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## THE ROLE OF LETTER NAMES IN THE ACQUISITION OF LITERACY

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### I. INTRODUCTION

### II. LETTER NAMES IN ENGLISH AND OTHER ALPHABETIC WRITING SYSTEMS

- A. ICONICITY
- B. DISCRIMINABILITY
- C. PHONOLOGICAL PATTERNING
- D. LEGALITY

### III. CHILDREN'S LEARNING OF LETTER NAMES

### IV. CHILDREN'S LEARNING OF LETTER SOUNDS

### V. ROLE OF LETTER NAMES IN LEARNING TO READ WORDS

### VI. ROLE OF LETTER NAMES IN LEARNING TO SPELL WORDS

### VII. CONCLUSIONS

### REFERENCES

### I. Introduction

Children in the United States usually know a good deal about letters before formal reading instruction begins. Preschoolers learn to sing the alphabet song and see letters on children's television programs and in alphabet books. Colorful displays of letters adorn the refrigerators of many homes. As a result of such experiences, most US kindergarten entrants know the names of a good many letters. In one study, with a group of children in Texas who had been in kindergarten for less than two months, the average child could label 18 or 19 of the 26 letters by name when shown each letter's

upper-case and lower-case form (Treiman *et al.*, 1998). Once children start kindergarten, much time is devoted to teaching them the names and the visual forms of the letters they do not yet know. This knowledge, it is assumed, will prepare them for the formal reading instruction that begins in first grade. The United States is not alone in the expectation that children will be familiar with letters before they start learning to read. For example, upper-middle class Israeli children often learn the names of letters at home before reading instruction begins (Levin *et al.*, 2002).

The belief, in the US and other societies, is that knowledge of letter names provides a foundation for early reading. True, a child's ability to label the letters of the alphabet in kindergarten is an excellent predictor of how well he or she will succeed in learning to read once formal reading instruction starts in first grade (e.g., Snow, Burns, & Griffin, 1998). But is knowledge of letter names causally related to learning to read? Some have argued for a causal relation, proposing that knowledge of letter names helps children bridge the gap between print and speech (Durrell, 1980; Ehri, 1983; Levin *et al.*, 2002). Others have argued against a causal relation and claimed that the observed correlation between letter-name knowledge and reading achievement reflects the fact that homes in which preschoolers master letter names are the same homes that stress achievement in school (Samuels, 1972). Indeed, some have suggested that "letter-name instruction in the pre-initial or initial stages of beginning reading might be downright harmful" to children (Feitelson, 1988, p. 137).

Research that has attempted to answer the question of whether letter-name knowledge helps children learn to read has been inconclusive. In studies by Johnson (1969) and Silberberg, Silberberg, and Iversen (1972), US children who received extra instruction about letter names before formal reading instruction began did not learn to read more easily than control children. As Ehri (1983) pointed out, however, the additional training may have had little impact because even the control children knew many letter names.

One possible reason why the debates and research on letter names have not led to a clear resolution is that the issue has been examined too globally. In English and other languages, letter names vary in how they relate to the letters' sounds. As a result, knowledge about the conventional names of letters may be helpful for some letters, less helpful for others, and perhaps even harmful for still others. In this chapter, we argue that researchers must look closely at the characteristics of letter names and the characteristics of the written and spoken language in order to understand the effects of letter names on the acquisition of literacy. We attempt to do so for English by discussing what children know about letters before they enter school and how this knowledge influences their early attempts to read and spell. We review research on letter names in languages other than English, where such

research exists, and consider other languages compare to reflect how letters are labeled with the characteristics of the

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<sup>1</sup>Because spelling is not always a phonemes (sounds) using the alphabet. Spellings are given in italics and pronounced e.g., *cat* is pronounced /kæt/. The corresponding English letter, but the f American pronunciation.

/aɪ/	<i>aisle</i>
/aʊ/	<i>sauerkraut</i>
/æ/	<i>apple</i>
/ɑ/	<i>wand, car</i>
/dʒ/	<i>badge</i>
/ð/	<i>then</i>
/e/	<i>Vegas</i>
/ɛ/	<i>edit</i>
/ə/	<i>casserole</i>
/ɡ/	<i>go</i>
/i/	<i>machine</i>

The mark /ɪ/ precedes a stressed syllable; s

research exists, and consider how the effects of letter-name knowledge in other languages compare to those observed in English. Differences may reflect how letters are labeled in various languages and how the names mesh with the characteristics of the languages.

An examination of children's knowledge of letter names is also useful for the insights it may provide on more general issues. One such issue is the interaction between informally acquired knowledge and formal education, an interaction that occurs in learning to read as in the learning of other school subjects. The skills that children bring with them to school—knowledge of letters and their names, in this case—shape the children's response to instruction. We examine how this occurs in the acquisition of literacy by asking how children use their knowledge of letter names to try to make sense of words' spellings. As we will see, this perspective allows us to understand certain errors and patterns of performance that might otherwise appear bizarre.

The study of children's knowledge of letter names also provides an opportunity to examine the roles of rote memorization and principled learning in the acquisition of literacy. To what extent do children memorize printed letters and words and the pronunciations to which they correspond? To what extent do they take advantage of the principles that underlie the system, such as the fact that almost all printed words that start with *p* have a /p/ at the beginning of their pronunciation?<sup>1</sup> Do letter names provide a bridge from the former approach to the latter?

<sup>1</sup>Because spelling is not always an unambiguous guide to pronunciation, we represent phonemes (sounds) using the alphabet of the International Phonetic Association (1996, 1999). Spellings are given in italics and pronunciations in IPA symbols surrounded by slash marks, e.g., *cat* is pronounced /kæt/. The values of most IPA symbols agree with those of the corresponding English letter, but the following require special attention. Usage reflects General American pronunciation.

/aɪ/	<i>aisle</i>	/ɪ/	<i>it</i>
/aʊ/	<i>sauerkraut</i>	/ɪ/	hallelujah
/æ/	<i>apple</i>	/o/	<i>obey</i>
/ɑ/	wand, car	/ɔɪ/	<i>coin</i>
/dʒ/	<i>badge</i>	/s/	soup
/ð/	<i>then</i>	/ʃ/	sure
/e/	Vegas	/tʃ/	<i>etch</i>
/ɛ/	<i>edit</i>	/u/	<i>rude</i>
/ə/	casserole	/ʊ/	rude, with unrounded lips (Korean)
/ɡ/	<i>go</i>	/ʌ/	<i>ugly</i>
/ɪ/	<i>machine</i>	/θ/	<i>thick</i>

The mark /ɪ/ precedes a stressed syllable; stress is marked only for words of more than one syllable.

We begin, in Section II, with a discussion of the letter names of English and other languages and how the names relate to the letters' sounds and shapes. Such information provides an important background for a discussion of the role of letter names in learning to read and spell, and has not been systematized previously. In Section III we present new data on the factors that make some pairs of letter shapes and letter names easier for children to learn than others. In Section IV, we review research showing that children use the names of the letters as a basis for learning about the sounds that the letters represent—something that is helpful for most English letters but that causes errors in a few cases. This discussion provides a foundation for considering, in Sections V and VI, how children use their knowledge of letter names in reading and spelling words. We review prior studies on this topic and present new information on the extent to which letter names can help in the reading and spelling of English. To conclude (Section VII), we return to the questions that motivate this chapter: Are letter names helpful or harmful to young children? Can linguistic analyses shed light on how letters are learned and used? Does the role of letter names in learning to read and spell differ across languages?

## II. Letter Names in English and Other Alphabetic Writing Systems

Children who are learning to read and write must learn the shapes and the sound values of the letters that are used in their language. Many languages also have formal labels for letters that include sounds other than those made by the letter. For example, the English label for *b* includes the phoneme /i/ as well as the phoneme that *b* represents, /b/. As we have described, young children are expected to learn the conventional letter names in the US and a number of other countries. Why do letters have names that differ from their sounds, and why are letter names used with children? One answer is that sound-based labels are ambiguous for sounds that correspond to more than one letter, such as English /k/, which may be spelled as *k* (e.g., *kite*) or *c* (e.g., *cat*). But formal letter names exist and are taught to children even in many languages with highly regular spelling-to-sound correspondences, suggesting that this is not a complete explanation.

Four considerations help explain the structure of letter-name systems: *iconicity*, *discriminability*, *phonological patterning*, and *legality*. In the four sections below, we will show how and why these principles apply to letter names. Special attention will be given to the English system, but we will also touch on other languages.

Iconic systems are those in which the letter name is similar to the sound it represents. In English, the letter *a* is actually a speech phoneme, /æ/, and the letter *e* is a speech phoneme, /e/. In English letter-name systems that we have examined, the letters contain the phoneme /æ/. Only /etʃ/, the letter *h*, and /'dʌbəlju/, the letter *u*, are exceptions.

Iconicity is such an important principle that it was introduced when lacking or when a letter was pronounced as /hetʃ/ rather than /h/. Another example is the letter *f*, which has the value /f/. The traditional iconicity and has been replaced by a more effective increase in the number of letters, *ch*, *ll*, and *ñ* as separate letters. *ch*, which has the value /tʃ/, is more common than the name for *c* follows. Names tend to be fairly fluid and do not have the stability that reflect a drive toward iconicity.

An important limitation of iconicity is that one sound, but letter names also have other sounds. For example, the English name for *a* is /æ/, but the sound of *a* is /e/. Words like *bake* but is not iconic. The Korean system systematically addresses this issue by beginning with the sound that the letter represents and ends with the sound that the letter represents. These sounds may be somewhat different.

