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Three Perspectives on Spelling Development

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Learning how to read and write can be one of the biggest challenges in children's lives. One of the most important components of writing at the single-word level is spelling. Although interest in spelling development has increased in recent years, the study of spelling has still not attracted as much attention as the study of reading (Caravolas, Hulme, & Snowling, 2001; Treiman, 1998). Studies of spelling development are important not only because of the pedagogical interest in understanding how children acquire this major facet of literacy, but also because children's early spellings provide information about their initial knowledge of the graphic and phonological characteristics of writing that could not be obtained in other ways.

Rather than exhaustively review the literature on the topic, we present in this chapter three current approaches to the study of early spelling development in alphabetic writing systems: the *phonological*, *constructivist*, and *statistical-learning* perspectives. We devote special attention to studies that have examined spelling development crosslinguistically, because such studies are crucial for differentiating universal properties of spelling development from those that are adaptations to specific features of the child's language or target writing system.

The Phonological Perspective

The phonological perspective holds that children's biggest challenge when learning to spell in alphabetic writing systems is understanding the idea that letters represent phonemes (e.g., Liberman, Shankweiler, Fischer, & Carter, 1974). Children also need to possess alphabetic knowledge, or knowledge of specific sound-to-letter correspondences, but gaining the ability to analyze spoken language into strings of

phonemes is a bigger hurdle, in this perspective, than learning specific links between phonemes and letters.

The phonological perspective describes the development of children's spelling skills in terms of their increasing ability to map sounds of words to phonetically appropriate letters, a process often called *encoding* (Ehri, 1992; Gough & Hillinger, 1980). Theorists such as Ehri (1991; 1992; 1998), Frith (1985), Henderson and colleagues (Beers, Beers, & Grant, 1977; Henderson, 1985), and Gentry (1982) represent the phonological perspective. These theorists have proposed phase and stage models of spelling development that differ slightly from each other but follow a similar pattern: Children move from an initial stage in which spellings are nonphonological to a later stage in which spellings are phonologically adequate. As children pass through different phases or stages, they rely predominantly on different types of knowledge. In common to the different theories is a focus on young children's attempts to represent the sounds of words in their spellings. In what follows, we will outline two representative theories: the stage theory proposed by Gentry, who proposed his model based on a case study of a child who began to spell without instruction (Bissex, 1980), and the phase theory proposed by Ehri.

These theorists believe that children's spellings are initially random strings of letters that have no relationship to the sounds in the words. For example, children may spell *quick* as *HS*[1] (Ehri, 1991); the letters *H* and *S* bear no relationship to the sounds in the word *quick*. This is what Ehri called the *prealphabetic* phase and Gentry called the *precommunicative* stage.

As children learn about letter names and sounds, they start to understand that letters symbolize sounds. Children then represent a few of the sounds in words with phonologically appropriate letters. Gentry (1982) cites an example of a 5-year-old child who, trying to get attention from his mother, spelled *RUDF* for *Are you deaf?* (Bissex, 1980, p. 3). These types of spellings are called *partial alphabetic* or *semiphonetic*. At this point in development, many of children's initial sound representations are based on a letter name strategy (e.g., *R* for *are* and *U* for *you*).

Many studies have shown that knowledge of letter names plays a particularly important role in young children's early spelling (e.g., Treiman & Kessler, 2003). Letter names are frequent within words (Pollo, Kessler, & Treiman, in press), and children may spell a letter name with its corresponding letter: the so-called *letter name strategy* (Treiman, 1993; 1994). Thus children may spell *car* as *CR* or *tell* as *TL,* using the consonants *R* and *L* to spell all of the sounds in the names of those letters. Because the name of a vowel letter is also typically one of the sounds it spells in English, evidence for the use of vowel letter names is more indirect. For example, Treiman (1993) showed the importance of vowel names when she observed that children more often wrote vowel letters when spelling a vowel sound that was the same as a letter name. Effects of letter name knowledge on reading and spelling have been documented not only in English but also in languages such as Hebrew (Levin, Patel, Margalit, & Barad, 2002) and Portuguese (Abreu & Cardoso-Martins, 1998; Cardoso-Martins, Resende, & Rodrigues, 2002; Martins & Silva, 2001).

