

# Learning to Spell in English by Chinese Students: A Cross-sectional Study

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## Abstract

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This study investigates the English spelling of students in grades 2 through 8 in Mainland China. A review of spelling and cross-linguistic research in spelling is presented. The orthographic development of 273 students was assessed *with validated spelling inventories* (Sterbinsky, 2007) to sample developmental features across three layers of English orthography. The sample size and the detailed analyses make this study unique. The 13 features in the analyses spanned development from beginning consonants to roots. Feature analyses predicted grade level, and there were significant differences across grades. Students made predictable spelling errors that reflected a similar developmental sequence to native English speakers. The error analyses across grades adds to the body of cross-linguistic literature illustrating how English language learners develop basic literacy skills in a similar manner to English-L1 children (Chiappe, Siegel, & Gottardo, 2002; Ford, Invernizzi, & Huang, 2014). This study indicates that as some English learners advanced in grades, their L1 has less of an impact on their spelling in English. When orthographic knowledge is examined across the alphabet, pattern, and meaning layers and cross-linguistically, researchers and educators can identify features students have mastered and what they are learning as a guide for a sequence of instruction and monitoring growth.

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**Keywords:** grades 2-8, spelling development, orthographic knowledge in second language, Chinese-speaking English learners, EFL, cross-language transfers

## Introduction

Students' spelling error patterns illuminate the development of their orthographic knowledge (Berninger, Abbott, Nagy, & Carlisle, 2009; Ehri, 2000; Ehri & Roberts, 2006; Templeton & Morris, 2000). This study contributes to the study of English spelling errors and orthographic knowledge in a cross-linguistic study of errors made by Chinese-speaking English L2 learners. Researchers have found that English learners gain their orthographic knowledge in a similar manner to their English L1 peers across the alphabet, pattern, and meaning layers of text while also using their knowledge of writing acquired from their experiences learning another writing system. Like all students, rates of acquisition among English learners vary with experiences (Helman, 2004; Invernizzi & Hayes, 2004; Yeong, Fletcher, & Bayliss, 2014). However, most of the research in developmental spelling and orthographic knowledge has been conducted with students whose primary language (L1) is English. In this study of second through eighth graders, the orthographic development of students who are building on Chinese are examined for developmental trends over these seven grades.

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The theoretical perspective in this study is that spelling reflects what learners know about the three layers of English orthography: the alphabet layer when sound-symbol correspondences are learned, the orthographic pattern layer, and the meaning in morphology layer. The sequence of learning specific features has been described in terms of five stages or phases. The five stages of spelling describe the spelling development and orthographic knowledge of English spelling (Henderson, 1980; Templeton & Bear, 2018). The first stage is the emergent stage when students are learning about phonological awareness, and the concepts of print and the spatial-temporal match between what we say and read. After the emergent stage, during the letter name-alphabetic stage, students focus on sound-symbol, and in English, letter-sound correspondences inherent in the alphabetic principle (Templeton & Morris, 2000). Students learn how to spell short vowels and many consonant digraphs and blends. This stage closes when students make generalizations about basic short vowel sounds that include commonalities in sound across a short vowel, and a tacit understanding of the closed syllable pattern containing short vowel, i.e., the highly phonetic short-vowel CVC pattern as in *bat*, *ball*, and *blank*. Having mastered these features, they begin to examine spelling patterns, a time when more abstract patterns are learned. This developmental stage is called the within word pattern stage, it is a time that has been described as an orthographic stage. In the pattern layer of English, students learn about long vowel (e.g., *meet/CVVC*, *time/CVCe*) and complex vowel patterns (e.g., *ou/around*, *ow/clown*). During the last two stages, students make the meaning connection as they learn about inflectional morphology (e.g., *hop/hopping*, *hope/hoping*, *talk/talking*), and then derivational morphology with roots (*ter*, *spect*, *duct*).

This study examines the spelling of English foreign language (EFL) learners in Mainland China from a developmental perspective (Templeton & Bear, 1992), an approach that has not been undertaken with Chinese speakers learning English. From this relatively large sample of errors, we wanted to know how the three layers of orthographic knowledge (alphabet, pattern, and meaning layers) are reflected in these students' spelling. The purpose of this study is to share an analysis of a wide range of orthographic features that may reveal developmental patterns in the acquisition of features. With this purpose in mind, three areas of investigation were undertaken:

1. What are notable developmental patterns in English spelling by Chinese EFL learners?
2. What cross-linguistic influences may impact the English spelling of Chinese EFL learners?
3. How does spelling achievement advance with schooling experience by grade level?

We begin with a brief description of developmental spelling, orthographic knowledge, and assessment.

## **Developmental Orthography**

### **Orthographic Knowledge and Spelling Development**

Phonological, orthographic, and morphological knowledge are described as components or layers of written English that are essential to learning to read, spell, and write (Berninger, Abbott, Nagy, & Carlisle, 2009; Blachman et al., 2013; Cho, McBride-Chang, & Burgess, 2005; Nagy & Townsend, 2012; Perfetti, 2007; Stanovich, 2000; Taft, 2003). A wide range of research that includes psycholinguistic, speech and language, anatomical, and neurolinguistic studies strongly suggests that underlying spelling and reading is a shared foundational knowledge (Beeson, Rising, Kim, & Rapsak, 2010; Cutler, Treiman, & van Ooijen, 2010; Ellis, 1997; Perfetti, 1997; Rapp & Lipka, 2010).

Developmental sequences have long been observed in reading (Biemiller, 1970; Invernizzi & Hayes, 2004) and spelling (Bahr, Silliman, & Berninger, 2009; Read, 1975; Templeton, 2003; Templeton & Bear, 2018), and these changes in reading and spelling have been described as stages or phases of learning to read and spell (Chall, 1983; Ehri, 1997, 2014; Wolf, 2007; Yin, Anderson, & Zhu, 2007). While there is evidence that spelling and reading share a foundation across the alphabet, pattern, and meaning layers, some researchers suggest that spelling and reading are different processes (Caravolas, Hulme, & Snowling, 2001; Ellis & Cataldo, 1990). It is suggested by others that spelling and reading achievement are highly correlated (Ehri, 1997; Ellis, 1997; Foorman & Petscher, 2010; Invernizzi & Hayes 2004; Mehta, Foorman, Branum-Martin, & Taylor, 2005; Templeton & Morris, 2000); for example, in a recent longitudinal study of Cantonese speakers, orthographic and morphological knowledge contributed to spelling (Yeung, Ho, Chan, & Chung, 2013).

A reciprocal relationship has been observed between reading and spelling with the consistent finding that spelling instruction can affect reading achievement, vocabulary, and morphological knowledge (Conrad, 2008; Ehri, 2006; Ehri, 2014; Graham, Harris, & Chorzempa, 2002; Graham & Santangelo, 2014; Nunes, Bryant, & Bindman, 2006; Richards et al., 2006; Rosenthal & Ehri, 2008; Taft, 2003; Treiman, 1998). Likewise, when students learn about inflected and derivational morphology during the last two stages, a reciprocal relationship between reading and orthographic knowledge has been observed in studies of morphological knowledge, word knowledge, and reading comprehension (Carlisle, 2007; Corson, 1997; Nagy, 2007; Nagy, Berninger, & Abbott, 2006).

### **Developmental Spelling Stages in English**

The three layers of orthographic development, alphabet, pattern and meaning, have also been described in terms of developmental phases or stages (Ehri, 2015; Templeton & Morris, 2000). In the assessments used in this study with 273 students, 15 features were examined that match the developmental continuum of the five spelling stages of development described by Henderson (1981) and his students (Templeton & Bear, 2018).

This study builds on the work of Charles Read (1971, 1975, 1986), who initially found that children's invented spellings are not random but are based on the learners' developmental theories of English spelling. Henderson and his students (Henderson, 1981, 1992; Henderson & Templeton, 1986; Morris, 2001) built on Read's work and described five stages of spelling that run parallel to the three layers of English orthography, alphabet (sound), pattern, and meaning (Henderson, 1974, 1992; Henderson & Templeton, 1986; Morris, 2001; Templeton & Morris, 2000). These five stages of development have been useful to understand children's orthographic development and knowledge (Lee & Scanlon, 2015) and are described here as a framework for the qualitative analyses of Chinese speakers' spelling in English. We look at these five stages quantitatively by the number of features students spell; we also collect and analyze qualitatively the spelling errors and examine errors for possible translanguage contrasts.

The *emergent* stage of spelling begins before school (ages 1–5). The spelling during this stage is mostly pre-phonetic, and the writing consists mostly of scribbles. During the latter part of the emergent stage, students have learned the names of several letters of the alphabet, and they may represent the beginning or most prominent sounds in a word (L for *elephant*). The reading of children in this stage is based on what they know about the text from pictures or having heard the story before (Ehri, 1997; cf. Biemiller, 1970).

