children’s spellings of words like *dirty* and *attic*. Both words contain a flap - a quick tap of the tongue against the upper part of the mouth. Flaps, being voiced, are similar to /d/ and children often misspell them as *d* (Read, 1975). If children use the root word *dirt* to aid their spelling of *dirty*, they should be unlikely to misspell the flap of *dirt* with a *d*. Such errors should be more common for *attic*, which is not related to *at*. Supporting these predictions, even kindergartners produced more correct spellings of flaps when there was a stem that could help them, as with *dirty*, than when there was no such stem, as with *attic*. Thus, young children appear to have some ability to represent meaning relations in spelling if these relations are clear and transparent.

Treiman and Cassar (1996) provided another example in which young children show some ability to represent meaning relations among words in their spelling. These investigators examined whether omission errors on final consonant clusters varied as a function of morphology. We mentioned previously that young children tend to bond the first consonant of a final consonant cluster to the preceding vowel. For example, *sand* is spelled “sad.” However, even among kindergartners, Treiman and Cassar (1996) found significantly fewer such spellings for words where the children could use morphological information. For example, due

to their knowledge of the word *rain*, the children were less likely to spell the word *rained* as “rad” than to spell *sand* as “sad.” Thus, as in the Treiman et al. (1994) experiment, children used morphology to override the tendency to commit a sound-based error.

Implications for models of spelling development

The literature addressing the acquisition of orthographic and morphological knowledge has important implications for views of spelling development. The critical issue is when children first begin to exhibit this knowledge. Kindergarteners and first graders who exhibit characteristics of sound-based spelling are able to recognize where double letters may occur in words (Treiman, 1993; Cassar & Treiman, 1997). Such a finding is inconsistent with stage theories of spelling development, which claim that sound-based spellers are not capable of orthographic analysis. The morphology studies of Treiman et al. (1994) and Treiman and Cassar (1996) are perhaps even more striking because they showed that the spelling patterns of a given child may be influenced by both sound-based (spelling *attic* as “adic” and *sand* as “sad”) and morphologically-based (spelling *dirty* as “dirty” and *rained* as “rad” less often) information. The co-existence of “lower-level” sound-based and “higher-level” orthographic/morphological influences runs counter to the central premise of stage theory - that different stages in the development of spelling are marked by reliance on qualitatively different types of information.

SUMMARY AND CONCLUSIONS

When they begin learning to read and write, children typically have achieved a reasonable spoken vocabulary. Given that spoken words are meant to convey meaning, it is perhaps not surprising that young children’s pre-alphabetic attempts at writing are influenced by the semantic characteristics of the words themselves. As children begin to grasp the alphabetic principle, their spellings reflect active (though often imperfect) attempts to symbolize the linguistic structure of spoken words. Children gradually acquire a more sophisticated knowledge of the spelling system, internalizing the classifications of sounds that are embodied in the

conventional writing system and improving in their knowledge of orthographic patterns and morphological information.

The early stages of alphabetic writing are principally characterized by reliance on sound-based information, with detailed knowledge of orthography and morphology coming later. As such, we are in agreement with the overall picture provided by stage theories of spelling development. However, our review of the literature suggests that as children's spelling vocabulary increases, their spellings change in degree rather than kind. Some of the findings are inconsistent with strong versions of stage theory. Specifically, we have presented evidence that children often produce spellings patterns that are neither consistent within a proposed stage of development nor marked by reliance on qualitatively different types of information. We have suggested that the problems of stage theories are due to the failure of such theories to take into account the complexities of phonological, orthographic, and morphological knowledge as they relate to spelling development.

Attention to the complexity within each of these types of knowledge leads to the conclusion that children's spelling vocabulary increases as a function of the continual and concurrent accumulation of all of these types of knowledge. For example, young children's spellings are largely sound-based, but they can also use rudimentary orthographic and morphological information. It is thus an oversimplification to label young children as sound-based spellers. What is needed is an approach to spelling development that emphasizes the interaction of various strategies and sources of information along the developmental spectrum (Treiman & Cassar, 1997; Rittle-Johnson & Siegler, 1999; Varnhagen et al., 1997). An understanding of the developmental patterns of each of these strategies and sources of information is the first step toward this end.

Acknowledgments

Preparation of this article was supported, in part, by grants from NSF (SBR-9807736) and the March of Dimes Birth Defects Research Foundation (12-FY98-204, 12-FY99-674).

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Figure 1. Message written by Bobby, a kindergartener. Message reads, “Why should I be warm enough?” This message was produced when Bobby’s mother told him that he must wear a jacket or sweater when he went outside so that he would be warm. *Note.* From “Spelling in Normal Children and Dyslexics” by Rebecca Treiman, 1997, in B. Blachman (Ed.), *Foundations of reading acquisition and dyslexia: Implications for early intervention* (p. 193). Hillsdale, NJ: Erlbaum. Reprinted by permission.

Figure 2. Journal entries of Trevor, a first grader. October 5 entry reads, “When I go outside I ride my bike and I play on my bike ride.” October 6 entry reads, “I like to eat pizza and I like to drink pop.” *Note.* From “Spelling in Normal Children and Dyslexics” by Rebecca Treiman, 1997, in B. Blachman (Ed.), *Foundations of reading acquisition and dyslexia: Implications for early intervention* (p. 194). Hillsdale, NJ: Erlbaum. Reprinted by permission.

Figure 3. Story written by Jillian, a first grader, in late March. Story reads, “Last spring I had a big sunflower. It was bigger than me and Alison. It was almost as big as my dad and my mom. And we did not plant any seeds. It was pretty and nice to see and lots of bumblebees came to get honey. Every day Alison and me came to see the sunflower. But all I can tell you that it is still growing.” *Note.* From “Spelling in Normal Children and Dyslexics” by Rebecca Treiman, 1997, in B. Blachman (Ed.), *Foundations of reading acquisition and dyslexia: Implications for early intervention* (p. 195). Hillsdale, NJ: Erlbaum. Reprinted by permission.

ASHA Questions

1. Prior to the 1960's, views of spelling development in English were influenced by the belief that
 - a. the division between phonetic and nonphonetic errors seen in many classification schemes may be misleading when applied to young children.
 - b. spelling is to a large extent a process of symbolizing the linguistic structure of spoken words.
 - c. the English writing system is complex and illogical.
 - d. people are active learners.

(p. 3)

2. A child 4 years of age typically does not yet understand
 - a. that writing generally consists of linearly arranged strings of units.
 - b. that the number of separate units in a written sentence is typically greater than the number of objects referred to.
 - c. that written words typically consist of a variety of symbols rather than the same symbol repeated several times.
 - d. none of the above.

(p. 6)

3. Ferriero and Teberosky (1982) proposed that children initially believe that the correspondence between writing and speech is at the level of
 - a. the onset cluster.
 - b. the syllable.
 - c. the phoneme.
 - d. the distinctive feature.

(p. 6)

4. Which of these is an example of young children's unconventional sensitivity to the sounds of words?
 - a. spelling *trap* as "chrap."
 - b. spelling *sky* as "sgie."
 - c. spelling *plaid* as "plad."
 - d. a and b.

(pp. 9 & 10)

5. Which of these findings is inconsistent with assumptions of stage theories of spelling development?
 - a. a child spells *car* as "cr" and *beet* as "bet."
 - b. a child spells *car* as "cr" and *beet* as "bt."
 - c. a child spells *attic* with a medial "d" and *dirty* with a medial "t."
 - d. a and c.

(pp. 14 & 21)