The next phase or stage is when children produce spellings that more completely represent the phonological forms of words. This is called the *full alphabeti*c phase or

*phonetic* stage. Children may be able to spell correctly many words such as *CAR* or provide phonologically plausible spellings such as *KAR*. In this stage, all or most of the phonemes of the words are represented in children's spelling.

Consistent with the phonological perspective, many researchers have demonstrated that children's early spellings are in large part attempts to represent the sounds in words (e.g., Read, 1975, 1986; Treiman, 1993). Those researchers reported that, when children do not know how to spell certain sounds, they sometimes invent their own spellings for those sounds. These early phonological attempts are called *invented spellings*.

The pioneering work on invented spellings was done by Read (1975; 1986). Read's observations of early spellings questioned the traditional view that children learn to spell by memorizing each word individually and shifted attention to the creative aspects of young children's spellings. Children's spelling mistakes show that they are aware of phonetic distinctions that adults no longer notice, perhaps because of all their exposure to correct spellings. Children may spell words that start with *tr* with *ch* instead—spelling *truck* as *CHRAC* or *troubles* as *CHRIBLS*. At first, these mistakes look bizarre, but they have a perfectly good phonological explanation: Before /r/, the phoneme /t/ is phonetically similar to the initial sound of *chat*. A similar pattern occurs with /d/ before /r/, which children may spell with a *j* or *g*.

As illustrated above, children in the phonetic stage are thought to assign letters to sounds with no regard to the conventions of orthography. As children start to learn more about conventional spellings and spelling patterns that occur in words, they are said to enter a *transitional* stage (Gentry, 1982). Finally, children attain the *correct* stage

(Gentry) or *consolidated alphabetic* phase (Ehri, 1998). At this point in development, children are competent readers and spellers.

It is difficult to overstate the importance of the phonological perspective in the study of spelling development. The major strength of this perspective lies in the idea that children have linguistic knowledge that they use in their invented spellings. This perspective is strongly opposed to the earlier idea that learning to spell is purely a matter of rote memorization, an idea that had gained currency because of the belief that English spelling is so complex and irregular that it could not be learned any other way. Work following this phonological perspective pioneered the idea that children's early misspellings reflect their knowledge about the sound properties of words.

Studies within the phonological framework have led to theories of spelling development that are able to explain a broad range of phenomena, stimulating research and guiding educators. Another positive aspect of this approach is that researchers have used not only naturalistic data (e.g., Gentry, 1982) but also experimental data (e.g., Ehri & Wilce, 1985; Read, 1975). This combination allows researchers to bring together the ecological validity of naturalistic observations and the quantitative rigor of experiments.

Because most of the work within the phonological perspective has targeted the English language, the question arises as to the generalizabilility of its models to children learning to spell in other languages. Wimmer and Hummer (1990), for example, have suggested that children learning to read and spell in more regular writing systems such as German skip the earliest phases and move straight into the full alphabetic phase. But other researchers have found evidence for prephonetic and phonetic phases of development in languages in which sound-to-letter encodings are more regular than in

English. For example, Cardoso-Martins and colleagues found evidence that children

learning to read and spell in Portuguese follow a similar pattern of development as that

proposed by Ehri (Abreu & Cardoso-Martins, 1998; Cardoso-Martins, 2005).

One feature of writing systems that receives special attention in the phonological

perspective is the regularity of the relations between the phonemes and the letters. Many

studies in the phonological perspective have shown this to be an important factor in

literacy acquisition (e.g., Aro & Wimmer, 2003; Defior, Martos, & Cary, 2002; Seymour,

Aro, & Erskine, 2003). Children learning languages that are regular read better, faster,

and commit fewer mistakes than children learning to read in languages like English that

are more irregular. Although large-scale crosslinguistic studies are not as common in

spelling research, similar kinds of differences have been observed. Several findings

suggest that the rate of spelling development is slower for English than for more regular

writing systems such as Czech (Caravolas & Bruck, 1993) and German (Wimmer &

Landerl, 1997). The differences found between spelling development in English and

other languages are attributed to differences between spelling-to-sound regularities

among those writing systems (see Caravolas, 2004, for a review), but for the most part

these differences have not been systematically quantified. In fact, few researchers have

comprehensively investigated the spelling–sound relationships of languages other than

English; among the exceptions are Ziegler, Jacobs, and Stone (1996) and Lange and

Content (1999), both investigating French. There is a need for reliable and

comprehensive information about other orthographic systems and, in addition, about

other language characteristics that could be relevant to children who are learning to spell.