In the *letter name-alphabetic spelling* stage (ages 5-8), children learn letter-sound correspondences, and they use the name of a letter to represent the sounds of the letter, such as spelling *mess* as MS and *help* as HLP because the names of the letters *s* and *l* are pronounced as /es/ and /el/ (Treiman & Cassar, 1997). Spelling errors often reflect how spellers use articulation to spell (i.e., how a sound is articulated, or feels in the mouth, influences a learner's spelling) (Read, 1971, 1975). During this stage, children use a letter name strategy to spell vowels. Long vowels are usually easy to represent because the names of the vowels match the letter names (HOP for *hope*). To spell short vowels, students in this stage often spell the short vowels with the long vowel name closest in articulation (FES for *fish*) (Read, 1975). For example, the /ɪ/ in *fish* and the letter name *e*, which is pronounced /i/, are articulated in a similar place; they are both high-front vowels (Finegan, 2008). By the end of this stage, children have a full understanding of the alphabet layer of English orthography and are capable of spelling most short vowels and consonant digraphs and blends, including preconsonantal nasals (Templeton & Morris, 2000).

Mastering the alphabetic principle (i.e., that certain letters correspond with certain sounds) is learned in kindergarten and first grade, and is highly related to concept of word in text and the ability to match syllabic units (Morris, Bloodgood, Lomax, & Perney, 2003; cf. Goswami, 2006). Once letter-sound correspondences are learned in English, the pattern layer comes into play first with students developing the idea that the CVC, closed syllable pattern, is a short vowel spelling.

In the *within word pattern stage* (ages 7-10), students learn the orthographic patterns for spelling long and ambiguous vowel patterns in English. Their spelling errors during this stage reflect growing knowledge of orthographic patterns, particularly long vowel patterns as when they spell *team* as TEME or TEEM. Gradually, they learn the correct spelling of long vowel words that include the consonant-vowel-consonant + e-marker (CVCe; i.e., *drive*), consonant-vowel-vowel-consonant (CVVC; i.e., *train*), and consonant-vowel-vowel (CVV; i.e., *say*) patterns, such as when they spell *team* as TEEM or TEME, and gradually they learn to spell nearly all single

syllable words correctly (Invernizzi, Abouzeid, & Gill, 1994). Learning to spell long vowel patterns in English grows in parallel to learning to spell low frequency consonant di- and trigraphs in initial and final positions. As children's sight vocabularies grow and the regularities of long vowel patterns are learned, complex vowel patterns are learned. Learning these aspects of the developmental sequence can take some students to the middle of third grade, though many students learn common long vowel patterns by the end of first grade. In the latter part of this stage, children learn about vowels that are neither long nor short and which may be ambiguous or inconsistent, such as the *ou* in *mouth, cough, through, and tough* (Gehsmann & Templeton, 2011, 2012).

Students in the fourth stage, *syllables and affixes spelling* (ages 8-18), expand their orthographic knowledge as they stretch into the meaning layer. As they learn to spell polysyllabic words they experiment with morphological elements like inflections (e.g., *stopped/hoped, shopping/hoping*), and past tense endings; e.g., that *-ed* signifies past tense regardless of the suffix's three pronunciations (/t/, /d/, or /ed/). They become familiar with the structure of syllables and principles of spelling including consonant doubling and the structure of open and closed syllables in relationship to the vowel; e.g., *pilot/napkin* and exceptions like *pivot*. The meaning layer is also seen in their learning the spelling and meaning of morphological elements like prefixes and suffixes.

Students may move into the last stage, *derivational relations spelling* as early as grade 4 or 5 (age 9 or 10); although the majority of them enter this stage in middle, high school, or even college. As the name implies, derivational relations spellers become aware of the derivational relations among words in terms of roots, origins, and meaning. They discover that words such as *compete, competition, and competitor* are connected in meaning, and therefore are similar in spelling pattern, even though they sound slightly different (Templeton, 2003). Students benefit from discovering spelling-meaning connections because it enables them to continue expanding their vocabulary throughout their lives. Hence, this is a lifelong stage (Henderson, 1990).

The concepts of phases or stages can be useful conceptually to describe a gradual progression in learning specific features. For example, students learn first about short and then long vowel patterns in parallel to their learning to spell consonant blends and digraphs. The relationships between reading and writing will vary with the structure of the orthography (Carlisle, 2010; Helman, Delbridge, Parker, Arnal, & Jara Mödinger, 2015) and the progression through the three layers varies with the particular orthography (Helman, 2004; Shen & Bear, 2000; Templeton & Morris, 2000).

The sequence of development reflected in these five stages is evident in the spelling development of children learning English as a second language where the impact of students' primary oral and written languages has been examined (Ford, Invernizzi, & Huang, 2014; Helman, 2004). These translanguage errors are useful for assessment and instruction among learners of different languages, in this case, Chinese students learning English as a foreign language. The next section presents a discussion of Chinese orthography and spelling to suggest features that may be seen in the cross-language spelling of students in grades 2-8.

### **Chinese and Pinyin**

Pinyin functions as an indispensable tool like the alphabetic principle in Western writing systems (Share, 1995). Pinyin is introduced to Chinese children in first grade and typically learned by the end of the year. They become fluent in pinyin and continue to use it throughout their primary school years. In their early years of writing when their character knowledge is limited, students write in pinyin to substitute for the characters they do not know (Cheung & Ng, 2003). After learning pinyin, students receive exposure to pinyin in conjunction with the Chinese characters to help them read and learn the logographic characters and understand the phonetic pronunciation of the characters.

Progression through the three layers of alphabet, pattern and meaning and a sequence of spelling development in Mandarin has been observed in patterns of spelling. Spelling accuracy increased significantly across grade levels, and the quality of the errors over the grades suggested a progression that related to the sound-pattern-meaning layers of Mandarin orthography (Shen & Bear, 2000). In an analysis of 7,000 spelling errors classified into 15 categories from the writing of 1,200 children in grades 1 through 6 in Mainland China, nearly 80 percent of the spelling errors had some phonological base, decreasing from 96 percent in first grade to 53 percent in sixth grade. Errors classified as pattern-type errors increased from 4 percent in first grade to 33 percent in sixth grade. Meaning-type errors jumped from 0.3 percent in first grade to 11 percent in sixth grade. Similar findings for responses to morphological instruction support the utility of addressing this morphological

layer of Mandarin (McBride-Chang et al., 2008). The development of the three layers reflects the depth and frequency of characters in Mandarin orthography.

### **Cross-linguistic Spelling Development among English Learners**

Building on English-L1 developmental spelling research, and using it as a source of comparison, cross-linguistic researchers have produced a growing body of literature on the influences of English learners' L1 on their English spelling and orthographic knowledge and development. Researchers have found that English learners make orthographic errors that often occur when a single phoneme is represented by different letters in different languages (Cook, 1997; Fashola, Drum, Mayer, & Kang, 1996). For instance, Fashola et al. (1996) found that Spanish-L1 children spelled *happy* as *japi* because /h/ is represented by the letter *j* in Spanish and by the letter *h* in English. In Japanese, Cook (1997) found that Japanese-L1 English learners confused /l/ and /r/ sounds in their spelling reflecting phonological differences in languages (Thompson, 2001). The following examples illustrate how English learners make phonetic errors, which often occur when a sound does not exist in the L1. Wang and Geva (2003a) found that Cantonese-L1 children substituted *sh* with *s* and *th* with either *s* or *z* due to the absence of these two phonemes in Cantonese. Similarly, Morris (2001) discovered that French-L1 children tended to spell *house* as OUSE, which is likely due to the absence of /h/ in the French language (Walter, 2001). At the same time, research suggests that L1s can be facilitative, depending on the nature of the two writing systems. In general, studies have shown that learners with an alphabetic L1 background usually do better on word identification and phonological awareness tasks than those with a non-alphabetic L1 (Leong, Cheng, & Tan, 2005; Wang, Perfetti, & Liu, 2005).

Some studies, such as Hamada and Koda (2008) and Wang, Koda, and Perfetti (2003), have illustrated learner performance differences on tasks due to varied L1 backgrounds. A number of studies have also documented that learners with the same written L1 background vary in word recognition abilities and phonological tasks given their variation in exposure to the alphabetic principle (Leong, Hau, Cheng, & Tan, 2005). Bertelson, Chen, and de Gelder (1997) found that students from Mainland China outperformed students from Hong Kong on tasks related to phonemic awareness, which is likely due to the Mainland learners' familiarity with pinyin that students in this study from Hong Kong lacked. In a recent meta-analysis of fMRI studies, language and writing processing networks in Chinese are largely similar to alphabetic language processing but there are distinct differences related specifically to Chinese (Wu, Ho, & Chen, 2012).

The facilitative effect of pinyin is also shown in research by Leong, Hau, Cheng, and Tan (2005), who investigated phonological sensitivity, and Cheung, Chen, Lai, Wong, and Hills (2001) in a study of phonological awareness among pre-readers in Hong Kong, Guangzhou in Mainland China, and New Zealand and by McDowell and Lorch (2008) among Chinese speaking students 15-19 years-old learning English.