Another potential problem with iconicity is that part of the name constitutes the letter's sound, but the generalization is that, if the letter's name is the value of the letter. However, the whole name is the value of the letter (e.g., *a* alone), and *y* /waɪ/, where the letter *y* is /w/, but it can spell /aɪ/). In some

## A. ICONICITY

Iconic systems are those in which a sign has properties of its referent. Words that name sounds, such as *tweet*, are often iconic in that the word is similar to the named sound. Letter-name systems, where the named sound is actually a speech phoneme, are optimal candidates for such iconicity. All letter-name systems that we know of are iconic in that the names of most letters contain the phoneme that the letter represents. For example, the English name of *s*, /ɛs/, contains /s/. The same is true for 24 of the 26 English letters. Only /ɛtʃ/, the typical pronunciation of the name of the letter *h*, and /ˈdʌbəlju/, the name of *w*, are totally noniconic.

Iconicity is such an important property of letter names that it is often introduced when lacking or deficient. For example, the name of *h* is pronounced as /hɛtʃ/ rather than /ɛtʃ/ in some parts of the English-speaking world. Another example comes from Portuguese, where *x* typically has the value /ʃ/. The traditional name of *x* (cf. Spanish /'ekis/) lacked iconicity and has been replaced by /ʃis/. As a third example, Spanish has effectively increased the number of letters in the Roman alphabet by treating *ch*, *ll*, and *ñ* as separate letters and giving them their own iconic names. Thus *ch*, which has the value /tʃ/, is referred to by the single syllable /tʃe/ rather than by the name for *c* followed by the name for *h*, as in English. Letter names tend to be fairly fluid because they are not usually spelled out in text and do not have the stabilizing influence of writing. The changes often reflect a drive toward iconicity.

An important limitation of iconicity is that several letters have more than one sound, but letter names almost always use only one of those sounds. For example, the English names of the vowels consist of their historically long sounds: The name of *a* is /e/, which iconically represents the letter's sound in words like *bake* but is not iconic with respect to the sounds in *cat*, *wall*, and so forth. The Korean system of letter names may be the only one that systematically addresses this issue. In Korean, the typical consonant name begins with the sound that the consonant has at the beginning of a syllable, and ends with the sound that the consonant has at the end of a syllable; these sounds may be somewhat different.

Another potential problem with iconicity is that it may not be clear which part of the name constitutes the letter's sound. In English, the name of *k* begins with the letter's sound, but the name of *l* ends with the letter's sound. The generalization is that, if the name contains a consonant, that consonant is the value of the letter. However, that generalization fails for *u* /ju/, where the whole name is the value of the letter (*u* cannot spell the consonant /j/ alone), and *y* /waɪ/, where the vowel is the value of the letter (*y* cannot spell /w/, but it can spell /aɪ/). In some languages, the locus of iconicity may be

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more or less regular than in English. In Spanish and Portuguese, for example, the names of some consonants, such as *s*, contain the sound in the middle (e.g., Spanish /'ese/). In contrast, in many systems, such as those of Hebrew, Greek, and Turkish, the names of all letters contain the letter's sound at the beginning.

Iconicity contributes to the fact that letter names are fairly short in most languages: Any phoneme besides the sound of the letter detracts from the overall iconicity of the letter name. English is typical in having one- or two-phoneme names for almost all its letters. Hebrew and Greek, which have some of the longest letter names, rarely go beyond a syllable or two. Exceptions, such as English /'dʌbəlju/ and Greek /'omikron/, contain adjectives that qualify more basic letter names (*double u*, *little o*).

Iconicity is a particular instance of linguistic motivation. The relatively few letter names that are not iconic are almost always motivated in the sense that the name has a transparent explanation. Some common types of letter names that are motivated but not iconic are names that describe the letter's form, function, or origin. English *w* takes its name from its shape, for example.<sup>2</sup> In French and Spanish, *y* is called "Greek *i*," a name that tells not only its sound but also its origin.

The iconicity of letter names should not be confused with the iconicity of the letter shapes themselves. The two types of iconicities did interact, though, in the development of the alphabet. In the Sinaitic script that is the ancestor of most alphabets, letter shapes were pictures of objects whose names began with the sound denoted by the letter. Letter names were the same as the names of those objects. For example, the letter that spelled /d/ was named /'daltu/, which meant "door," and this letter took the form of a stylized picture of a door. Such confluence of iconicities does not exist in modern scripts because the shapes of the letters have changed so much as to be completely unrecognizable as pictures of natural objects. The names themselves, however, are still used in more or less altered forms in many modern languages, such as Hebrew and Greek. That is why their letter names are not as short as would be predicted by pure letter-sound iconicity, as discussed above: They were also influenced by an ancient letter-shape iconicity.

#### B. DISCRIMINABILITY

The principle of iconicity may lead one to think that the ideal letter names should comprise only the sound of the letter. Indeed, some educators

<sup>2</sup>i.e., "double *u*." "Double *v*" might appear more appropriate, but originally *v* was just a variant of *u* and shared its name.

advocate that children should practice, it is fairly unnatural: listeners can have trouble telling consonant sound adds greatly discriminable. This is perhaps (in English, /p/, /t/, /k/, /b/, /n/, /l/, /r/, /f/, /s/),<sup>3</sup> but in a traditional letter-name system: in English /ke/ for *k*.

In principle, the vowel in before the consonant or after examples of both (cf. *k*, *l*). borrowed their letter names (e.g., Spanish) also including Latin is unusual in its use: substantial number of consonant names of consonants begin observation suggests that in element, the sound of the name advantage is that consonants than after vowels. Korean, as consonant sound both at the name. This increases discriminability.

Overall, however, the discriminability is rather low. It is easy to mistake for a *d* or an *n* for an *m*. Even help one distinguish /niun/, the *m*. The problem is well attested: depend on accurate spoken letter sets of letter names designed, for example, use the names *Mike*. Research dating back at least excessive similarity can cause languages that have maintained intact, principally Hebrew are much easier: Compare the distinction that of /bi/ vs. /di/.

<sup>3</sup>Stops are so called because the flow of sounds; air flow is continuous for continuous blockage makes it particularly difficult to

advocate that children should name letters by their sound alone. But in practice, it is fairly unnatural to pronounce consonants in isolation, and listeners can have trouble telling what letter is meant. Adding a vowel to the consonant sound adds greatly in making the name both pronounceable and discriminable. This is perhaps more important for the stop consonants (in English, /p/, /t/, /k/, /b/, /d/, /g/) than for the continuants (such as /m/, /n/, /l/, /r/, /f/, /s/);<sup>3</sup> but in all cases, adding a vowel helps quite a bit. All traditional letter-name systems add a vowel to the names of consonants, as in English /ke/ for *k*.

In principle, the vowel in a consonant letter name could be added before the consonant or after it. As mentioned earlier, English offers examples of both (*cf.* *k*, *l*). The same is true for other languages that borrowed their letter names from Latin, with some of these languages (e.g., Spanish) also including letter names with the sound in the middle. Latin is unusual in its use of a vowel-consonant structure for a substantial number of consonant names. In most other systems, the names of consonants begin with the sound of the consonant. This observation suggests that it is more natural to put the more important element, the sound of the named letter, first. For the listener, a decided advantage is that consonants are easier to discriminate before vowels than after vowels. Korean, as mentioned earlier, has chosen to put the consonant sound both at the beginning and at the end of the consonant name. This increases discriminability.

Overall, however, the discriminability of most letter-name systems is rather low. It is easy to mishear letter names, such as to mistake a *b* for a *d* or an *n* for an *m*. Even in Korean, not many acoustic cues can help one distinguish /niun/, the name for *n*, from /mium/, the name for *m*. The problem is well attested by the fact that many organizations that depend on accurate spoken letter understanding have adopted official sets of letter names designed for higher discriminability. Pilots, for example, use the names *Mike* and *November* for the letters *m* and *n*. Research dating back at least to Conrad (1964) has confirmed that excessive similarity can cause confusions in short-term memory. The languages that have maintained the ancient letter names essentially intact, principally Hebrew and Greek, make the job of the listener much easier: Compare the distinctiveness of Hebrew /bet/ vs. /'dalet/ to that of /bi/ vs. /di/.

<sup>3</sup>Stops are so called because the flow of air is blocked for a while when producing these sounds; air flow is continuous for continuants. The fact that the main part of a stop is air blockage makes it particularly difficult to generate a discriminable stop in isolation.

## C. PHONOLOGICAL PATTERNING

Phonological patterning refers to the tendency for letter names to be similar to one another. For example, above and beyond the fact that they include their sounds, the English names of the consonants *l*, *m*, and *n* all consist of /*ε*/ followed by the consonant. There are several reasons why letter names tend to be similar to each other. One is that letter names for a new writing system are all invented at the same time. People tend to give similar names when naming similar items simultaneously, as when parents select rhyming names for twins. Likewise, it is natural to choose the same vowel to fill out the names of consonant letters. A second reason why letter names tend to be similar to one another is that, even when the names are not invented simultaneously, they may be patterned on existing names for related items. For example, parents often give girls names ending in *a*, even when inventing new names, because that vowel appears at the end of many other female names. Similarly, when the consonant *v* was added to the alphabet, it was named /*vi*/ because many other consonant names ended in /*i*/ (*b*, *c*, *d*, etc.). A third reason for phonological patterning in letter names is that they are often recited in a series, in the same fixed order. In such cases, people tend to anticipate the sound of the next item in the series. For example, the /*f*/ in the English word *four* probably comes from anticipating the initial consonant of the following number, *five*. In like manner, the name of the letter *j*, /*dʒe*/, took its vowel from the name of the following letter, *k* /*ke*/. The original name, still heard occasionally in Scotland, was /*dʒaɪ*/.