The most significant drawback of research in the phonological perspective is that it tends to give short shrift to nonphonological aspects of learning to spell in the earliest phases. Researchers in this tradition grant that many young children possess certain literacy-related skills, including knowledge about letters' shapes and names. Indeed, the fact that young children in the prephonetic phase (or precommunicative stage) of spelling development often use real letters as opposed to other symbols when asked to spell suggests that children have some knowledge about the writing system. However, researchers who subscribe to the phonological perspective have not usually studied how such knowledge is deployed in spelling. For example, these researchers have not tested the assumption that children's random-letter spellings are indeed random. Productions that appear to be random letter strings from a phonological perspective may consist of letters from a young child's name (Treiman, Kessler, & Bourassa, 2001) or may reflect certain characteristics of the writing system to which the children have been exposed, such as the relative frequencies of different letters. Studies show that U. S. children as young as kindergarten (about 5 to 6 years old) show some sensitivity to graphic patterns and permissible letter sequences in spelling. For example, English-speaking children have some understanding that certain letter sequences like *ck* or *rr* rarely occur at the beginnings of words. Evidence for this early sensitivity comes from naturally produced spellings (Treiman, 1993) as well as from experimental studies in which children rated nonwords like *baff* as more wordlike than nonwords like *bbaf* (Cassar & Treiman, 1997). The same pattern of results is found for other languages. For example, Pacton, Perruchet, Fayol, and Cleeremans (2001) showed that French-speaking children in Grade 1 (about 6 years old) are sensitive to which letters can be doubled. Such results suggest that early

spelling involve more than phonology. In our view, nonphonological knowledge is important from early in the course of spelling development and is not restricted to later phases.

<center>The Constructivist Perspective</center>

A second theoretical perspective in the study of spelling development may be called the constructivist perspective. This perspective is well represented in many non-English-speaking countries, including those using French (e.g., Besse, 1996), Italian (e.g., Pontecorvo, 1985; Pontecorvo & Zuchermaglio, 1988), Portuguese (e.g., Martins & Silva, 2001; Silva & Alves-Martins, 2002; Rego, 1999), and Spanish (e.g., Ferreiro & Teberosky, 1982). In the United States, it falls under the rubric of emergent literacy research (e.g., Sulzby, 1985). Researchers in this tradition prefer to use the term *writing* rather than *spelling* because they wish to embrace what "preschoolers know about general features of writing, not just what they know about the orthographic conventions of particular scripts" (Tolchinsky & Teberosky, 1998, p. 2).

Researchers in the constructivist tradition have been influenced by the work of Piaget. Piaget created a method of clinical observation to understand how children view the world and postulated a general developmental stage theory that was later applied to a variety of specific behaviors, including children's literacy skills. Ferreiro was particularly influential in extending the Piagetian framework to literacy development. Her work was based mostly on observations of Spanish-speaking children. Ferreiro and colleagues (Ferreiro, 1990; Ferreiro & Teberosky, 1982; Vernon & Ferreiro, 1999) focused on children's early conceptions about written language, proposing that children know a good

deal about writing even before they grasp the alphabetic principle. This knowledge

includes beliefs about written language and how words should be written.

Ferreiro and colleagues (e.g., Ferreiro & Teberosky, 1982) described three broad

stages in the evolution of writing, in the course of which children adopt and abandon

different hypotheses about written language until they understand the alphabetic

principle. At first, in what Ferreiro called the *presyllabic* stage, children do not

understand that the function of writing is to represent sounds of the language. Even at this

point, though, children hold hypotheses about written language. One of these is the

principle of *minimum quantity*, whereby children think that a text needs to have several

letters. For example, children are more likely to accept the sequence *BDC* as a word than

*BD*, even though they probably saw neither of those exact letter sequences before.