To date, there are only a handful of studies that have examined the development of cross-linguistic spelling. Within this limited number of studies, researchers have found that English language learners develop their basic literacy skills in a similar manner to English-L1 children (Chiappe, Siegel, & Gottardo, 2002; He & Wang, 2009), and their progression may be influenced by various factors, including their L1 (Wang & Geva, 2003a, 2003b), with a modest impact for phonological influences on learning English as a foreign language. Early studies revealed that younger children made more L1-influenced errors than older children, and as their grade level advanced, the number of L1-influenced errors decreased; likewise, as English proficiency grew, English learners used more of their knowledge of English and spelled more English words correctly (Fashola et al., 1996; Ferroli & Shanahan, 1993;).

Longitudinal studies of the evolution of specific features in spelling by emergent bilinguals have also been illuminating (McBride-Chang, Liu, Wong, Wong, & Shu, 2012). In a study by Wang and Geva (2003a), younger bilingual learners (Grade 1) made more predictable L1-specific phonological errors in their spelling than their English-L1 counterparts. By the end of Grade 2, these ESL spellers performed as well as their English-L1 peers. Nassaji (2007) analyzed the development of English spelling and orthographic knowledge of a Farsi-L1 student's spelling errors from his daily journals and free writings over a four-year period, from grade one through four. Nassaji found that the child's spelling followed a stage-like sequence in a similar fashion to English L1 speakers, in which the child developed more complex spelling abilities and accuracy over time.

To summarize, previous cross-linguistic research indicates that English learners develop their basic literacy skills in a similar way to English-L1 children, and as their English proficiencies grow their spelling abilities also develop. As students' knowledge of English develops, English learners make fewer L1-influenced errors. To examine the three components or layers of English spelling cross-sectionally across grades 2–8 by features and developmental stages, this study focused on how Chinese, Mandarin-L1 students learning English as a foreign language spell both quantitatively and qualitatively.

## Method

### Participants

273 students from two primary schools and two middle schools in northeastern China participated in the study (Grade 2: N = 41, Grade 3: 32, Grade 4: 40, Grade 5: 40, Grade 6: 40, Grade 7: 40, Grade 8: 40). They ranged in age from seven to 14. At the time of data collection, each participant had at least one academic year of English instruction as a foreign language as part of the regular curriculum. They received one hour of English instruction each day. All participants spoke Mandarin Chinese at school and at home.

### Measures

Students' spelling was assessed with two spelling inventories (Bear, Invernizzi, Templeton, & Johnson, 2016) designed to measure the students' spelling knowledge. Inventories consist of 25 words (grades 2 & 3) and 26 words (grades 4–8), both of which have undergone a validation study (Sterbinsky, 2007). Two spelling inventories were used to provide developmentally appropriate words and spelling features for the participants who varied by age, ranging from second grade to eighth grade. While these spelling inventories are different, they largely measure the same spelling features, ranging from initial consonants to inflected endings, and the more advanced spelling inventory also measuring more challenging spelling features, such as syllable junctures and roots. In the classroom setting, the classroom teacher followed the inventory instructions, read the directions in Chinese and read each word, followed by a sentence in English using the word, and then the word again. Participants were asked to spell the best they could even when they did not know how to spell a word.

Sterbinsky (2007) conducted a reliability and validity analysis of both spelling inventories in which 647 students completed the Primary Spelling Inventory and 862 students completed the Elementary Spelling Inventory. The results indicate that both inventories are “reliable instruments and valid predictors of student achievement” (Sterbinsky, 2007, p. 19).<sup>1</sup> Twelve features are studied in this inventory in a sequence that reflects the three layers (alphabetic, pattern, and meaning) of English orthographic knowledge, and the corresponding stages of spelling. Emergent stage spelling was not evident in this sample, so the features we examined begin with (1) beginning consonants, (2) ending consonants, (3) short vowels, (4) consonant digraphs and (5) blends (e.g., *bed*, *ship*, *when*, *lump*). In the pattern layer of English spelling during the within word pattern stage of spelling development, students' knowledge of (6) long vowel patterns (*float*, *train*, *place*, *drive bright*, and *throat*), and (7) other vowel patterns including diphthongs (*spoil*) and r-influenced vowels (*serving*) are examined. Upper level spelling knowledge for the syllables and affixes stage begins with (8) inflected endings (*serving*, *chewed*, *carries*, and *marched*), then includes an examination of other features with words with (9) syllable junctures and (10) unaccented syllables (*shower*, *bottle*, *favor*, *ripen*, *cellar*). Finally, derivational morphology and knowledge of (11) more difficult affixes and (12) roots (*pleasure*, *fortunate*, *confident*, *civilize*, and *opposition*) are examined.

## Data Analysis

Students' spellings were analyzed for words and features spelled correctly, and scores for the total features and words spelled correctly were obtained for each student. Two trained college students at a research institution in the western United States first coded the data. An experienced researcher then coded 70 students' spelling (10 in each grade) to confirm the errors had been identified accurately. The handwriting posed a greater than usual challenge for the scorers, and there were times when the children used a character to spell a word. Discrepancies in scoring were discussed between the two scorers, and when agreement could not be reached, the first and second authors were consulted. The scoring guide for the features has been used extensively in research and

teaching (Bear, et al., 2016), and the mean scores and standard deviations for this study are presented in Tables 1 and 4. The feature types and their developmental order are presented from top to bottom for the primary inventory in Table 1 and the elementary inventory in Table 4. The specific features and words are presented in the following discussion of the data.

For informal, post hoc analyses, spelling stages were matched to power scores, the number of words spelled correctly. These criteria were set developmentally (Bear et al., 2016), and a range of development was described for grade levels by power scores. While the two different spelling inventories measure many of the same spelling features, the results of the two spelling inventories were not compared from one inventory to the other. This approach was utilized to illustrate how each age range performed on their respective spelling inventories.

## Results

### Grades 2 and 3

As described earlier, students' spelling abilities were analyzed by the total number of words and features spelled correctly. This section will briefly examine descriptive statistics, and then explore specific features in detail. The list of specific spelling features addressed in the results section is not exhaustive, but rather focuses on notable findings, and features that characterize the stages of development. Table 1 presents the means and standard deviations from independent *t*-tests for second and third graders. Students in both grades experienced difficulty with short vowels. More students in grade 3 struggled when spelling the final consonants than students in grade 2 ( $t = 2.17$ ,  $df = 71$ ,  $p = .03$ ,  $d = .60$ ).<sup>2</sup> No significant differences ( $p \leq .05$ ) were observed in the other features examined. We continue with an analysis of the categories of orthographic development.

Table 1  
*Means and Standard Deviations of Spelling Features in Grades 2-3*

	2 <sup>nd</sup> (n = 41)			3 <sup>rd</sup> (n = 32)	
	Max.	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Words Correct	26	2.22	2.29	2.06	1.72
Features Correct	56	21.90	5.69	21.53	4.74
Total Score	82	24.12	7.55	23.59	6.14
Features					
Initial Consonants	7	6.56	.63	6.44	.91
Final Consonants <sup>3</sup>	7	5.78	1.29	5.16	1.11
Short Vowels	7	2.22	1.51	1.97	.82
Digraphs	7	3.54	1.82	3.91	1.51
Blends	7	2.44	1.30	2.21	1.24
Long Vowels	7	.34	.62	.50	.76
Diphthongs, and R-influenced Vowels	7	.27	.63	.56	.76
Inflected Endings	7	.76	1.02	.79	.97

*Note.* Total N=73.

### Consonants

As noted in Table 1, students in second and third grade spell beginning and final consonants with great accuracy. This illustrates their expertise with this feature, which is much higher than their spelling of other features. The words for these features are regular and familiar; only the *r* in *rob* might be difficult. The beginning consonants were spelled accurately by second graders 94% of the time, compared to 83% for the third graders.

### Short vowels

Short vowel sounds were difficult for the second- and third-grade students to spell correctly. The most difficult short vowel was *u* as in *gum*, with only 2.74% of the students spelling it correctly. Forty-one percent of the students spelled *gum* as *gam*. This is likely because the *u* in *gum* (represented phonemically as /ʌ/, which is similar to /ə/) “is sometimes replaced by /a/” (Chang, 2001, p. 311). This case of misspelling is also likely influenced by the place articulation, as all of these are central vowels; /ʌ/ and /ə/ are mid-central vowels and /a/ is a low-central vowel (Finegan, 2008).

The *e* as in *sled* was the second most difficult short vowel sound for the 2<sup>nd</sup> and 3<sup>rd</sup> grade participants. This is likely related to the lack of a distinct /ɛ/ phoneme in Chinese (Duanmu, 2006). The most frequent replacement was *a*. The letter *A* was also the most frequent substitution for *e* as in *pet*. These instances may be influenced by how /ɛ/ in *sled* sounds like the letter name *a*, which is pronounced /e/; both /ɛ/ and /e/ are front central vowels (Finegan, 2008). Table 2a displays the most prevalent misspellings of short vowels for the second and third graders.