The nature and extent of phonological patterning varies between languages. The English system is of intermediate consistency. All the vowel letters are named by their historically long value. Virtually all consonants have two-phoneme names, usually either an /*ε*/ before the consonant or an /*i*/ after it. Even the selection of those two vowel extensions has a phonological patterning: /*ε*/ is used before a continuant (*f*, *l*, *m*, *n*, *s*) and /*i*/ after a stop (*b*, *d*, *p*, *t*). However, the English system has several perturbations due to its long historical development. The letter *c* is named with an /*i*/ because originally (in Latin) it was always a stop. After the consonant changed to a continuant, the original pattern was obscured, and the new letter names for *v* and (in America) *z* were built with /*i*/ instead of /*ε*/, even though they are continuants. The names for *k* and *q* used different vowels, to distinguish them from *c*. The name of *r* reflects the fact that /*εr*/ sequences changed to /*ar*/ in English. The name /*zɛd*/ for *z*, used in many parts of the English-speaking world, comes from the Greek name *zeta*. The irregular names for *h*, *j*, and *w* have already been mentioned.

The middling degree of patterning found in English is typical of languages that adopted the Latin letter-name system. Phonological patterning is, on

the whole, even lower in languages that did not adopt the Latin system. In Hebrew, for example, the sound of the letter, but specifies the language's history and of other phonemes in the letter name. In much higher degree of phonological patterning, the names of consonants are /*e*/, with thoroughgoing regularity in countries, and has recently changed.

A high degree of patterning in letter names may hurt the ability to recognize new names as letter names, because a letter that has a given name hurts discriminability, because it is so similar to one another.

Legality means that letter names are placed on all words of the same set of phonemes as any other words. There are no rules for the arrangement of letters that a schwa (/ə/) would be the only vowel that can make a name (e.g., /bə/) because of the rules of many languages, such as Sanskrit, do not have a phoneme, but this phoneme is not legal. Thus, *b* cannot be named /b/. The further consequence that English has no schwa sounds, which would be illegal (e.g., /i/). Although the traditional rules of many languages generally conform to the rules of many languages, teaching methodology and other criteria. Referring to the points of view, but these are not legal words.

## III. Children's

Our discussion of letter names and shapes provides a background for this information. Children in



the whole, even lower in languages that retained the old Semitic letter names. In Hebrew, for example, the names of consonants all begin with the sound of the letter, but speakers of the language who are not aware of the language's history and of related letter-name systems cannot predict the other phonemes in the letter name. In contrast, several other systems have a much higher degree of phonological patterning than English. In Turkish, for example, the names of consonants comprise the consonant sound, plus /e/, with thoroughgoing regularity. The same system is used in many Balkan countries, and has recently come into use in Portugal.

A high degree of patterning should make it simpler to learn letter names, recognize new names as letter names, and determine the sound value of the letter that has a given name. In contrast, strong phonological patterning hurts discriminability, because many letter names become extremely similar to one another.

#### D. LEGALITY

Legality means that letter names should meet the phonological requirements placed on all words of the language. Letter names must draw from the same set of phonemes as any other word, and they must follow the same rules for the arrangement of the phonemes. For example, one might think that a schwa (/ə/) would be the ideal vowel to add to a consonant sound to make a name (e.g., /bə/) because it is a very neutral sound. Although some languages, such as Sanskrit, do that, this option is not available in the many languages that do not have a schwa phoneme. English does have a schwa phoneme, but this phoneme cannot occur at the ends of stressed syllables. Thus, *b* cannot be named /bə/. The need to avoid illegal names has the further consequence that English vowels are labeled not with their "short" sounds, which would be illegal (e.g., /ɛ/ for *e*), but with their "long" sounds (e.g., /i/). Although the traditional letter-name systems of English and other languages generally conform to the legality requirements of their respective languages, teaching methodologies sometimes ignore legality in favor of other criteria. Referring to letters as /æ/, /bə/, /kə/, and so on may be desirable from the points of view of iconicity and phonological patterning, but these are not legal words of English.

### III. Children's Learning of Letter Names

Our discussion of letter names and their relation to the letters' sounds and shapes provides a background for examining how children learn this information. Children in the United States often learn about the

phonological forms of certain letter names before they learn the letters' shapes. Through the alphabet song and other experiences, preschoolers may learn that /e/, /bi/, /si/ and so on belong to a special set before they learn the visual appearance of *a*, *b*, and *c*. As we have discussed, letter names share certain phonological characteristics (e.g., most English letter names are short, many consist of a consonant followed by /i/), making them differ phonologically from other words in the language. Phonological cues may help children distinguish between letters and members of other categories, such as numbers, just as phonological cues apparently help children distinguish between male first names and female first names (Cassidy, Kelly, & Sharoni, 1999).

To test the idea that some children pick up the phonological patterns in letter names at a young age, Treiman, Tincoff, and Richmond-Welty (1997) asked preschoolers (mean age 4 years, 9 months) whether various syllables were real letters. The children sometimes responded that consonant-/i/ syllables such as /gi/ were letters, producing false positive errors 11% of the time to such syllables. The error rate was significantly lower, 7%, for consonant-vowel syllables that ended with other vowels, such as /ga/, and vowel-consonant syllables that began with /i/, such as /ig/. Letter names that follow the English system have been observed in production as well as recognition, as when a bright 3½-year-old child of our acquaintance said that *Fred* starts with the "letter" /fri/ and that *little* starts with /li/. Preschoolers' tacit appreciation of the phonological patterns of letter names may explain why the letter names invented by Dr. Seuss (1955), such as *yuzz*, are funny.

An important step in learning about letters is mastering the associations between the letters' upper- and lower-case forms and their names. With its 26 letters, most of which appear rather different in upper and lower case, and with its largely arbitrary pairings between visual forms and names, this is a major undertaking for English. To study the factors that affect children's learning of shape-name associations, we examined several sets of previously collected data on preschoolers' ability to name upper-case and lower-case letters. As Table I shows, the data were gathered in the US and Australia, where young children's experiences with letters are similar to those of US preschoolers. The children in each study were shown the letters of the alphabet in a scrambled order and were asked to say the name of each letter. The children in these studies had not yet entered kindergarten, where systematic instruction about letter names is typically provided in the US and where better knowledge of some letters than others is likely to reflect, in large part, the sequence in which the letters are taught. For each study, we calculated the percentage of correct responses to each letter of the alphabet. The mean values are shown in Table I.

Studies of English-speaking Preschoolers

Case of letters	Location of study	Mean age of children <sup>a</sup>	
Upper	California	3 years, 0 months	
	California	4 years, 0 months	
	Detroit	4 years, 10 months	
Lower	California	3 years, 0 months	
	California	4 years, 0 months	
	Australia	4 years, 8 months	

<sup>a</sup>In all but the study by Treiman *et al.* (1998), reports.

Before examining the factors that make some letters easier to learn than others, it is important to note that cause difficulty in one study may not be the same in another, thus calculated correlations between pairs of studies. The mean correlation for letters was a modest .39 using Pearson's *r*. Spearman rank correlation coefficients were substantially higher for lower-case letters (mean .58). Performance on upper-case letters was, to some extent, with a mean correlation of .45. Differences among children in the studies thus cause some difference in the results. These differences, there are enough to encourage a search for factors that affect learning.

One factor that may affect the learning of letter names is the visual form of the target letters. Letters with distinctive shapes, such as *h* and *k*, are easier to learn over letters whose shapes are similar, such as *b* and *d*. Another potentially important factor is the letter's position in the alphabet. If the letter is the same in upper- and lower-case, as with *a* and *e*, English-speaking countries tend to teach the letter first. If the letter is different, as with *b* and *d*, the letter that is a smaller version of the other is typically taught first. It may be easier to recognize than one that is a larger version. The phonological commonalities among letters may also affect learning.

TABLE I  
Studies of English-speaking Preschoolers' Ability to Produce Names for Letters  
Presented Visually

Case of letters	Location of study	Mean age of children <sup>a</sup>	Number of children	Source of data	Mean (and SD) percent correct responses
Upper	California	3 years, 0 months	38	Worden & Boettcher, 1990	17.2 (5.7)
	California	4 years, 0 months	35	Worden & Boettcher, 1990	54.2 (10.3)
	Detroit	4 years, 10 months	57	Treiman <i>et al.</i> , 1998	74.4 (8.4)
Lower	California	3 years, 0 months	38	Worden & Boettcher, 1990	11.4 (8.7)
	California	4 years, 0 months	35	Worden & Boettcher, 1990	39.2 (13.5)
	Australia	4 years, 8 months	77	Byrne, 1992	23.3 (12.9)

<sup>a</sup>In all but the study by Treiman *et al.* (1998), mean ages are estimated from information provided in the reports.

Before examining the factors that make some visual form-name pairs easier to learn than others, it is important to determine whether the letters that cause difficulty in one study also cause difficulty in other studies. We thus calculated correlations between the results for individual letters in all pairs of studies. The mean correlation for studies involving upper-case letters was a modest .39 using Pearson correlation coefficients (.23 when Spearman rank correlation coefficients were used). The figure was substantially higher for lower-case letters, .79 (.81 using rank correlation coefficients). Performance on upper-case and lower-case letters overlapped to some extent, with a mean correlation of .46 (.33 using rank correlation coefficients). Differences among children's experiences with letters and other factors thus cause some differences across studies and age groups. Despite these differences, there are enough similarities in letters which children know to encourage a search for factors that may explain them.

One factor that may affect the learning of letter names is the extent to which the visual form of the target letter looks like those of other letters. Letters with distinctive shapes, such as lower-case *s*, may have an advantage over letters whose shapes are similar to those of many other letters, such as lower-case *d*. Another potentially important factor is whether the shape of a letter is the same in upper- and lower-case, as with *o* and *c*. Children in many English-speaking countries tend to learn upper-case letters before lower-case letters (as shown, for example, by the data in Table I), and so a lower-case letter that is a smaller version of a previously known upper-case letter may be easier to recognize than one that appears quite different. In addition, the phonological commonalities among the names of letters may influence

learning. The effect could be positive, as when a child who remembers that a letter name begins with /v/ but forgets the following vowel guesses /i/, the most common vowel in English letter names. The phonological similarities among letter names might alternatively hurt performance. A child who remembers only the final vowel of a letter name and who selects from among the set of known names has more possibilities from which to choose, and thus more chance of being wrong, when the vowel is /i/ than when it is /e/. Table II shows the definitions of visual similarity, case similarity, and phonological similarity that we used for the analyses reported here, together with the mean value of each variable.