According to Ferreiro, this minimum is fixed for a given child and is typically either three

or four letters; it is independent of the minimum number of letters per word in the child's

language. In the same stage, children also believe that the letters in a word must be

different from each other—what Ferreiro called the *variation* hypothesis. For example,

children prefer the string of letters *BDC* over *BBB*. Children are unlikely to have seen

either sequence, a fact that advocates of the constructivist perspective take to mean that

children generate rather abstract ideas on their own. Moreover, Ferreiro and colleagues

suggested that children's preference for variation is independent of the frequency of

doubled letters in the writing systems to which they are exposed (Ferreiro, Pontecorvo, &

Zucchermaglio, 1996).

Although children at this first stage may be very good at discriminating writing

from drawing (Tolchinsky-Landsmann & Levin, 1985), they are inclined to represent

words in terms of their semantic attributes. They may believe that variation in the written

forms of object's names reflects variation of the properties of the objects. For example, in

a study of Italian preschoolers, Stella and Biancardi (1990) showed that children tended

to use longer spellings to represent bigger objects. In this study, children spelled

*coccinella* 'ladybug' and *farfalla* 'butterfly' with fewer letters than they used for *orso*

'bear' and *mucca* 'cow'. Also, children used more letters to spell *palle* 'straws' than *palla*

'straw', even though both words have the same number of phonemes. In these cases,

children appeared to match the number of letters in the spellings to semantic properties of

the objects, namely their size or quantity.

As children learn more about print, they observe that the physical characteristics

of objects rarely match the physical features of written words. According to Ferreiro and

colleagues, children now hypothesize that the individual letters they see in print stand for

syllables. This hypothesis results in *syllabic* spellings, in which children write one

symbol per syllable. For example, children may spell the Spanish dissyllabic words *palo*

'stick' and *sapo* 'frog' as *AO* (Ferreiro & Teberosky, 1982). Reports of syllabic spellings

among preschool children are frequent not only in Spanish but also in other Romance

languages such as Portuguese. For example, Nunes Carraher and Rego (1984) cited a

Portuguese-speaking child who spelled *urubu* 'vulture' as *UUU*, and Rego (1999)

described spellings such as *OA* for *bota* 'boot' and *AE* for *café* 'coffee'. In Italian, there

are reports of spelling such as *IAEA* for *primavera* 'spring' (Pontecorvo, 1996).

The syllabic stage is a crucial intermediary stage in Ferreiro's theory of spelling

development, because it is taken to be the child's first attempt to represent in print the

sounds of language. As children gain more experience with print, they observe that the

number of letters in written words usually exceeds the number of syllables in the corresponding spoken words. This causes children to move from the syllabic stage to the alphabetic stage, when they understand that letters stand for smaller sounds than syllables, namely, phonemes.

A strength of constructivist theories is their acknowledgment that young children in literate societies learn a good deal about writing before they understand that it represents language at the level of phonemes, or indeed before they understand that it represents language at all. In Romance-speaking countries, Ferreiro's theory is by far the predominant paradigm for explaining young children's spelling acquisition, to such an extent that early literacy instruction is generally approached as an effort to guide children out of the presyllabic stage of spelling and into the syllabic and later stages (Silva & Alves-Martins, 2002). However, despite its widespread popularity and acceptance, Ferreiro's theory has some limitations.

It has been surprisingly difficult to formulate rigorous empirical criteria for determining whether a child is in the syllabic stage. If children are asked to spell a list of words, some matches between the number of syllables in words' spoken forms and the numbers of letters in children's spellings would be expected to occur by chance. Procedures are needed to determine whether the number of matches exceeds the number that would occur by chance, and these have not been offered by advocates of syllabic theories.