Table 2a  
*Misspelling of Short Vowels by Children in Grades 2-3*

Short Vowels	% Feature Correct	Misspellings (%)
<b>fan</b>	65.75	fun (10.96); fain (4.11)
<b>pet</b>	26.03	pat (26.03); pait (5.48)
<b>dig</b>	53.42	deg (9.59); dg (6.85)
<b>rob</b>	24.66	raob/raop (15.07); roub/roubo/rout (8.22)
<b>gum</b>	2.74	gam (41.10); garm (4.11)
<b>sled</b>	10.96	slad (13.70), slaid (9.59)
<b>stick</b>	28.77	sdk (12.33); sdek/sdekc/sdeke (9.59)

Note. N=73. In the Misspellings column, similar types of errors were combined as noted.

### Consonant digraphs

Compared to spelling short vowel sounds, students spelled more digraphs correctly. A notable exception was the /θ/ sound as in *thorn* and *third*, which had lower rates of accuracy. The other digraphs did not impose a significant obstacle for most students. This may be because pinyin has similar digraphs (e.g., *ch* and *sh*), but lacks a *th* digraph, which is represented in the spelling inventory and in this case, matches the /θ/ phoneme. Most students replaced it with either *s* or *f*, two common substitutions for the /θ/ sound among Mandarin speakers (Rau, Chang, & Tarone, 2009). This substitution makes sense as all three sounds are voiceless fricatives, and thus, only differ in the place of articulation. The students replaced an unfamiliar sound, a /θ/ (an interdental fricative), with a familiar sound, either an /s/ (an alveolar fricative) or an /f/ (a labiodental fricative). Table 2b shows the most frequent misspellings of digraphs.

### Consonant blends

Students had trouble with the majority of the blends except *sl* as in *sled* and *fr* as in *fright*. Table 2c displays this analysis. Students often inserted a vowel between consonants and wrote some single-syllable words as two-syllable words. This is likely because there are no consonant clusters in Chinese (Chang, 2001). As shown in Table 4, students added either *i* or *a* between the *s* and the *l* in *sled*, and *e* or *u* between the *b* and the *l* in *blade*; however, this addition was not consistent.

There are a few reasons why students' might have spelled *cr* as *kr*. One is that there is also a /k/ sound in pinyin that is represented by the letter *k*. Consequently, they may have made an error based on their orthographic knowledge in pinyin. Another possible reason is that in English, the /k/ phoneme can be spelled as



*c*, *cc*, *ck*, *k*, and *ke*. While learning to spell in English as a foreign language in their early years, these students were less familiar with the varied spellings of the /k/ phoneme in English where there is a greater frequency of initial *c*-blend compared to a *k*-blend.

Interestingly, students often replaced the *tr* in *tries* with *ch*, affrication, a logical linguistic confusion that is often observed at this point in students' development. Additionally, many students also replaced the *dr* in *drive* with a *j*. This phenomenon represents how when alveolar stops are followed by an *r*, palatalization can occur. Thus, *t* becomes /tʃ/ (or *ch*) and *d* becomes /dʒ/ (or *j*). This is an interesting finding that aligns with previous studies of the development of L1 English children (Henderson & Beers, 1980; Read, 1975).

Table 2b  
*Misspelling of Digraphs by Children in Grades 2-3*

Digraphs	Feature Correct (%)	Misspellings (%)
<b>sh</b> ine	78.08	sun/sunny (12.33); sai/san/saie/sam/sane (6.58)
co <b>ach</b>	67.12	kouh/holh/coldh/cdh,/coh (9.59)
<b>ch</b> ewed	71.23	cug/cud/coud/cund (9.59) treed/tryd/trd (5.48)
w <b>is</b> hes	60.27	wsas/ws/wesds/wsaz/weiseis (6.85); wrhz/wxhz/wszh (5.48)
<b>th</b> orn	5.48	saon/sone/son/sonjn/sorn/sosoht/sen/sanyin/san/sany/saone/ sonn/seen/sloor (42.47); fao/faoen/foth/faon/fon/foog/fan/foan/foin/forh/foun/ford/ fane/found/fonu/foon/fng (30.14)
<b>sh</b> outed	72.60	soutb/sotd/saoied/saotd/saofeit/sahtd/std/soutd/suo/suts (15.07)
<b>th</b> ird	31.51	sed/serd/sede/st/srot/srt/sd/seed/srerd/sot/snes/sered/srid/ sterl/seth/stas/sorasd/sride/sead/sends/sensd/sred (30.14); 3ed (2.74)

*Note.* N=73. In the Misspellings column, similar types of errors were combined, and the subsequent percentage illustrates the total percentage of spellings with that type of error.

Table 3  
*Misspelling of Blends by Children in Grade 4*

Blends	Feature Correct (%)	Misspellings (%)
<b>lump</b>	2.50	lam (25.00); larm (5.00)
<b>fl</b> oat	85.00	fol (5.00)
<b>tr</b> ain	70.00	tain (10.00); tian (5.00)
<b>pl</b> ace	97.50	--
<b>dr</b> ive	62.50	diver (7.50)
<b>br</b> ight	47.50	blight (7.50); grit (7.50)
<b>sp</b> oil	37.50	sbout (5.00); sbor (5.00)

*Note.* N=40. Only the two most frequent misspellings are reported. Misspellings only occurring once are not included in this table.

### **Long vowels, diphthongs, and r-influenced vowels**

On average, second and third graders spelled less than one long vowel and one diphthong and r-influenced vowel correctly (see Table 1). Some vowels were spelled with two or three vowels; e.g., *CHUAIS/CHUAIZ* for *tries* and *GEEM/GAIME* for *dreams*. Some words are more frequent and spelled more accurately than pattern would belie. For example, the word *hope* was spelled correctly by 8 of the 63 second and third graders. The word *dream* was not spelled correctly by any child. The chance for error is much greater for *dream* than a word like *wait*; the word *dream* is less common and is a more difficult word to spell correctly with the *dr* affricate, a vowel digraph, and a final nasal that can be confused by English learners more so than with native English speakers (Helman et al., 2012). This pattern continues with the vowel patterns in the *other vowels* category; and we see that no second or third graders spelled the following words in this category correctly: *chewed*, *crawl*, *thorn*, *shouted*, *spoil*, and *growl*. The word *third* was spelled correctly by nine children who may have learned the word through reading and instruction. Specifics for a number of the features in this category are discussed below; we have chosen to discuss the most salient features given space limitations.

### **Inflected endings**

This was a difficult feature for students to spell correctly. None of the second and third grades spelled *chewed*, *shouted*, and *camped*, correctly and only one student spelled *wishes* and *tries* correctly. Fewer than one of seven features were spelled correctly; third grade mean was .79 for spelling words with inflected endings correctly, except for the frequently occurring word *riding*, spelled correctly by 13 students, and the word *clapping* (7), a word with a fairly unambiguous vowel and syllable pattern.

### **Developmental spelling analyses**

As seen in Tables 2a and 2b, the mean score was slightly above 2 words spelled correctly. This score has been used as a power score to relate to stages of spelling development, and for these students a score of 2 indicates that a student is in the letter name–alphabetic stage of spelling. For context, this stage also corresponds roughly to a lexile level (see [lexilie.com](http://lexilie.com)) of up to 300, a beginning reader, first grade level. Consider that the first four words (*fan*, *bet*, *dig*, *rob*) were the easiest words to spell correctly, accounted for the vast majority of errors, and reflected knowledge of short vowels. The feature analyses as noted in Tables 2a and 2b also indicate a beginning knowledge of short vowels (2.22/7) compared to final consonants (5.78/7).

Qualitative analyses across features revealed similar patterns of the letter name–alphabetic stage in which students use a phonetic principle that incorporates articulatory information to spell, a strategy shared by English-L1 students. For instance, similar to English-L1 children, some of these Chinese students spelled like early letter name–alphabetic stage spellers when they deleted vowels. Examples include spelling *dig*, *bled*, and *stick* as *dg*, *bld*, and *sdk*, respectively. Participants also spelled *dr* as *gr*, which is similar to their English-L1 counterparts. To spell vowels, students in the middle of this stage may have employed the letter-name strategy with the alphabetic principle and used their knowledge of a vowel's name to spell long and short vowels (e.g., *HOP* for *hope*, *GREM* for *dream*, or *PAT* for the short vowel in *pet*) (Helman et al., 2012).

### **Grades 4–8**

The spelling inventory included several more difficult words including the last two words, *civilize* (0 correct spellings) and *opposition* (4 correct spellings). Table 3 presents the means and standard deviations of these analyses. As expected, the total words spelled correctly and feature score totals were highly correlated in a Pearson correlation ( $r = .94$ ,  $p < .001$ ). Statistical analyses confirm the findings of previous research in English as a second language that learners gain orthographic knowledge as their English language proficiency advances; in this instance, spelling achievement predicted grade level, the proxy for experience with English, with the total feature and words correct score accounting for 44 percent of the variance ( $F(1,198) = 154.79$ ,  $p < .000$ ), a large effect size (Cohen's  $d$  of .98 based on  $r$ -squared). A factor analysis of the raw scores of each feature was computed across fourth through eighth grade levels. The Kaiser-Meyer-Olkin measure of sampling adequacy indicates that the factor analysis is appropriate for these data (.91). The general sequence of features followed the predicted developmental sequence except for the consonant digraph feature. The first factor included the first eight features except for the consonant digraph category and together, they accounted for 49.9% of the variance. The second factor included for the last two features, harder suffixes and roots, accounted for 10.39% of the variance.