Regression analyses were carried out to predict performance on letter naming, and the results are shown in Table III. For upper-case letters, only phonological similarity was consistently related to letter naming. The effect was negative, with letters whose names were phonologically similar to the names of many other letters yielding poorer performance than letters whose names were more distinctive. In all three data sets of lower-case letters, children performed significantly better on letters that resembled their upper-case forms than on letters that showed less resemblance. A reliable effect of visual similarity was found in two of the three data sets of lower-case letters, such that children tended to do well on letters that were visually dissimilar to other letters. Phonological similarity had a

TABLE II  
Predictor Variables for Analyses of Letter Naming

Variable	Definition	Mean (SD)
Visual similarity	No. of other letters whose visual forms share 50% or more of strokes in target letter's form in same position or whose overall visual form is identical to target letter when rotated or flipped	3.30 (3.77) for upper-case font in California study, 2.70 (3.44) for upper-case font in Detroit study, 2.80 (2.14) for lower-case font in California study, 2.90 (2.04) for lower-case font in Australia study
Case similarity	1 if visual form of letter alike in upper and lower case, 0 if not	.35 (.49)
Phonological similarity	No. of other letters whose names share 50% or more of phonemes in target letter's name in same position, counting affricates and diphthongs as single phonemes	4.50 (3.18) for US pronunciations of letters, 4.20 (2.81) for Australian pronunciations of letters

Results of Regression Analysis		
Case of letters	Study	R <sup>2</sup> (adjusted)
Upper	California, age 3	.36 (.27)
	California, age 4	.24 (.13)
	Detroit	.30 (.21)
Lower	California, age 3	.66 (.61)
	California, age 4	.52 (.43)
	Australia	.63 (.58)

significant impact in two of the letters whose names were phonologically similar to other letters yielding relatively few factors explained over half the variance for lower-case letters.

The results of the regression analyses suggest caution, as certain of the variables are correlated. Also, our goal is not to predict letter naming in regression, but to understand the existing alphabet. To supply the letters that yielded consistent results across studies. Upper-case letter naming in all three upper-case studies, as mentioned earlier. For letters in all three upper-case studies, the names of *A* and *O* are similar, and their shapes are fact that *A* is at the beginning of the alphabet, *O*, performance may be facilitated easily identified by children and was in the bottom third in all three studies. visual and phonological similarity and visual similarity appear to be in the order of learning of these letters. experiences with the first letter are important to their knowledge of the alphabet (Broderick, 1998), and these experiences are dependent on the child's own naming experiences.

TABLE III  
Results of Regression Analyses Predicting Performance in Letter Naming

Case of letters	Study	$R^2$ (adjusted $R^2$ )		Visual similarity		Case similarity		Phonological similarity	
			$p$	$\beta$	$p$	$\beta$	$p$	$\beta$	$p$
Upper	California, age 3	.36 (.27)	.019	-.32	.082	.13	.454	-.42	.025
	California, age 4	.24 (.13)	.109	-.11	.574	.22	.253	-.40	.049
	Detroit	.30 (.21)	.044	.22	.257	.31	.099	-.50	.017
Lower	California, age 3	.66 (.61)	.000	-.24	.096	.62	.001	-.30	.029
	California, age 4	.52 (.43)	.001	-.38	.027	.44	.010	-.20	.214
	Australia	.63 (.58)	.000	-.32	.048	.49	.004	-.35	.015

significant impact in two of the three data sets of lower-case letters, with letters whose names were phonologically similar to the names of many other letters yielding relatively poor performance. Together, the three factors explained over half the variance in each of the data sets with lower-case letters.

The results of the regression analyses must be interpreted with some caution, as certain of the variables deviated from a normal distribution. Also, our goal is not to predict performance on new items, as is usually the case in regression, but to understand the factors that affect performance on the existing alphabet. To supplement the regression analyses, we examined the letters that yielded consistently good or consistently poor performance across studies. Upper-case letters showed a good deal of variability across studies, as mentioned earlier. However, *A* and *O* were in the top third of letters in all three upper-case data sets, and *V* was always in the bottom third. The names of *A* and *O* are below the median in phonological similarity, and their shapes are below the median in visual similarity. The fact that *A* is at the beginning of the alphabet may help performance. With *O*, performance may be facilitated by the fact that a circle is a basic shape, easily identified by children and often referred to as an *O*. *V*, the letter that was in the bottom third in all three data sets, is above the median in both visual and phonological similarity to other letters. Although phonological and visual similarity appear to affect performance on upper-case letters, the order of learning of these letters is rather variable and personal. Children's experiences with the first letters of proper names likely contribute importantly to their knowledge of upper-case letters (e.g., Treiman & Broderick, 1998), and these experiences differ from one child to another depending on the child's own name and the names of friends and family members.

With lower-case letters, *i*, *o*, *s*, *w*, and *x* were in the top third in all the studies and *d*, *g*, *h*, *l*, and *q* were in the bottom third. Of the five easiest letters, three are below the median in visual similarity, with the remaining two (*i* and *x*) above. Four are below the median in phonological similarity, and one (*s*) is at the median. Four of the easy-to-name letters, all but *i*, have identical shapes in lower and upper case. This is not true of any of the five letters in the bottom third in lower-case naming. All the difficult letters are above the median in their visual similarity to other letters, and three (all but *h* and *q*) are above the median in phonological similarity. These observations lend support to the results of the regression analyses and help explain why performance on lower-case letters is more similar across studies than is performance on upper-case letters. Children learn lower-case letters later than upper-case ones, and a major determinant of performance on lower-case letters is whether they have the same shapes as their upper-case counterparts.

One would expect children to perform better on letters they have seen many times than on less common letters. The finding that children do better on lower-case letters that are identical in shape to their upper-case counterparts may be considered a kind of frequency effect, in that performance on a lower-case letter is aided by previous experience with its upper-case version if the two are alike in form. However, several other measures that might be expected to reflect children's experience with specific letters did not account for significant additional variance in our analyses. One of these measures was based on McBride-Chang's (1999) suggestion that the beginning letters of the alphabet are stressed more than the end letters in informal learning. In none of our preschool data sets, however, did position contribute significant additional variance when coded as first half or second half of the alphabet. We suggested that children may do relatively well on upper-case *A* because it is the first letter of the alphabet, but we do not find evidence for order effects beyond the first position.

Another possible index of preschoolers' exposure to letter names may be the frequency of letters in words in written materials designed for young children. For this measure, we examined the words that appear with a U value (frequency per million words adjusted for variation in distribution of words across content areas) of 1 or more in written materials at the kindergarten and first-grade levels in Zeno *et al.* (1995). The analyses were limited to words that also appeared in a second source (*CMU Pronouncing Dictionary*, 1998), eliminating 54 entries, mostly erratic or low-frequency words. The remaining set of 6,232 words comprises words that young children would have a chance of seeing, although a given child would certainly not see every word. How often each letter occurred in this corpus, weighting words by their frequencies, did not account for significant

additional variance in any of focus primarily on the initial letter frequency in this position. The regressions either.

A measure of letter frequency of letter names is whether the child's name is often the first part and write, often as early as age 3 (Treiman and Broderick (1998) task and a letter printing task, of their own name than with other the child's greater exposure to personal importance that this Broderick found that the letter somewhat elevated levels of performance effects were not significant.

Children's learning of the parts of their names has the hallmarks of by stimulus similarity and rote measures of frequency that capture. Indeed, rote memorization of languages like English, where the child's point of view, arbitrary children's learning of shape-motivated letter shapes. For designed to graphically depict consonant is made, but it is not learn the letters.

#### IV. Children's

Among US children, the ability which we refer to as letter-sound provide the letters' names. On the belief that children can learn to know most letter names before culturally determined, is that without a vowel, are difficult to words of the language. Never some letters before they enter school Worden and Boettcher (1990)

additional variance in any of the regressions. Because young children may focus primarily on the initial letters of words, we also examined each letter's frequency in this position. This variable did not add significantly to the regressions either.

A measure of letter frequency that *does* influence preschoolers' knowledge of letter names is whether the letter appears in the child's own first name. A child's name is often the first printed word that he or she learns to recognize and write, often as early as age 3 (Hildreth, 1936; Villaume & Wilson, 1989). Treiman and Broderick (1998) found that, in an upper-case letter naming task and a letter printing task, children performed better with the first letter of their own name than with other letters. These differences probably reflect the child's greater exposure to the first letter of his or her name and the personal importance that this letter develops for the child. Treiman and Broderick found that the letters of the child's name beyond the first showed somewhat elevated levels of performance in the naming task, although these effects were not significant.

Children's learning of the pairings between the visual forms of letters and their names has the hallmarks of paired-associate learning. It is influenced by stimulus similarity and response similarity and, apparently, by those measures of frequency that capture young children's experiences with letters. Indeed, rote memorization of shape-name pairs is the only option with languages like English, where the shapes of almost all letters are, from the child's point of view, arbitrary. To our knowledge, no data are available on children's learning of shape-name pairs in writing systems with many motivated letter shapes. For example, Korean consonant letters were designed to graphically depict the location in the vocal tract where the consonant is made, but it is not known whether this helps Korean children learn the letters.