Another limitation is that there is a lack of evidence for the syllabic stage—the most distinctive stage in Ferreiro's theory—in certain languages. Kamii, Long, Manning, and Manning (1990), for example, did not find evidence for a syllabic stage among

English-speaking children. Instead, they reported children representing words with only consonants—what the authors called a *consonantal* stage. Advocates of the syllabic hypothesis have proposed that the apparent discrepancy between English and Romance languages reflect differences between the languages. Kamii et al. pointed to the unclearness of many of the unstressed vowels in English polysyllables as a reason for the predominant use of consonants by English-speaking children. Ferreiro (1990) argued that syllabic spellings are rare or absent among English-speaking preschoolers because English has more one-syllable words than other languages such as Spanish. In any case, an expansion of the theory is necessary to account for the data of English-speaking children.

A last weakness of Ferreiro's theory of literacy development is that the original theory does not account for literacy development after children reach the alphabetic stage. As discussed earlier, many studies have shown that spelling development is not complete after children reach the alphabetic stage. Nonphonological knowledge plays an important role in mastering the complexities of the spelling system.

Statistical-Learning Perspective

The statistical-learning perspective agrees with the constructivist idea that young children in literate societies formulate and deploy hypotheses about the nature of writing before they understand that letters represents phonemes. In children's earliest spellings, where classical phonological theorists see random strings of letters, statistical-learning theorists agree with constructivists in finding meaningful patterns. However, while constructivism tends to emphasize constructions emerging spontaneously from the mind of the child, the statistical-learning perspective emphasizes that children's writing reflects

the characteristics of the input to which they have been exposed, as filtered through their perceptual and learning mechanisms.

Statistics, in this context, refers to frequencies. A statistical pattern or regularity is said to exist when a set of events or objects co-occur more often than expected by chance. Considerable evidence shows that people, including young children and infants, implicitly learn statistical regularities (Zacks & Hasher, 2002). Saffran and colleagues (Saffran, Aslin, & Newport, 1996; Aslin, Saffran, & Newport, 1999), for example, have shown that statistical relationships between sounds in speech help infants, young children, and adults to segment words. The applicability of the statistical learning perspective to spelling is suggested by the fact that in most literate societies, children often see words on street signs, in books and magazines, and so on. Children's early spellings may reflect the knowledge that they have gained by exposure to such material. A statistical perspective seeks to minimize the number of stipulations that must be made, by showing how theories of language learning and of learning in general can account for the learning of spelling.

An important implication of the statistical-learning perspective is that the same basic mechanism underlies spelling acquisition throughout development. This contrasts with the idea that children move through stages whose operative principles are divorced from those of previous stages. In a statistical perspective, one expects children to learn a variety of information simultaneously: A child may, for example, learn some principles of graphotactics quite early, such as the proper placement of capital letters, and other patterns later; this contrasts with the phonological perspective that all important graphotactic learning occurs in the final stage of spelling development. Another

implication of the statistical-learning perspective is that children's early strategies may be strongly informed by unique properties of their language and the writing system they are learning. Thus, we may expect quite different productions from speakers of different languages, even before they generate phonetically plausible spellings.

The connectionist framework provides a simple but powerful model of how people might learn statistical regularities. Connectionist models attempt to explain cognition in terms of networks of simple units. Pattern learning involves modifying the connections between the units in response to exposure to a substantial number of examples (Seidenberg, 1997). Recent studies of reading and spelling emphasize that connectionist learning mechanisms pick up subtle regularities in the input, arguably providing a better explanation of skilled reading and reading development than previous models that focus on all-or-none rules. For example, Hutzler, Ziegler, Perry, Wimmer, and Zorzi (2004) argued that connectionist models are able to explain an advantage of learning to read in regular versus irregular languages. Although more research using a connectionist framework has been done on reading than on spelling, connectionist models have recently been developed to account for data on normal and impaired spelling (e.g., Houghton & Zorzi, 2003). Such models require further development before they simulate human spelling in all respects. But with their emphasis on learners' sensitivity to the properties of the input, they provide an important foundation for the statistical-learning perspective being proposed here.