Table 4  
Means and Standard Deviations (Grades 4-8, n = 160)

	4 <sup>th</sup> (n = 40)		5 <sup>th</sup> (n = 40)		6 <sup>th</sup> (n = 40)		7 <sup>th</sup> (n = 40)		8 <sup>th</sup> (n = 40)		
	Ma x	M	SD	M	SD	M	SD	M	SD	M	SD
Words Correct	25	3.50	2.19	8.83	2.82	10.28	2.09	9.25	2.47	11.65	2.42
Features Correct	62	22.23	4.93	36.58	5.41	39.48	4.60	36.23	6.09	42.58	4.98
Total Score	87	25.73	6.90	45.40	7.88	49.75	6.54	45.48	8.25	54.23	7.21
Features											
Initial Consonants	2	1.88	0.36	2.00	0.00	1.98	0.16	1.75	0.44	2.00	0.00
Final Consonants	5	3.75	1.02	4.85	0.36	4.93	0.27	4.83	0.38	4.95	0.22
Short Vowels	5	2.85	0.97	3.83	0.96	4.15	0.48	3.90	0.55	4.08	0.53
Digraphs	6	4.83	1.01	5.10	0.63	5.00	0.88	5.25	0.81	5.53	0.60
Blends	7	4.05	1.17	5.40	1.13	6.25	0.71	5.38	0.90	5.68	0.80
Long Vowels	5	1.00	1.07	3.10	0.90	3.38	0.63	3.48	0.72	4.00	0.45
Diphthongs and r- influenced vowels	7	0.65	0.80	2.23	1.23	3.20	1.22	2.35	1.23	3.25	1.43
Inflected Endings	5	0.98	0.87	2.50	1.30	3.45	0.93	2.63	1.39	3.78	0.89
Syllable Junctures	5	1.28	0.72	3.60	0.78	3.63	0.81	3.18	1.08	3.60	0.71
Unaccented Final Syllables	5	0.83	0.88	2.28	0.91	2.30	0.79	2.25	1.28	2.80	0.97
Harder Suffixes	5	0.15	0.36	1.58	1.08	1.03	0.95	1.03	0.89	2.08	1.05
Bases or Roots	5	0.00	0.00	0.13	0.40	0.20	0.61	0.23	0.48	0.85	1.03

### Short vowels

Students in grades 4 through 8, spelled 3.76 of the 5 short vowel features correctly. Like so many of the second and third graders, 30 percent of the fourth graders, and 63 percent of the fifth graders spelled the *u* in *lump*, with an A. A quarter of the students in grades 4 and 5 spelled the *e* in *bed* with an A, also a common error among students in grades two and three, and students among English-L1 students in the middle letter-name stage (Bear et al., 2016). Closeness in articulation of the short vowel with the long vowel letter name may account for this error (Read, 1975).

### Consonant blends and digraphs

Blends and digraphs were spelled correctly more often than the vowels; 5.14 of 6 blends and 5.35 of 7 digraphs were spelled correctly. The majority of the students spelled at least one of the features in the blends (e.g., *m* as *mp* and *t* as *tr*). One possible reason for these errors is the absence of consonant clusters in Chinese (Chang, 2001). Again, these errors are expected of students in the letter name – alphabetic stages by English L1 learners (Bear et al., 2016).

Similar to their peers in grades 2 and 3, students in grades 4 through 8 had difficulty spelling unaspirated sounds, such as *p* in *spoil*. Expectedly, some of students spelled *sp* as *sb*. This may be related to the voicing differences in *p* and *b*; additionally, the vowel sound after the onset is voiced, which could have affected the students' interpretation of the previous consonant sound. Students in grade 4, in particular, had trouble with the blends. However, unlike students in the lower grades, these students did not often insert a vowel between

consonants. This result might suggest that as their experience with English increased, the influence of a phonetic strategy from their L1 faded. Table 4 illustrates the misspelling of blends by grade 4 students.

Additionally, the *mp* in *lump* was difficult for students in grades 4-8. Only 12% of these students spelled *lump* correctly attributable to both errors in the *u* and the preconsonantal nasal in *mp*. Again, this is likely because of the lack of final consonant clusters in Chinese. Learners often insert a reduced vowel or as we found, particularly with fourth grade students, “simplify the cluster...by dropping the last consonant” (Chang, 2001, p. 312).

### **Long vowels**

Almost three of the five long vowels were spelled correctly in fourth through eighth graders. The majority of the students found it difficult to spell *oa* in *float* and *igh* in *bright*. Most students either used a letter-name alphabetic stage misspelling (*flot*), the most common error of sixth and seventh graders (23%), or they applied their English knowledge of the CVCe pattern to produce the /o/ sound with *flote*, an error made by 14% of the fourth through eighth grade. Students also spelled *float* with other possible variants such as *ou* and *ow*. Students who spelled *float* with *ow* may have been using their knowledge of other sight words, like the /ow/, long o in *flow*, *mow*, *row*, *tow*. Using two vowels to spell the long o reflects students’ knowledge of orthographic patterns in English, a move beyond the more linear, phonetic strategies used during the letter name – alphabetic stage.

The misspelling of *igh* as in *bright* can be understood in a similar way. The most common substitution for *bright* was *brite*, just as *flote* was a common error for *float*, (12% by fourth through seventh grade) which may reflect their experimenting with orthographic patterns of long vowels. The students’ spelling errors are similar to those of English-L1 students in the early within word pattern stage (Templeton & Bear, 2018). As older students made fewer of these types of errors, these results again indicate that as students’ knowledge of English expanded, they tended to make fewer L1-influenced errors. There was an interesting jump in the correct spelling of *bright* by 8<sup>th</sup> graders (92.50%), a change from 55% in seventh grade. Perhaps this word was taught directly or learned through reading. In contrast, *float* was spelled correctly by just a few eighth graders and none in grades four and six.

### **Diphthongs, r-influenced vowels, inflected endings, and syllable junctures**

Students’ lower accuracy rates for the spelling of “other vowels” that included diphthongs and r-influenced vowels, may be related to the fact that in pinyin there are no vowel digraphs. In pinyin, all vowels sound the same in length. Across all grades, many misspellings of *other vowels* were substitutions of short vowels for ambiguous vowels, such as spelling *in* this case, the r-influenced vowel in *marched* was spelled *mucht*, an error which is also made by English-L1 students in the early within word pattern stage (Helman, 2004). Furthermore, the students in grade 4, had particular difficulty identifying the inflected ending in *marched* (hence the misspelling *much* by over 57%), a word that has a complex final consonant cluster /ɪʃt/ that is not permitted in Chinese phonology. However, as students progressed they were more accurate in their identification of sounds (*marcht*) and use of inflected endings (*marched* spelled correctly by 60% of the students in grade 4).

In the last two stages of spelling with the analysis of syllable junctures, the consonant doublet was difficult to spell across all later grade. Gradual competency spelling words with doublets increased for spelling these words correctly at 34.8% for the word *shopping*, 21.2% for *carries*, and 25.8% for *bottle*. The word *cellar* was gradually spelled more accurately each year, up to 32.50 percent by eighth grade, an unsurprising error rate for this unfamiliar word.

The final five words on the spelling inventory asked students to spell five words with less frequent suffixes, and five word roots. Less frequent suffixes (*-ent*, *-tion*) and word roots (*civ*, *fid*) were rarely spelled correctly. Nineteen students spelled *pleasure* correctly, two spelled *fortunate* correctly, and no children spelled the last word, *confident*, correctly.

### **Developmental spelling analyses**

The mean number of words spelled correctly for the fourth through eighth graders in this study was 8.70 which corresponds to the later part of the within word pattern stage of spelling development, a 420-820 extended lexile level range, and a second-grade reading level (Bear et al., 2016). There was a range from 3.5 words spelled

correctly for 4<sup>th</sup> graders to 10.275 for 8<sup>th</sup> graders. Accordingly, there were many students who did not spell the short or long vowel features correctly (3.76/5; 2.99/5, respectively). See Table 4 for mean scores by grade. There were difficulties spelling short vowels, particularly *e* and *u*, and they spelled more consonant digraphs and blends correctly than short vowels. Students in grade 4 also had more trouble with blends than their older, more experienced peers. Like the younger spellers in grades 2 and 3, the greater the error rate, the greater the number of variants they produced. The eighth graders were refining their knowledge of other vowels (e.g., *our*, *ow*) at the same time that they were learning about syllable junctures and inflected morphology. They were spanning the focus from basic vowel patterns of single syllable words to a beginning analysis of morphemes and unaccented syllables.