#### IV. Children's Learning of Letter Sounds

Among US children, the ability to provide sounds for individual letters, which we refer to as letter-sound knowledge, lags behind the ability to provide the letters' names. One reason for the discrepancy is the common belief that children can learn letter sounds at school, whereas they should know most letter names before they start school. Another reason, not culturally determined, is that consonant letter sounds, as pronounced without a vowel, are difficult to discriminate and produce and are not legal words of the language. Nevertheless, many children learn the sounds of some letters before they enter school. The California 4-year-olds studied by Worden and Boettcher (1990) responded correctly to 21% of letters when

asked to provide their sounds. (The letter-sound task of this study used the case that had yielded best performance in the letter-name task for each child, which was usually upper case.) The Detroit preschoolers studied by Treiman *et al.* (1998) responded correctly to 33% of letters when shown the upper-case forms and asked to supply the sounds.

As discussed earlier, the names of letters in English and other languages tend to be iconic, in that they include their sounds. Do children benefit from this iconicity, using the fact that /b/ is heard at the beginning of *b*'s name to learn and remember that *b* represents /b/? Alternatively, do children treat name-sound pairings as arbitrary, using rote memorization to learn these pairs as they do to learn shape-name pairs in English? Children in the US have been found to benefit from the iconicity of letter names. Evidence for name-to-sound facilitation comes from the finding (McBride-Chang, 1999; Treiman *et al.*, 1998) that children perform best on letter-sound tasks for letters whose sounds are at the beginnings of their names, such as *b*. Performance tends to be poor for letters whose sounds are not heard in their conventional names, such as *w*. Intermediate levels of performance are found for letters whose sounds are at the ends of their names, such as *l*. The /b/ of a syllable like /bi/, which is called the onset, is more salient and accessible than the /l/ of a syllable like /ɛl/. This, together with the fact that consonant-vowel letter names are more common in English than vowel-consonant letter names, makes the letter name more useful in the former case than the latter case.

When we examined the two sets of data on preschoolers' knowledge of upper-case letter-sound correspondences that were mentioned earlier, we found that *B, G, K, O, P, T,* and *Z* ranked in the top third of letters in both studies. For all these letters, at least one of its common sounds appears at the beginning of the letter's name. The letters that ranked in the bottom third in both studies of letter-sound knowledge were *L, R, Q, W, Y,* and *X*. For these letters, the sounds that are taught to children and scored as correct in tests of letter-sound knowledge are not found at the beginning of the letter's name.<sup>4</sup>

Although the results presented above support the idea that the position of a letter's sound in its name is important for letter-sound learning, raw knowledge of letter sounds may not provide the best way to assess the idea that children use the names of letters to help learn and remember their sounds. A high or low ranking in sound knowledge could reflect high or low familiarity with a letter's shape in addition to ease or difficulty of deriving

the sound from the name. For shape-name learning, as for children's good knowledge of knowledge and sound knowledge, children can derive the sound should be relatively small when its name and large when this is the consonant-/i/ letters *D, T* letters in terms of name-sound in the top third. These two sets the sound from the name.

Studies in which children are provide direct evidence that learning of letter sounds. In (mean age 4 years, 11 months) were selected who knew the r their sounds. Over several se letter and were asked to select that corresponded to a sound substantial improvement over the two taught pairs for which letter's name. Some improvement such as /l/-*l* and /m/-*m*, which Little or no improvement oc name of the letter that is use children learned the sound-*l* fashion, such differences wou

A number of US preschool study just described, know m culturally mainstream and co neither letter names nor sou control group in testing the h facilitated by prior knowledge a control group in a study of The experimental children lea thereof) for six letter-like syn The sound was included in the the other two (e.g., /h/ in /etf/ that were phonologically unre group performed significantly the letters' sounds, and th letters with the sound in the

<sup>4</sup>The sound of *Q* is popularly considered to be /kw/, only the first phoneme of which appears at the beginning of the name /kju/.



the sound from the name. For example, *O* is among the easiest letters for shape-name learning, as mentioned earlier, and this could partially explain children's good knowledge of its sound. The difference between name knowledge and sound knowledge may better reflect the ease with which children can derive the sound of a letter from its name. The difference should be relatively small when a letter's sound can be generated easily from its name and large when this is not the case. In both of the preschool studies, the consonant-/i/ letters *D*, *G*, *K*, and *V* ranked in the lowest third of all letters in terms of name-sound discrepancies. *H*, *Q*, *R*, *W*, *Y*, and *X* ranked in the top third. These two sets of letters clearly differ in the ease of deriving the sound from the name.

Studies in which children are taught different types of letter-sound pairs provide direct evidence that the name-sound relation influences children's learning of letter sounds. In a study by Treiman *et al.* (1998), preschoolers (mean age 4 years, 11 months) were taught the sounds of 10 letters. Children were selected who knew the names of the critical letters but few or none of their sounds. Over several sessions, children were told the sound of each letter and were asked to select, by pointing to one of the ten letters, the letter that corresponded to a sound spoken by the experimenter. Children showed substantial improvement over the course of the study for /d/-d and /v/-v, the two taught pairs for which the sound appears at the beginning of the letter's name. Some improvement, although not as much, was seen for pairs such as /l/-l and /m/-m, which have their sounds at the ends of their names. Little or no improvement occurred for sounds that are not found in the name of the letter that is used to spell them, as with /w/-w and /j/-y. If children learned the sound-form pairs solely in a rote, paired-associate fashion, such differences would not have been expected.

A number of US preschoolers, like those who participated in the training study just described, know many letter names but few letter sounds. Few culturally mainstream and cognitively normal 4-year-olds in the US know neither letter names nor sounds. Such children would provide a useful control group in testing the hypothesis that the learning of letter sounds is facilitated by prior knowledge of letter names. Share (1999) included such a control group in a study of Israeli children who did not know English. The experimental children learned English names (or slight modifications thereof) for six letter-like symbols before they learned the letters' sounds. The sound was included in the name in four cases (e.g., /t/ in /ti/), but not in the other two (e.g., /h/ in /etf/). The control group learned real-word names that were phonologically unrelated to the letters' sounds. The experimental group performed significantly better than the control group when learning the letters' sounds, and this superiority was especially marked for letters with the sound in the name. These findings support the view that

prior knowledge of letter names helps children learn letters' sounds. The control group gained familiarity with the letters' shapes before learning the sounds, as did the experimental group, so the superior performance of the experimental group is not due to better knowledge of the letters' visual forms.

The results of the training studies confirm that the knowledge of letter names that most US children bring with them to the task of learning letter sounds influences their performance. For the majority of English letters, such as *b* and *v*, the effects are positive. The sounds of the letters are heard in their names, and this helps children associate the sound with the name. For a few letters, the effects are negative. Children who know that *y* is called /waɪ/ probably have a harder time learning that it corresponds to /j/ when used as a consonant than children who do not know the name of *y*. Supporting the idea that negative effects occur for some letters, kindergartners sometimes say that *y* makes the sound /wə/ and that *w* makes the sound /də/ (Treiman, Weatherston, & Berch, 1994). These errors, which might at first seem bizarre, are regularizations of the kind that have been observed elsewhere in language learning. They reflect the generalization that the sound of a letter is often the first phoneme of the letter's name, just as *goed* for *went* reflects a generalization about the form of the past tense. Errors in which children give the first phoneme in the name of letters such as *s* and *r* as the sound have not been systematically documented, but we have observed them in some English-speaking children. Such errors may reflect children's experiences with English, where the sounds of letters are more often at the beginning of letters' names than at the ends, or a more universal tendency to look to the beginning of the syllable for the sound of the named letter.

Venezky (1975) argued that English letter names cannot provide much help in learning the letters' sounds because only 9 of the 26 letters—*b*, *d*, *j*, *k*, *p*, *t*, *q*, *v*, and *z*—begin with the sound that is traditionally introduced first for the letter in reading programs. Although we would argue that *q* is not as useful as the other names just mentioned, as it begins with /kj/ rather than the /kw/ that is taught in schools, we believe that the number of helpful letter names is much larger than Venezky claimed. The data reviewed here show that young children benefit from letter names that end with the sound, although less than from letter names that begin with the sound. This means that *f*, *l*, *m*, *n*, *r*, *s*, and *x* are letter names that are at least somewhat helpful. Although the "hard" sounds of *c* and *g*, /k/ and /g/, are typically taught first to children, the "soft" sounds /s/ and /dʒ/, which are at the beginning of the letter names, are reasonably common. With vowels, the short sounds are usually taught first but the long sounds, which are the letters' names, are often found in words. Children are typically taught that *y* symbolizes /j/

when used as a consonant, as in *baby*. However, *y* corresponds to /ɪ/ in *by* and *my*. This leaves *h* as the only letter whose name does not correspond to its sound in English names are arguably /hɛtʃ/ by some English speakers for them. Thus, although learning the letters' sounds helps the majority of English letter names,

The fact that the names of letters and their sounds has implications for teaching. Many US kindergartens and first graders spend a week learning the sounds of each letter. The training studies suggest that it takes time to learn the sounds of *s* and *r*, which is difficult to learn, with *s* (1994) often continuing to claim that *s* had spent the allotted week and difficulty of various letter names on classroom time effectively and

Most existing studies have shown that differences among children in how they derive more benefit from letter names generally offer and, if not, differences (but see Share, 1991) take advantage of the iconicity of letter names in reading problems, reflecting the treatment of print-speech relations. A major issue for future research is whether this is true for languages other than English. We have suggested that languages like Turkish should be taught to children may derive special benefits from Korean, which include the consonant-vowel combinations that demonstrate its sound in both directions. To be done, knowing the names of letters and the associations between letters and

## V. Role of Letter N

So far, we have discussed the role of letter names and labels and sounds of individual letters in words. Researchers have discussed

when used as a consonant, as in *yellow*, and /i/ when used as a vowel, as in *baby*. However, *y* corresponds to the /aɪ/ at the end of its name in words like *by* and *my*. This leaves *h* and *w* as the only two letters whose American English names are arguably useless in learning their sounds. And *h* is called /hetʃ/ by some English speakers, as mentioned earlier, taking it off the list for them. Thus, although English letter names are surely less helpful in learning the letters' sounds than are the names of Turkish or Korean, a large majority of English letter names provide cues that children can and do use.