Consistent with the statistical-learning framework, studies have shown that the letter patterns that children and adults see in their daily experiences with printed words influence their reading and spelling. One pattern that exerts an important influence on

children early in life is their own first name. Young children see the spelling of their own name quite often and find it quite interesting, and this appears to play a central role in early literacy development. For example, studies have shown that young children identify the letters from their own first name more accurately than other letters. This has been demonstrated in languages as distinct as English (Treiman & Broderick, 1998), Hebrew (Levin & Aram, 2004), and Portuguese (Treiman, Kessler, & Pollo, submitted). Other studies, as mentioned previously, have shown that U.S. kindergartners tend to overuse letters of their own names when trying to spell other words (Treiman et al., 2001). Children's overuse of letters from their own name reflects the disproportionate frequency with which they encounter those letters.

As children are exposed to a greater number of printed words, the effects of exposure to their own names may be proportionately reduced: Children start to be influenced more by more general patterns of the writing system. Supporting this view are studies that have shown that when children (about 6 years old) make intrusion errors—inserting letters that are not phonologically appropriate—they are more likely to use letters that are frequent in their reading materials (Treiman et al., 2001).

If statistical properties of printed words influence children's spelling very early in spelling development, then certain phenomena that have been described by researchers in the constructivist perspective may find a more parsimonious explanation under the statistical-learning framework. This perspective can also help to explain some of the observed differences and similarities among children who speak different languages, because the children will have been exposed to different linguistic and orthographic input. Indeed, we consider quantitative crosslinguistic studies to be crucial in

understanding literacy acquisition. In what follows, we will discuss a crosslinguistic study conducted in our lab (Pollo, Kessler, & Treiman, in press) that illustrates how the statistical-learning framework can help explain early differences in children's spelling.

As mentioned previously, several differences have been reported between spellings produced by English speakers and those produced by speakers of Romance languages. Pollo et al. (in press) addressed two of those differences by investigating early acquisition of spelling in Portuguese and English. The first difference is in the postulated syllabic stage of spelling development. As described earlier in this chapter, young spellers of Romance languages have been reported to spell one symbol per syllable, while children learning English are rarely reported as spelling words in a syllabic manner. A second difference involves the acquisition of consonants and vowels. While Romance speakers often omit consonants, producing all-vowel spellings (e.g., Ferreiro & Teberosky, 1982), vowel omissions represent a large part of spelling mistakes among English-speaking children (Kamii et al., 1990; Read, 1986; Treiman, 1993; Varnhagen, Boechler, & Steffler, 1999). Pollo et al. tested the hypothesis that such differences in spellings reflect children's propensity to use letter names in spelling, as discussed earlier. Languages can vary to a great extent in how many letter names are found in words (e.g., Cardoso-Martins et al., 2002) and in the relative frequency with which the different letters are represented. Asymmetries between languages in letter name systems and in vocabularies could lead to different patterns in the spellings of young children.

In order to quantify some of the differences in language statistics that could lead children's spelling to differ in English and Portuguese, Pollo et al. (in press) counted how frequently letter names occurred within words in texts that young children would be

likely to see. The analyses showed that Portuguese words have many more vowel letter names than English. Words like *bola* /bɔla/—in which both vowel phonemes are the names of letters—are very common in Portuguese, whereas words like the English translation *ball* /bɔl/—in which the vowel is not the name of a letter—are more typical of English. Consonant letter names are much less commonly found within words than are vowels in either language. Pollo et al. also showed that the ratio of vowels to consonants is twice as high in Portuguese as in English, as exemplified again by the words for 'ball'. Thus, Portuguese-speaking children should encounter vowel letters and vowel letter names proportionately much more often than English-speaking children.

To verify the hypothesis that children are affected by these properties of the writing systems, Pollo et al. asked five-year-old Portuguese and English speakers to spell words that were matched except for whether the word contained one letter name (like *bunny*, which ends in the name of the letter *e*) or two (like *pony*, which contains the names of *o* and *e*); all the letter names were those of vowels. In both languages, the words with more letter names were spelled with more vowels and elicited more spellings that were phonologically plausible, showing that both groups of children often applied the strategy of spelling sounds with the letters whose names comprise those sounds.