### Discussion

The examination of students' spelling showed them to master features in an order that reflects the three orthographic layers and the five stages of spelling. The second- and third-grade children showed greater proficiency with features associated with the alphabetic layer of English orthography (e.g., consonants, short vowels, digraphs, and blends), than with the pattern layer features (e.g., long vowel patterns), and the meaning layer (e.g., inflected endings, base and roots). These children did quite well spelling beginning and ending consonants, features of the alphabetic layer, and they did better spelling short vowels, blends, and digraphs than features associated with the pattern and meaning layers of English orthography. Native English-speaking children likely find short vowels easier to learn than these Chinese speaking EFL students as they match familiar sounds with a single letter. Chang (2001) has shown how Chinese speakers have a variety of difficulties mastering short vowels, which may be influenced by the greater number "of vowel contrasts in English than in Chinese, so English vowels are closer to each other in terms of position of articulation than Chinese vowels. This means that more effort is required to distinguish them" (p. 311). The better performance of Chinese students with digraphs over short vowels is perhaps influenced by this phenomenon and also suggests that their knowledge of consonants and consonant digraphs (e.g., *ch*, *sh*, *zh*) in pinyin may have served as a springboard to developing their orthographic knowledge of some digraphs in English.

After one or two years of instruction in English, most second and third grade students were centering on the alphabetic layer and in the letter name – alphabetic stage as evidenced in the way they spelled features associated with the alphabetic layer of English orthography (e.g., consonants, short vowels, blends, and digraphs). Overall, the results show that these Chinese students developed greater proficiency with the alphabetic layer before the orthographic pattern and meaning layers of English orthography, and while this pattern illustrates the general trend, the data also illustrate interesting differences between native English speakers and Chinese English learners in their development and proficiency of short vowels and digraphs, as illustrated above.

In the present study, the 173 fourth through eighth grade students' spelling abilities developed as their grade levels advanced. Spelling ability among students in grade 4 was less developed than that of students in later grades. Notably, students gradually progressed in their proficiency from the alphabetic stage to the pattern stage of English orthography. Students in fourth grade struggled substantially more than their older peers with spelling features related to the pattern stage (e.g., long and other vowels). Scores for spelling long vowels, diphthongs, and r-influenced more than tripled from fourth to fifth grade. This spike in development illustrates a shift from the alphabetic to pattern layer of English orthography, as students were developing their abilities to recognize and utilize long and other vowel patterns in which the same sound can be represented with different orthographic patterns (e.g., *fare*, *fair*). Furthermore, there are noticeable differences when comparing grade 4 students to grade 8 students in terms of ability to spell features associated with the meaning layer (such as suffixes and roots). However, their knowledge of both the pattern and meaning layers of English orthography is still in development. Ultimately, this illustrates how these older students also develop their knowledge of English orthography in a similar manner to native English speakers.

Analysis of the data reveals a few more interesting differences among students in different grades. While students in grade 8 outperformed students in the early grades, in most areas, students in grade 6 led students in both grades 5 and 7 on spelling three features: blends, diphthongs, and r-influenced vowels (like *ew*, *oi*, *or*), and inflected endings. This outcome might be influenced by the preparation students in grade 6 were receiving for

the entrance examination for middle school; their constant review of English may have helped their performance on the assessment.

There were occasions across all grades that students could spell some more difficult words than easy words. For instance, among second and third graders, more students spelled *riding* correctly (Grade 2: 6/41; Grade 3: 7/32) than *chewed* (Grade 2: 0/41; Grade 3: 0/32). Among students in grades 4 through 8, the word *bottle* was spelled correctly more often than an easier word, like *float* (Grade 4: 10 vs. 0; Grade 5: 30 vs. 1; Grade 6: 36 vs. 0; Grade 7: 26 vs. 0; Grade 8: 27 vs. 7). This outcome may be because these more difficult words might occur more frequently than the easy ones in their instructional context, and thus, students learn them earlier because of greater exposure. Nonetheless, taking the results from the spelling of students in grades 2 and 3 into consideration, it can be concluded that the influences of students' L1 became less of an issue as their experience with English advanced.

This study adds empirical evidence to the body of cross-linguistic literature that has found that English learners develop basic literacy skills in a similar manner to their English-L1 peers (Chiappe, Siegel, & Wade-Wooley, 2002). More specifically, the present study lends support to previous research that has suggested that learners of written English acquire their orthographic knowledge in a similar manner and vary primarily in the rate of acquisition (Invernizzi & Hayes, 2004).

While this study contributes to our understanding of how young Chinese students develop their English literacy skills, it also has its limitations. One notable limitation was that individuals were only measured once, and thus, individual patterns and development over time could not be examined. In this study, grade level was a proxy for experience and achievement. Following students over time would provide unique insights into development. Additionally, the specific vocabulary covered in the curricula is also unknown, and thus, it is unknown if the students are already familiar with the words on the spelling inventories. This information may provide a deeper understanding of why some difficult words saw greater rates of accuracy than easier words (e.g., greater accuracy spelling *riding* than *stick* or *fright* for the students in grades 2 and 3). More information about instruction may account for the achievement of the sixth-grade sample. Finally, the two results of the two spelling inventories were analyzed separately in this study, as to focus on how each age range performed on their respective spelling inventories. However, the analysis could have been conducted differently and compared the same spelling features across age groups and spelling inventories, which may have revealed patterns related to the children's spelling development and proficiency with various spelling features over a larger age range.

Future research examining how the spelling of individuals and groups develops over time would be valuable as it may indicate what patterns and phenomena are difficult to capture through examining a single spelling sample at a specific point in time. Additionally, research that compared different pedagogical practices (e.g., various combinations of vocabulary, phonics, word study, etc.) and how those practices influence spelling development would also be helpful. While examining the spelling development of Chinese students is important for what is learned about word knowledge, it would be beneficial to explore more deeply comparisons between spelling development and other components of literacy, such as word recognition, comprehension, morphological knowledge, phonological awareness, fluency, and writing. Investigating these relationships might provide unique insights into Chinese students' developmental processes in literacy and provide additional perspectives on the similarities and differences of Chinese speaking English learners and their English L1 peers. The advanced students in this study would be interesting to study as they learn beginning morphological orthographic features, something that can be learned from secondary students; see Carlisle, 2010; McBride-Chang et al., 2008.

This study suggests some important implications. At the alphabet layer, there were some specific sounds, letters, and patterns that caused difficulty for participants. Learners may benefit from specific instruction related to these difficult features. The short vowels *e* and *u* were difficult, and minimal pair exercises that help learners discriminate these vowel sounds with others may be beneficial (e.g., contrasting *pet* to *putt* or *bed* to *bad* or *mud* to *mod*). Drawing attention to the difficult short vowel sounds and juxtaposing them with other vowels may help students discriminate these sounds from others and ultimately, read and spell these sounds with greater mastery.

During the pattern layer of analysis, participants' spelling illustrated how they experimented spelling long vowel patterns (e.g., spelling *float* as FLOTE). Thus, explicit instruction on long vowel patterns may be helpful for students, particularly showing them patterns like the CVVC, CVV, CVCe patterns. Blends were particularly

difficult for younger students, which is understandable given the lack of consonant clusters in Chinese (Chang, 2001). Thus, explicit instruction in early grades that highlights pure blends vs. blends with a slight inserted vowel (e.g., *blade* - /bled/ vs. /bøled/) may draw attention to the differences in these sounds and concepts for younger students and promote mastery at a younger age. Once long vowels patterns are mastered, students are ready to examine other vowels in English. During vocabulary lessons, students will benefit from seeing the words written as part of the instruction (Rosenthal & Ehri, 2008).

Vocabulary learning expands at the meaning layer in the examination of inflected and derivational morphology (Nagy & Townsend, 2012). It has been emphasized that students' reading, including vocabulary and comprehension, will improve when accompanied by spelling instruction (Cutler et al., 2010; Foorman & Petscher, 2010; Graham & Santangelo, 2014). In an integrated and generative form of instruction, students can begin with inflected morphology and related word families in general, and domain-specific academic vocabulary (Templeton et al., 2015).

### Conclusion

The orthographic development in English of Chinese L1 students illustrates interesting similarities and differences in comparison to English L1 learners. This study aligns with previous studies as it illustrates that Chinese EFL learners develop their English skills in a similar fashion to English L1 peers (Chiappe, Siegel, & Gottardo, 2002; Helman & Bear, 2007). However, differences in acquisition were also found, which are likely related to the differences in phonology between English and Chinese and students' familiarity with pinyin. This study builds upon previous research by providing specific information and analyses of Chinese students' English orthographic development, which is particularly valuable given the efforts of the Chinese education system to promote English skills for their students as well as the increasing presence of Chinese speakers in the United States and around the world. Moving forward, when researchers and educators understand students' orthographic knowledge from developmental and cross-linguistic perspectives, they are better prepared to identify which features students have mastered, and they have a guide for a sequence of instruction that includes features that might be confusing cross-linguistically.