The fact that the names of most English letters are helpful in learning their sounds has implications for the teaching of letter-sound associations. Many US kindergartens adopt a "letter-of-the-week" method in which children spend a week learning about the visual form, name, and sound of each letter. The training studies show, however, that children need more time to learn the sounds of some letters than others. The sound of *y* is one that is difficult to learn, with the kindergartners tested by Treiman *et al.* (1994) often continuing to claim that *y* makes the sound /wə/ even after they had spent the allotted week learning about *y*. Information about the ease and difficulty of various letter-sound pairs can help educators allocate classroom time effectively and respond appropriately to children's errors.

Most existing studies have focused on differences among letters rather than differences among children. Little is known about whether some children derive more benefit than others from the cues to sound that letter names generally offer and, if so, about the causes or consequences of such differences (but see Share, 1999, for some preliminary evidence). Failure to take advantage of the iconicity of letter names may be an early indicator of reading problems, reflecting poor phonological skills and a tendency to treat print-speech relations as arbitrary rather than principled. Another issue for future research is name-to-sound facilitation in languages other than English. We have suggested that the highly systematic letter names of languages like Turkish should be quite helpful in learning their sounds. Children may derive special benefit from the consonant letter names of Korean, which include the consonant both before and after a vowel and so demonstrate its sound in both positions. Although much research remains to be done, knowing the names of letters clearly facilitates the learning of associations between letters and sounds in many cases.

## V. Role of Letter Names in Learning to Read Words

So far, we have discussed children's knowledge about the conventional labels and sounds of individual letters. What about the reading of entire words? Researchers have distinguished two methods of learning to

read words in alphabetic systems. One method involves rote learning of printed words' pronunciations and/or meanings, much like rote learning of the largely arbitrary associations between English letter shapes and letter names. A second method, which takes full advantage of the alphabetic system, involves relating each letter in a printed word to a phoneme in the word's pronunciation. The first method is poor at securing words in memory and allowing generalization to new words. For example, a child who has linked the red semicircle in the *Crest* logo to the word's meaning may remember the word as *toothpaste* or *brush teeth* and may read other words that contain a semicircle in the same way. A child who has connected the *C*, *r*, *e*, *s*, and *t* of *Crest* to the /k/, /r/, /ε/, /s/, and /t/ of /krest/ knows the word's precise pronunciation and can likely decipher words such as *rest* and *set*. Full alphabetic connections, with their benefits for precision and generalization, take time and effort to master. Children who would form such connections must treat spoken words as sequences of phonemes and must link the phonemes and the letters. Before children's phonological skills and knowledge of letter sounds are advanced enough to do this, they are thought to rely on rote, paired-associate learning (Byrne, 1992; Ehri, 1998; Frith, 1985; Gough & Hillinger, 1980).

In this section, we suggest a third option, one that takes more advantage of the alphabetic system than rote memorization but that requires less skill and knowledge than use of letter sounds. This method involves connections between print and speech that are based on letter names. For example, a child may use the fact that the names of *b* and *e* are heard in the pronunciation of *bead* to help learn and remember this word's spelling. Such a child does not connect the *a* and *d* of *bead* to phonemes in the word's pronunciation, and so may misremember the word as *beach* or *beat*. Having learned *bead*, the child may have difficulty deciphering new words in which *b* is followed by a vowel other than /i/. This lack of precision and generalization make links based on letter names a transitional method at best. However, letter names may play an important role in the early acquisition of literacy by helping children understand that words' spellings are not arbitrary. At least some of the letters in words' spellings reflect the words' pronunciations.

Evidence for a role of letter names in linking print and speech comes from a study in which children were taught to pronounce artificial words that offered different types of connections between spellings and pronunciations (Treiman & Rodriguez, 1999). In the name condition, the entire name of the word's first letter could be heard in the pronunciation, as when *BD* was taught as a spelling for *bead*. In the sound condition, the phoneme corresponding to the first letter was heard in the word's pronunciation but the complete letter name was not. For example, *BD* was pronounced as *bud*

in this condition. In a third condition, the entire name of the first letter was heard, but to either the names or sounds of the other letters. In this condition, to avoid repetition, children learned words in which the first letter was not the same as the other letters; the children were taught words like *bead* and *beat* in the sound condition and *bead* and *beat* in the name condition. Children who were 4;0 (4 years, 0 months) performed in the sound condition or children who had begun to read in the name condition. In another study, younger children (3;0-3;6) showed some ability to form connections between the beginnings of words (Treiman & Rodriguez, 2002), for example, pre-read for *art* but showed no significant ability to read for *art*.

The use of letter names to help children learn to read once children become able to use letter names to read. Adults use letter names to help children learn to read (2002; Treiman, Sotak, & B. letter-name connections may help children learn to read memory (Perfetti, 1992). For example, the letter name /i/ in the spoken form of *bead*.

If readers use letter names to help learn to read, how much could this help children learn to read? We examined the 6,232 words in the kindergarten and first grade word lists with *OK* and *CBS*, can one of its symbols. This helps children learn to read letter names when learning to read words, where letter names can help explain why the spelling is for children to read. Consonant letters are sometimes a consonant because the names of kana represent. Although English letter names in sequence to read words, some words. Of the words in the list, one letter whose American English letter is sometimes a consonant often a vowel, as with the *a*.

Another way to look at the words' spellings are associated with letter names. For example, *o*

in this condition. In a third condition, the pronunciation did not correspond to either the names or sounds of the words' letters, as with *wine* for BD. To avoid repetition, children learned a different set of words in each of the three conditions; the children were told that these were words in a "made-up" language. Children who were not able to read simple words (mean age 5 years, 0 months) performed significantly better in the name condition than in the sound condition or the condition with arbitrary spellings. Only children who had begun to read were able to benefit from sound-based links. In another study, younger preschoolers (mean age 4 years, 3 months) also showed some ability to form letter-name connections for consonants at the beginnings of words (Treiman, Sotak, & Bowman, 2001). Children find it harder to form these connections for consonants at the ends of words than consonants at the beginnings of words. In a study by Bowman and Treiman (2002), for example, prereaders benefited from the R at the beginning of RT for *art* but showed no significant benefit from the R at the end of TR for *tar*.

The use of letter names to connect print and speech does not disappear once children become able to form connections based on letter sounds. Even adults use letter names to facilitate word learning (Bowman & Treiman, 2002; Treiman, Sotak, & Bowman, 2001). For older children and adults, letter-name connections may allow for a degree of redundancy that facilitates memory (Perfetti, 1992). For example, knowledge of letter names permits the /i/ in the spoken form of *bead* to link not only to the *ea* but also to the *b*.

If readers use letter names in a direct way to connect print and speech, how much could this help in learning to read English? To find out, we examined the 6,232 words described earlier that occur in reading materials at the kindergarten and first-grade levels (Zeno *et al.*, 1995). Only rarely, as with *OK* and *CBS*, can one read a word simply by concatenating the names of its symbols. This helps explain why some children who can benefit from letter names when learning to read artificial words cannot read common real words, where letter names do not permit a fully correct pronunciation. It also helps explain why the syllabic symbols of Japanese, the *kana*, are easy for children to read. Concatenation of names works well in this case, because the names of *kana* symbols almost always match the sounds they represent. Although English-speaking children cannot just say the letters' names in sequence to read words, letter names are useful for some letters of some words. Of the words in our set, 43.1% contain in their spelling at least one letter whose American English name appears in the pronunciation. This letter is sometimes a consonant, as with the *r* of *start*, but is much more often a vowel, as with the *a* of *take*.

Another way to look at the matter is to ask what percentage of letters in words' spellings are associated, in the same word, with the corresponding letter name. For example, only one letter of the four in *take* is heard, the *a*.

TABLE IV  
Reliability of Letter Names in Reading and Spelling in Set of 6,232 Words Found in Reading Materials for Kindergarten and First-grade Children

Letter	Reading		Spelling	
	No. of words with letter in spelling	Percent of those words with letter name in pronunciation	No. of words with letter name in pronunciation	Percent of those words with letter in spelling
A	2834	21.7	590	97.1
B	777	6.2	38	100.0
C	1364	1.6	62	35.5
D	1702	4.8	71	98.6
E	4319	25.1	1030	68.1
F	559	1.3	7	71.4
G	1220	.8	12	75.0
H	1169	.1	1	100.0
I	2429	19.9	472	91.5
J	122	8.2	10	100.0
K	596	2.5	44	34.1
L	2018	8.3	114	100.0
M	963	4.8	37	100.0
N	2418	8.5	160	100.0
O	2168	24.2	476	99.2
P	1170	5.4	52	100.0
Q	38	.0	9	.0
R	2645	8.0	183	100.0
S	3054	4.1	75	98.7
T	2222	4.2	78	98.7
U	1109	5.8	61	90.2
V	286	3.1	9	100.0
W	642	.0	0	—
X	78	10.3	11	72.7
Y	665	.6	34	11.8
Z	90	14.4	22	45.5
All	36657	10.7	3658	85.6

Table IV shows the reliability of each letter in reading, meaning the percentage of cases in which words with this letter in their spelling have the corresponding letter name in their pronunciation. Over all letters, the average reading reliability is 10.7%. These counts include words where the letter name in the spelling does not actually symbolize the letter in question. For example, *cherry* contains an *e* in its spelling and an /i/ in its pronunciation, but the *e* does not symbolize the final /i/. The lack of alignment is less relevant to young children than to adults, as children do

not at first know which of words that contain pronunciation falls to 37 like the one with *cherry*.