There were also notable differences between the two groups of children. Portuguese-speaking children used more vowels than English-speaking children, even though the stimuli for both languages had equal numbers of vowels. These differences can be explained by the aforementioned statistical differences between the two writing systems. Because Portuguese speakers see more vowel letters in texts, they may write more vowel letters in their spellings. More importantly, because Portuguese speakers hear

more vowel letter names in words, they may be more encouraged to use letter name spelling strategies when spelling vowel sounds than are young speakers of English.

The data of Pollo et al. (in press) also support an alternative explanation for syllabic spellings. Spellings such as *AO* for Spanish *sapo* are often adduced as syllabic spellings, because the child wrote two letters for a word with two syllables. However, this example is typical in that the letters that were written correspond to the only two letter names heard in the words. Our results support the alternative hypothesis that these spellings reflect children's use of letter names (Cardoso-Martins & Batista, 2003; Treiman & Kessler, 2003). It was demonstrated that vowel letter names are extremely frequent in Portuguese words and that words with vowel letter names are spelled with more vowel letters. The confluence of these two facts could explain why all-vowel spellings are reported in Romance languages. Putatively syllabic spellings could be a result of children's attempt to spell by letter names, which is a more parsimonious explanation than stipulating the presence of a syllabic stage of development.

The Pollo et al. (in press) study demonstrated that differences among languages in their systems of letter names and the prevalence of letter names in their vocabularies are one source of crosslinguistic differences in early spelling development. However, together with researchers in the phonological tradition, we believe that the regularity of the mappings between phonemes and letters is also important. We maintain that differences among languages in their sound-to-letter links must be quantified more precisely than has been done in the past. Previous classifications of writing systems have often been made impressionistically, for example, by asking researchers who are speakers of different languages to categorize their languages into one of several levels of regularity

(Seymour et al., 2003). Kessler and Treiman (2001) studied the sound-to-spelling relationships in the monosyllabic words of English in a more quantitative way, finding that English is not as irregular as is often assumed. Although many phonemes have more than one possible spelling, consideration of context can increase the predictability of sound-to-spelling translation. That is, regularity is higher when context is taken into account. Studies have shown that children benefit from the contextual regularities that English provides, using probabilistic patterns that are based on the statistics of the language (Hayes, Treiman, & Kessler, 2005).

In summary, the statistical-learning perspective holds that children can take advantage of statistical regularities of printed words in the language early in their development. These regularities give children information about graphical as well as phonological patterns of the language that is reflected even in their very early spellings. We believe that statistics of the languages may explain apparent differences between spellings of children in different languages.

## Conclusions

In this chapter we have described several approaches for studying spelling development. The phonological perspective holds that the key insight in literacy development is the understanding that letters represent the sounds in spoken words. For a child who has not yet grasped the alphabetic principle, spellings are basically random strings of letters (e.g., Ehri, 1998; Frith, 1985; Gentry, 1982). This perspective is predominant in English-speaking countries. A second theoretical approach is what we call the constructivist perspective. This perspective acknowledges that young children in literate societies know something about writing before they understand that letters

represent phonemes. However, some of the key ideas of the constructivist perspective, such as the syllabic stage theory, have not been defined precisely enough to enable rigorous experimental verification. This perspective is well represented in many Romance-speaking countries, and advocates have not clearly explained why the spelling development of English speakers does not appear to follow the same patterns.

In the last part of the chapter we presented a third perspective, which we call the statistical-learning perspective on spelling development. It holds that statistical properties of printed words and spoken languages influence children's spellings early in development. This perspective encourages crosslinguistic studies because they are important for determining how specific properties of a language can make it easier or harder for children to read and spell. An important start has been made in the phonological perspective with crosslinguistic comparisons of sound-to-letter regularity. However, the statistical-learning perspective suggests that additional features of the language may influence children in their literacy development. Thus, it is vital to analyze other aspects of the language that have been neglected in previous studies. We summarized work showing the importance of letter names and letter patterns in young children's spelling development and showing how differences in spelling performance can be explained by those characteristics of the writing systems. We hope that this chapter will encourage further work along these lines.

Footnotes

[1]Children's spellings are written in uppercase. Phonemes are represented using the conventions of the International Phonetic Association (1999).

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