### Notes

- <sup>1</sup> Internal consistency was evaluated and overall reliability was established with a coefficient of .915 (Cronbach's alpha). Analyses for reliability by item discrimination and difficulty, and internal consistency provide evidence that these instruments differentiate between relatively higher and lower performing students reliably. Test-retest data for these two inventories indicate similar reliability when English learners, special education, and gifted students are included. Reliability estimates for both inventories were acceptable (Sterbinsky, 2007).
- <sup>2</sup> According to Cohen (1988), effect sizes (*d*) of .2, .5, and .8 are small, medium, and large, respectively.
- <sup>3</sup> Only significant finding.

### References

- Bahr, R. H., Silliman, E. R., & Berninger, V. (2009). What spelling errors have to tell about vocabulary learning, pp. 177–210. In C. Wood & V. Connelly (Eds.), *Contemporary perspectives on reading and spelling*. London: Routledge.
- Bear, D. R., Invernizzi, M. A., Templeton, W. S., Johnston, F. (2016). *Words Their Way: Phonics, vocabulary, and spelling instruction* (6<sup>th</sup> ed.). Boston, MA: Allyn & Bacon.
- Beeson, P. M., Rising, E., Kim, E. S., & Rapcsak, S. A. (2010). A Treatment Sequence for Phonological Alexia/Agraphia. *Journal of Speech, Language, and Hearing Research*, 53(2), 450–468. doi:10.1044/1092-4388(2009/08-0229)
- Berninger, V.W., Abbott, R.D., Nagy, W., & Carlisle, J. (2010). Growth in phonological, orthographic, and morphological awareness in grades 1 to 6. *Journal of Psycholinguistic Research*, 39(2), 141-163. doi:10.1007/s10936-009-9130-6

- Bertelson, P., Chen, H-C, & de Gelder, B. (1997). Explicit speech analysis and orthographic experience in Chinese readers. In H-C, Chen (Ed.), *Cognitive process of Chinese and related Asian languages* (pp. 27–46). Hong Kong: Chinese University Press.
- Biemiller, A. (1970). The development of the use of graphic and contextual information as children learn to read. *Reading Research Quarterly*, 6(1), 75-96.
- Blachman, B. A., Schatschneider, C., Fletcher, J. M., Murray, M. S., Munger, K. A., & Vaughn, M. G. (2013, August 12). Intensive reading remediation in Grade 2 or 3: Are there effects a decade later? *Journal of Educational Psychology*. Advance online publication. doi:10.1037/a0033663
- Caravolas, M., Hulme, C., & Snowling, M. J. (2001). The foundations of spelling ability: Evidence from a 3-year longitudinal study. *Journal of Memory and Language*, 45(4), 751-774. doi:10.1006/jmla.2000.2785
- Carlisle, J. F. (2010). Effects of instruction in morphological awareness on literacy achievement: An integrative review. *Reading Research Quarterly*, 45(4), 464-487. doi:10.1598/RRQ.45.4.5
- Chang, J. (2001). Chinese speakers. In M. Swan & B. Smith (Eds.), *Learner English* (2<sup>nd</sup> ed., pp. 310-324). Cambridge, United Kingdom: Cambridge University Press.
- Cheung, H., Chen, H.C., Lai, C.Y., Wong, O.C., & Hills, M. (2001). The development of phonological awareness: Effects of spoken language experience and orthography. *Cognition*, 81(3), 227-241. doi:10.1016/S0010-0277(01)00136-6
- Cheung, H., & Ng, L. K. H. (2003). Chinese reading development in some major Chinese societies: An introduction. In C. McBride-Chang & H-C. Chen (Eds.), *Reading development in Chinese children* (pp. 3-17). Westport, CT: Greenwood Press.
- Chiappe, P., Siegel, L.S., & Gottardo, A. (2002). Reading-related skills of kindergartners from diverse linguistic backgrounds. *Applied Psycholinguistics*, 23(1), 95–116. doi:10.1017/S014271640200005X
- Chiappe, P., Siegel, L., & Wade-Wooley, L. (2002). Linguistic diversity and the development of reading skills: A longitudinal study. *Scientific Studies of Reading*, 6(4), 369–400. doi:10.1207/S1532799XSSR0604\_04
- Chow, B. W-Y., McBride-Chang, C., & Burgess, S. (2005). Phonological Processing Skills and Early Reading Abilities in Hong Kong Chinese Kindergartners Learning to Read English as a Second Language. *Journal of Educational Psychology*, 97(1), 81-87. doi:10.1037/0022-0663.97.1.81
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Cook, V. J. (1997). L2 users and English spelling. *Journal of Multilingual and Multicultural Development*, 18(6), 474–488. doi:10.1080/01434639708666335
- Cronnell, B. (1985). Language influences in the English writing of third- and sixth-grade Mexican-American students. *Journal of Educational Research*, 78(3), 168–173.
- Cutler, A., Treiman, R., & van Ooijen, B. (2010). Strategic deployment of orthographic knowledge in phoneme detection. *Language and Speech*, 53(3), 307-320. doi:10.1177/0023830910371445
- Duanmu, S., 2006. Chinese (Mandarin): Phonology. In K. Brown (Ed.), *Encyclopedia of Language and Linguistics*, (2<sup>nd</sup> ed., pp. 351-355). Oxford, UK: Elsevier Publishing House
- Ehri, L. C. (2006). Alphabetic instruction helps children learn to read. In R. M. Joshi & P. G. Aaron (Eds.), *Handbook of orthography and literacy* (pp. 649–678). Mahwah, NJ: Lawrence Erlbaum.
- Ehri, L. C. (1997). Learning to read and learning to spell are one and the same, almost. In C. A. Perfetti, L. Rieben, & M. Fayol (Eds.) *Learning to spell: Research, theory, and practice across languages* (pp. 237–269). Mahwah, NJ: Erlbaum: Lawrence Erlbaum Associates.
- Ehri, L. C. (2014). Orthographic mapping in the acquisition of sight word reading, spelling memory, and vocabulary learning. *Scientific Studies of Reading*, 18(1), 5–21.
- Ehri, L., & Roberts, T. (2006). The roots of learning to read and write: Acquisition of letters and phonemic awareness In D. K. Dickinson & S. B. Neuman (Eds.), *Handbook of Early Literacy Research* (Vol. 2, pp. 113-131). New York, NY: Guilford Press.
- Ellis, N. (1997). Interactions in the development of reading and spelling: Stages, strategies, and exchange of knowledge. In C.A. Perfetti, L. Rieben & M. Fayol (Eds.), *Learning to spell: Research, theory, and practice across languages* (pp. 271 – 294). Mahwah, NJ: Lawrence Erlbaum Associates.



- Ellis, N., & Cataldo, S. (1990). The role of spelling in learning to read. *Language and Education*, 4(1), 1-28. doi:10.1080/09500789009541270
- Fashola, O. S., Drum, P. A., Mayer, R. E., & Kang, S. J. (1996). A cognitive theory of orthographic transition: Predictable errors in how Spanish-speaking children spell English words, *American Educational Research Journal*, 33(4), 825–843. doi:10.3102/00028312033004825
- Ferrolli, L., & Shanahan, T. (1993). Voicing in Spanish to English spelling knowledge transfer. *National Reading Conference Yearbook*, 42, 413–418. is <http://eric.ed.gov/?id=ED358739>
- Finegan, E. (2008). *Language: Its structure and use* (5<sup>th</sup> ed.). Boston, MA: Thomson Wadsworth.
- Foorman, B.R., & Petscher, Y. (2010). Development of spelling and differential relations to text reading in grades 3–12. *Assessment for Effective Intervention* 36(1), 7-20. doi:10.1177/1534508410379844
- Ford, K. L., Invernizzi, M. A., Huang, F. (2014). Predicting first grade reading achievement for Spanish-speaking Kindergartners: is early literacy screening in English valid? *Literacy Research and Instruction*, 53(4), 269–286. doi:10.1080/19388071.2014.931494
- Gehsmann, K., & Templeton, S. (2011/2012). Of stages and standards in literacy: Teaching developmentally in the age of accountability. *Journal of Education*, 192(1), 5–16.
- Graham, S., Harris, K.R., & Chorzempa, B.F. (2002). Contribution of spelling instruction to the spelling, writing, and reading of poor spellers. *Journal of Educational Psychology*, 94(4), 669-686. doi:10.1037/0022-0663.94.4.669
- Graham, S., & Santangelo, T. (2014). Does spelling instruction make students better spellers, readers, and writers? A meta-analytic review. *Reading and Writing*, 27, 1703–1743. doi: 10.1007/s11145-014-9517-0
- Hamada, M., & Koda, K. (2008). Influence of first language orthographic experience on second language decoding and word learning. *Language Learning*, 58(1), 1–31. doi:10.1111/j.1467-9922.2007.00433.x
- He, T-H., & Wang, W-L. (2009). Invented spelling of EFL young beginning writers and its relation with phonological awareness and grapheme-phoneme principles. *Journal of Second Language Writing*, 18(1), 44–56. doi:10.1016/j.jslw.2008.06.001
- Helman, L. (2004). Building on the sound system of Spanish: Insights from the alphabetic spellings of English language learners. *Reading Teacher*, 57, 452–460.
- Helman, L. (2005). Using literacy assessment results to improve teaching for English language learners. *The Reading Teacher*, 58(7), 668-677. Newark, DE: International Reading Association.
- Helman, L. A., & Bear, D. R. (2007). Does an established model of orthographic development hold true for English learners? In D. W. Rowe, R. Jimenez, D. L. Compton, D. K. Dickinson, Y. Kim, K. M. Leander, & V. J. Risko (Eds.), *56th Yearbook of the National Reading Conference* (pp. 266–280).
- Helman, L. A., Bear, D. R., Templeton, S., Invernizzi, M. A., & Johnston, F. (2012). *Words their way with English learners: Word Study for Phonics, Vocabulary, and Spelling Instruction* (2<sup>nd</sup> ed). Boston, MA: Allyn & Bacon.
- Helman, L. A., Delbridge, A., Parker, D., Arnal, M., & Jara Mödinger, L. (2015). Measuring Spanish orthographic development in private, public, and subsidised schools in Chile. *Assessment in Education: Principles, Policy & Practice*, 1-26. <http://dx.doi.org/10.1080/0969594X.2015.1038217>[dx.doi.org]
- Henderson, E.H. (1974). Correct spelling—An inquiry. *The Reading Teacher*, 28(2), 176–179.
- Henderson, E. H. (1981). *Learning to read and spell: The child's knowledge of words*. DeKalb, IL: Northern Illinois Press.
- Henderson, E.H. (1990). *Teaching spelling* (2<sup>nd</sup> ed.). Boston: Houghton Mifflin.
- Henderson, E. H. (1992). The interface of lexical competence and knowledge of written words. In S. Templeton & D. Bear (Eds.), *Development of orthographic knowledge and the foundations of literacy: A memorial Festschrift for Edmund H. Henderson*. (pp. 1-30). Hillsdale, NJ: Lawrence Erlbaum.
- Henderson, E. H., & Beers, J. (Eds.) (1980). *Developmental and cognitive aspects of learning to spell: A reflection of word knowledge*. Newark, DE: International Reading Association
- Henderson, E. H. & Beers, J. W. (1980). *Developmental and cognitive aspects of learning to spell*, (Eds.). Newark, DE: International Reading Association.
- Henderson, E.H., & Templeton, S. (1986). The development of spelling ability through alphabetic, pattern, and meaning. *Elementary School Journal*, 86(3), 304–316.