The results in Table IV they predict the presence generally the best prediction has a reliability of only a of their sounds) at the be than those with the sound to 6.2%. Thus, US child speech if they use letter encounter in words. Such learning to read, helping systematically related to first partial connections to

Educators could take a speech on the basis of letter *eat* in early instruction. valuable for children who systematically related to relation between the letter use those letters in connection. Children may most read the first letter of their own name form, as with *jail* for Joe.

Children learning to read connections from print to prereaders who are familiar spellings like CBL for *cebola* (Abreu & Cardoso from the fact that the Portuguese name of the fruit of letter names do not le arbitrary ones. What mal is that many words in spelling, especially vowels tion. Indeed, 51 of the 56 in books for Brazilian children whose name appears in the Resende, & Rodrigues, 20 the names of all of the

und in Reading

Percent of those  
words with  
letter in spelling

97.1  
100.0  
35.5  
98.6  
68.1  
71.4  
75.0  
100.0  
91.5  
100.0  
34.1  
100.0  
100.0  
100.0  
99.2  
100.0  
.0  
100.0  
98.7  
98.7  
90.2  
100.0  
-  
72.7  
11.8  
45.5  
85.6

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l letters, the  
ds where the  
in question.  
n /i/ in its  
The lack of  
children do

not at first know which letters represent which phonemes. The percentage of words that contain at least one letter whose name appears in the pronunciation falls to 37.5% for monosyllabic words, where misalignments like the one with *cherry* are unlikely to arise.

The results in Table IV show that letters differ markedly in how reliably they predict the presence of names in pronunciations. Vowel letters are generally the best predictors. However, even the highest ranking vowel, *e*, has a reliability of only about one in four. Letters with their sounds (or one of their sounds) at the beginning of their names are somewhat less reliable than those with the sounds at the ends of their names, 3.8% as compared to 6.2%. Thus, US children could make some connections from print to speech if they use letter names, but only for a minority of the letters they encounter in words. Such letters may nevertheless play a special role in learning to read, helping children understand that the spellings of words are systematically related to their pronunciations and helping them form their first partial connections between printed and spoken words.

Educators could take advantage of children's tendency to link print and speech on the basis of letter names by including words such as *OK*, *jail*, and *eat* in early instruction. The teaching of such words may be especially valuable for children who are having difficulty grasping the idea that print is systematically related to speech. Research has not examined the possible relation between the letters in a child's own name and the child's ability to use those letters in connecting print and speech, but a link may well exist. Children may most readily form connections for words that start with the first letter of their own name and that have the letter name in their spoken form, as with *jail* for Joe.

Children learning to read in languages other than English can also form connections from print to speech that are based on letter names. Brazilian prereaders who are familiar with letter names have been found to learn spellings like CBL for *cebola* (onion) more easily than those like HMN for *cebola* (Abreu & Cardoso-Martins, 1998). These children appear to benefit from the fact that the pronunciation of *cebola* starts with /se/, the Portuguese name of the first letter in CBL. Prereaders with little knowledge of letter names do not learn the motivated spellings more easily than the arbitrary ones. What makes letter names particularly useful in Portuguese is that many words in this language have one or more letters in their spelling, especially vowels, that correspond to letter names in the pronunciation. Indeed, 51 of the 56 most common content words in a list of words in books for Brazilian kindergartners contain at least one vowel letter whose name appears in the corresponding spoken word (Cardoso-Martins, Resende, & Rodrigues, 2001). For a number of words, such as *bola* (ball), the names of all of the vowel letters are heard in the pronunciation.

Although comprehensive analyses have not been carried out, spellings that make sense on the basis of letter names appear to be more common in Portuguese than English.

Young speakers of Hebrew also take advantage of letter names in recognizing printed words. When presented with the word *בטון* and asked whether that spelled /be'ton/ (*concrete*) or /ka'fri/ (*rustic*), the Israeli kindergartners tested by Levin *et al.* (2002) could usually judge correctly that it was /be'ton/. /bet/ and /kaf/ are the names of Hebrew letters, and seeing the letter *ב* at the beginning (right side) of the word /be'ton/ helps children identify the word. The children did not perform as well on words whose pronunciations do not begin with the name of the letter that their spelling begins with. The utility of matching full letter names may be restricted by the fact that relatively few Hebrew words contain an entire letter name, in part because the names of Hebrew letters are relatively long (averaging 3.5 phonemes). However, Levin *et al.* found that children's performance also improves to a lesser extent when only some of the phonemes of the letter name are present in the word. Because partial matches are more frequent in the vocabulary, they may help Hebrew-speaking children connect print and speech.

Direct use of letter names to connect print and speech, in the sense of mappings that link a letter to its entire spoken name, should be available in all or almost all languages with alphabetic writing systems. All languages show iconicity in their letter names; most have letter names with no "extra" phonemes besides the letter's sound (in the case of vowels) or just one (in the case of consonants); and the "extra" phoneme, if present, tends to be reasonably common in the language. As a result, some words contain letter names in their spoken forms and the corresponding letters in their printed forms. The number of such words probably differs across languages, as discussed above, making the tendency to use letter names more useful for reading in some languages than others. Cross-linguistic studies are needed to quantify these differences and examine their effects on early reading.

Letter-name knowledge also helps reading indirectly, in the sense that knowledge of letter names helps children learn letter sounds and knowledge of letter sounds in turn benefits reading. For example, children who use *b*'s name to help learn that *b* corresponds to /b/ can connect the *b* of a word like *bone* to the /b/ in the word's spoken form. Cardoso-Martins, Resende, and Rodrigues (2001) have argued that Brazilian Portuguese-speaking children can make such sound-based connections from an early age, using their knowledge of letter names to learn simplified spellings in which the letters correspond to phonemes, not letter names. Thus, letter names can aid reading directly, for words in which letters correspond to entire names, and indirectly, by helping children form connections based on sounds.

## VI. Role of Letter Names

When children spell, they so words with the corresponding letter where it leads young speakers of *cone* and *mul* for *mule*, omitting spellings of these words (e.g., Re 1993). The tendency is also for children to produce spellings like 1993, 1994). Children are more with vowel-consonant names names. The errors are most common. When a vowel is followed by /r difficult for children to divide cohesiveness probably reflects differences respects to vowels. We saw evidence the large discrepancy between knowledge for *r*.

Errors like those described above and first graders who are trying occur among younger children preschoolers (mean age 5 years, the first letters of words spoken to say that *beech* starts with *b* than & Richmond-Welty, 1996). The that a word like *deaf* ends with phenomena occur among young the examples given so far, use of names sometimes cause errors in children think that *seed* starts with

Of the 6,232 words in the list described earlier, 2,919 contain letter in their spelling. Thus, children letter will usually produce a letter of the word. Balanced against this our list do not contain a letter name the reliability of the individual letter direction. Only a few letters are spelled with *s*; *k* and *q*, because *n* is spelled with *s*; and *y*, because /i children who represent a letter corresponding letter will usually



## VI. Role of Letter Names in Learning to Spell Words

When children spell, they sometimes symbolize letter names in spoken words with the corresponding letters. This tendency is found for vowels, where it leads young speakers of English to produce misspellings like *con* for *cone* and *mul* for *mule*, omitting the final *e* that appears in the conventional spellings of these words (e.g., Read, 1975; Reece & Treiman, 2001; Treiman, 1993). The tendency is also found for consonants, where it leads young children to produce spellings like *kr* for *car* and *hlp* for *help* (e.g., Treiman, 1993, 1994). Children are more likely to make such errors on consonants with vowel-consonant names than consonants with consonant-vowel names. The errors are most common for *r* and next most common for *l*. When a vowel is followed by /r/ or /l/, the sequence is quite cohesive and difficult for children to divide into its component phonemes. This cohesiveness probably reflects the fact that /r/ and /l/ are similar in many respects to vowels. We saw evidence for a special difficulty with /r/ earlier in the large discrepancy between letter-name knowledge and letter-sound knowledge for *r*.

Errors like those described above are common among US kindergartners and first graders who are trying to spell whole words. Similar phenomena occur among younger children in simpler spelling tasks. In one study, US preschoolers (mean age 5 years, 5 months) who were asked to orally provide the first letters of words spoken to them by an experimenter were more likely to say that *beech* starts with *b* than that *bone* starts with *b* (Treiman, Tincoff, & Richmond-Welty, 1996). The children were also more accurate at saying that a word like *deaf* ends with *f* than that *loaf* ends with *f*. Similar phenomena occur among young learners of Hebrew (Levin *et al.*, 2002). In the examples given so far, use of letter names aids spelling. However, letter names sometimes cause errors in both languages, as when English-speaking children think that *seed* starts with *c* rather than *s*.

Of the 6,232 words in the list of kindergarten and first-grade words described earlier, 2,919 contain a letter name. Of these, 92.1% have that letter in their spelling. Thus, children who symbolize a letter name with that letter will usually produce a letter that is found in the conventional spelling of the word. Balanced against this is the fact that over half of the words in our list do not contain a letter name in their pronunciation. Table IV shows the reliability of the individual letter names in the pronunciation-to-spelling direction. Only a few letters drop below 50%—*c*, because /s/ is usually spelled with *s*; *k* and *q*, because most /k/ is spelled with *c*; *z*, because most /z/ is spelled with *s*; and *y*, because /aɪ/ is usually spelled with *i*. For consonants, children who represent a letter name in a spoken word with the corresponding letter will usually produce a correct consonant letter but

omit the vowel. The resulting spellings are wrong, as with *hlp* for *help*, but comprehensible to parents and teachers. With vowels, spelling by letter names also fails to give a fully correct spelling in many cases. Children who use this method will often omit one letter of a digraph, as in *et* for *eat*, or a final *e*, as in *con* for *cone*. These are errors, but again understandable ones. Relatively rarely, as when children symbolize the first two phonemes of *wife* with *y*, are spellings based on letter names far afield.

Languages differ in how many of their spoken words contain letter names. Portuguese and Spanish appear to contain more such words, especially those with letter-name vowels, than English and Hebrew. In English, as mentioned earlier, the names of vowel letters are the vowel's long sound in order to make the name legal. However, the short forms of vowels are more common in English words. Few Hebrew words contain letter names because the names in this language are longer than those of other languages. Languages also differ in how many of the words with letter names in their spoken form contain the corresponding letter in their spelling. The percentage of such words is high in English, as we have seen, and is surely higher in many other writing systems. Languages also differ in how often use of letter names leads to a fully correct spelling. In all languages, letter-name spelling of consonants usually yields one letter of the correct spelling but, in the absence of other spelling strategies, causes spellers to omit vowels. For vowels, letter names probably permit more fully correct spellings in languages such as Spanish, which does not use digraphs to spell simple vowels, than in languages such as English, with its many vowel digraphs and silent *es*.

Differences among languages like those just described may help explain why children's early spellings sometimes differ in character from one language to another. For example, Ferreiro and Teberosky (1982) reported spellings such as *ao* for *sapo* (*toad*) and *ao* for *palo* (*stick*) among young Spanish-speaking children. The matter has not been studied quantitatively, but we believe that all-vowel spellings are uncommon among young English speakers. Ferreiro and Teberosky attributed spellings such as *ao* for *sapo* to children's initial belief that print represents speech at a syllabic level. However, an alternative hypothesis is that these spellings reflect children's reliance on letter names. Both vowels in the Spanish words *sapo* and *palo* are the names of letters, and the large number of such words in this and other languages may lead to a large number of all-vowel spellings.

As with reading, letter names influence spelling both directly and indirectly. Direct influences occur when children symbolize an entire letter name with the corresponding letter. Indirect influences occur when children use the name of a letter in determining how to spell a phoneme. Such indirect influences emerge rather early. For example, Treiman, Weatherston,

and Berch (1994) asked preschool kindergartners (mean age 5 years) that would be used in spelling consonant syllables. The children as /v/ and /b/ than with phonemes that probably perform relatively well. The sound occurs at the beginning of phonemes such as /l/, which occurs which does not occur in a letter name earlier, phonemes that appear in caused difficulty for the children sometimes misspelled /w/ as y. An explanation for the findings, as even though /g/ is the more common

In English, a number of common occur in the name of any letter. phoneme; /θ/ and /ð/ are others. do not occur in a letter name phonemes (7/24) and 42% of all (5/12) are not heard in the American could contribute to the difficulty also help explain why young English with vowels than consonants (e. English spelling is probably one of a number of different possible syllables consonants. However, the fact that the name of a letter may be another French also have a fair number name. These phonemes are more part the nasalized vowels that occur in languages, virtually all phonemes /r/ is the only unambiguously misspelled filled by unofficial versions of the *rr*, whose name does include that effects of these factors on spelling play in different patterns of performance

\*The most diphthongized vowels, /aɪ/ because children may spell them on the basis of the same reason, the discussions of other languages

and Berch (1994) asked preschoolers (mean age 5 years, 2 months) and kindergartners (mean age 5 years, 11 months) to state the consonant letter that would be used in spelling various consonant-vowel and vowel-consonant syllables. The children performed better with phonemes such as /v/ and /b/ than with phonemes such as /l/, /g/, and /w/. Children probably perform relatively well on phonemes such as /v/ because this sound occurs at the beginning of a letter's name. Performance is poorer on phonemes such as /l/, which occurs at the end of a letter name, and /g/, which does not occur in a letter name at all. Consistent with results reviewed earlier, phonemes that appear in a misleading letter name, such as /w/, also caused difficulty for the children in this study. For example, the children sometimes misspelled /w/ as *y*. Phoneme frequency cannot be a complete explanation for the findings, as children were worse at spelling /g/ than /v/ even though /g/ is the more common phoneme.

In English, a number of common consonant and vowel phonemes do not occur in the name of any letter. As mentioned, /g/ is one such consonant phoneme; /θ/ and /ð/ are others. Of the vowels, /ɪ/ and /æ/, among others, do not occur in a letter name. Indeed, 29% of all English consonant phonemes (7/24) and 42% of all non-diphthongal English vowel phonemes (5/12) are not heard in the American English name of a letter.<sup>5</sup> These facts could contribute to the difficulty of learning to spell in English. They could also help explain why young English-speaking spellers have more difficulty with vowels than consonants (e.g., Treiman, 1993). The inconsistency of English spelling is probably one contributor: vowel phonemes tend to have a number of different possible spellings and are more inconsistent than consonants. However, the fact that a number of vowels do not occur in the name of a letter may be another contributor. Brazilian Portuguese and French also have a fair number of phonemes that do not occur in a letter name. These phonemes are more often vowels than consonants, reflecting in part the nasalized vowels that occur in these languages. In certain other languages, virtually all phonemes occur in a letter name. For example, trilled /r/ is the only unambiguously missing phoneme in Spanish, and that gap is filled by unofficial versions of the alphabet that include an additional letter, *rr*, whose name does include that sound. Research is needed to examine the effects of these factors on spelling development and the role that they may play in different patterns of performance across languages.

<sup>5</sup>The most diphthongized vowels, /aɪ/, /aʊ/, and /ɔɪ/, are not included in these counts because children may spell them on the basis of their components rather than as units. For the same reason, the discussions of other languages do not consider diphthongs.

Even those researchers who adopt a stage theory of literacy development, postulating an initial stage of reading development in which children rely on paired-associate learning, believe that children go beyond rote memorization earlier in spelling than in reading (e.g., Frith, 1985). From a young age, children attempt to construct the spellings of many words from the words' phonological forms. The data we have presented show that letter names can facilitate this process. Children who rely solely on letter names cannot be good spellers, but letter names may help them move forward.

## VII. Conclusions

Discussions of alphabetic writing systems have concentrated on the regularity of print-speech relations. When differences in performance are found among children learning different writing systems, they are often attributed to differences in the regularity of the writing systems (e.g., Wimmer & Goswami, 1994). For example, systems such as Finnish have been characterized as predictable and easy to learn, whereas systems such as English have been characterized as less consistent and hence more difficult. In this chapter, we have focused on an aspect of writing systems that researchers have often ignored—the names that are given to the letters. This aspect of writing systems is important because children in literate societies often become very familiar with the names of letters before they start to read and write. This knowledge, typically acquired informally before systematic reading instruction begins, shapes how children learn to read and spell and how they respond to classroom instruction. Children use their knowledge of letter names to try to make sense of why words are written the way they are, and they do so in ways that teachers might not always suspect. Differences in performance among children learning different writing systems may reflect, in part, differences in the properties of the letter names and how the names mesh with the characteristics of the spoken language.

The relation between the names and shapes of letters is largely arbitrary in English, although a number of motivated letter shapes exist in certain other alphabets. As a result, English-speaking children have no choice but to memorize the links between letters' shapes and names in a rote fashion. Importantly, the relation between the names and the sounds of letters is not arbitrary in English or any other alphabetic system. English-speaking children take advantage of the fact that most letter names contain their sounds, and this makes learning of letter sounds quite different from learning of letter names. Children who know the names of letters can take advantage of certain relations between printed and spoken words, such as the link between the *e* in the printed *eat* and the /i/ in its spoken form. This

helps children move from trying to treating them as maps of

As we described earlier, such may be harmful to children. The research reviewed here are more helpful than have and other languages. Then the US and a number of an important foundation educators is to take advantage them to school, showing children reading and spelling words mislead.

The letter names of English systematic as those of certain system of English letter names make different choices. For /da/ than as /di/ if there are fact there are in the sample here. It might be helpful to the current *c*, *h* to show how Spanish follows this approach system have borne little fruit letter names in general use.

Although some research on languages other than English. One of our goals in writing linguistic research on this language, show some under noticeable surface differences provide direct and indirect languages. A combination should be valuable in studying learn about letter names and read and spell.

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helps children move from treating printed words as arbitrary visual patterns to treating them as maps of linguistic structure.

As we described earlier, some researchers have suggested that letter names may be harmful to children and should not be taught (Feitelson, 1988). The research reviewed here shows, on the contrary, that letter names are more helpful than harmful to children who are learning English and other languages. There is some truth to the belief, deeply held in the US and a number of other countries, that letter names provide an important foundation for reading instruction. The challenge for educators is to take advantage of the knowledge that children bring with them to school, showing children how letter names can often aid them in reading and spelling words and pointing out cases in which letter names mislead.

The letter names of English, although generally iconic, are not as systematic as those of certain other languages. If we were to design a new system of English letter names to maximize pedagogical utility, we might make different choices. For example, it might be more useful to label *d* as /da/ than as /di/ if there are more words that contain /da/ than /di/, as in fact there are in the sample of kindergarten and first-grade words examined here. It might be helpful to label *ch* as /tʃ/ followed by a vowel rather than the current *c*, *h* to show how it sounds in words. As mentioned earlier, Spanish follows this approach. Efforts to reform the English spelling system have borne little fruit, however. We doubt that efforts to reform the letter names in general use would fare substantially better.

Although some research on children's use of letter names has been done in languages other than English, most of the research has examined English. One of our goals in writing this chapter has been to encourage cross-linguistic research on this topic. Letter names, like other aspects of language, show some underlying similarities across languages but some noticeable surface differences. The extent to which letter names provide direct and indirect aid in reading and spelling also differs across languages. A combination of behavioral studies and language statistics should be valuable in studying how young speakers of different languages learn about letter names and how they use this information in learning to read and spell.

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