- Hoeffel, E., Rastogi, S., Ouk Kim, M., & Shahid, H. The United States Census Bureau, (2012). *The Asian population: 2010-2010 census briefs*. Retrieved from website: <https://www.census.gov/prod/cen2010/briefs/c2010br-11.pdf>
- Institute of International Education. (2010, November 15). *Open doors 2010 fast facts*. Retrieved from <http://www.iie.org/Research-and-Publications/Open-Doors/Data/~//media/Files/Corporate/Open-Doors/Fast-Facts/Fast Facts 2010.ashx>
- Institute of International Education. (2013, November 11). *Open doors 2013 fast facts*. Retrieved from <http://www.iie.org/~//media/Files/Corporate/Open-Doors/Fast-Facts/Fast-Facts-2013.ashx>
- Invernizzi, M., Abouzeid, M., & Gill, J. T. (1994). Using students' invented spellings as a guide for spelling instruction that emphasizes word study. *The Elementary School Journal*, 95(2), 155-167.
- Invernizzi, M., & Hayes, L. (2004). Developmental-spelling research: A systematic imperative. *Reading Research Quarterly*, 39(2), 216-228. doi:10.1598/RRQ.39.2.4
- Lee, S. H., & Scanlon, D. M. (2015). The effects of the Interactive Strategies Approach on at-risk Kindergarten spellers. *Reading and Writing*, 28, 313-346. doi:10.1007/s11145-014-9526-z
- Leong, C. K., Hau, K.T., Cheng, P.W., & Tan, L.H. (2005). Exploring two-wave reciprocal structural relations among orthographic knowledge, phonological sensitivity, and reading and spelling of English words by Chinese students. *Journal of Educational Psychology*, 97(4), 591-600. doi:10.1037/0022-0663.97.4.591
- Leong, C. K., Tan, L. H., Cheng, P. W., & Hau, K. T. (2005). Learning to read and spell English words by Chinese students. *Scientific Studies of Reading*, 9(1), 63-84. doi:10.1207/s1532799xssr0901\_5
- Li, H., & Rao, N. (2000). Parental influences on Chinese literacy development: A comparison of preschoolers in Beijing, Hong Kong, and Singapore. *International Journal of Behavioral Development*, 24(1), 82-90. doi:10.1080/016502500383502
- Lin, D., McBride-Chang, C., Shu, H., Zhang, Y., Li, H., Zhang, J., Aram, D., & Levin, I. (2010). Small Wins Big: Analytic Pinyin Skills Promote Chinese Word Reading. *Psychological Science*, 21(8), 1117-1122. doi:10.1177/0956797610375447
- Liow, S.J.R., & Lau, L.H.S. (2006). The development of bilingual children's spelling in English. *Journal of Educational Psychology*, 98(4), 868-878. doi:10.1037/0022-0663.98.4.868
- McBride-Chang, C., Liu, P.D., Wong, T., Wong, A., & Shu, H., (2012). Specific reading difficulties in Chinese, English, or both: Longitudinal markers of phonological awareness, morphological awareness, and RAN in Hong Kong Chinese children, *Journal of Learning Disabilities*, 45(6) 503-514. doi:10.1177/0022219411400748
- McBride-Chang, C., Tardif, T., Cho, J.R., Shu, H., Fletcher, P., Stokes, S.F., & Leung, K. (2008). What's in a word? Morphological awareness and vocabulary knowledge in three languages. *Applied Psycholinguistics*, 29(3), 437-462. doi:10.1017/S014271640808020X
- McDowell, H.J., & Lorch, M.P. (2008). Phonemic awareness in Chinese L1 readers of English: Not simply an effect of orthography. *TESOL Quarterly*, 42(3), 495-513. doi:10.1002/j.1545-7249.2008.tb00143.x
- Mehta, P., Foorman, B.R., Branum-Martin, L., & Taylor, W.P. (2005). Literacy as a unidimensional multilevel construct: Validation, sources of influence, and implications in a longitudinal study in grades 1 to 4. *Scientific Studies of Reading*, 9(2), 85-116. doi:10.1207/s1532799xssr0902\_1
- Morris, L. (2001). Going through a bad spell: What the spelling errors of young ESL learners reveal about their grammatical knowledge. *Canadian Modern Language Review*, 58(2), 273-286. doi:10.3138/cmlr.58.2.273
- Nagy, W., & Townsend, D. (2012). Words as tools: Learning academic vocabulary as language acquisition. *Reading Research Quarterly*, 47(1), 91-108.
- Nassaji, H. (2007). The development of spelling and orthographic knowledge in English as an L2: A longitudinal case study. *Canadian Journal of Applied Linguistics*, 10(1), 77-98.
- Perfetti, C.A. (1997). The psycholinguistics of spelling and reading. In C. A. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell: Research, theory, and practice across languages* (pp. 21-38). Mahwah, NJ: Lawrence Erlbaum Associates.
- Perfetti, C.A. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, 11(4), 357-383. doi:10.1080/10888430701530730

- Rapp, B. & Lipka, K. (2010). The literate brain: The relationship between spelling and reading. *Journal of Cognitive Neuroscience* 23(5), 1180–1197. doi:10.1162/jocn.2010.21507
- Rau, D.V., Chang, H-H. A., & Tarone, E.E. (2009). Think or sink: Chinese learners' acquisition of the English voiceless interdental fricative. *Language Learning*, 59(3), 581–621. doi:10.1111/j.1467-9922.2009.00518.x
- Read, C. (1971). Pre-school children's knowledge of English phonology. *Harvard Educational Review*, 41(1), 1–34.
- Read, C. (1975). *Children's categorizations of speech sounds in English* (Research Report No. 17). Urbana, IL: National Council of Teachers of English.
- Read, C. (1986). *Children's creative spelling*. Boston, MA: Routledge.
- Rosenthal, J., & Ehri, L. (2008). The mnemonic value of orthography for vocabulary learning. *Journal of Educational Psychology*, 100(1), 175-191. doi:10.1037/0022-0663.100.1.175
- Share, D. (1995). Phonological recoding and self-teaching: sine qua non of reading acquisition. *Cognition*, 55(2), 151–218. doi:10.1016/0010-0277(94)00645-2
- Shen, H., & Bear, D. R. (2000). The development of orthographic skills in Chinese children. *Reading and Writing: An Interdisciplinary Journal*, 13, 197–236.
- Stanovich, K.E. (2000). *Progress in Understanding Reading: Scientific Foundations and New Frontiers*. New York, NY: Guilford.
- Sterbinsky, A. (2007). Words Their Way Spelling Inventories: Reliability and validity analyses. Memphis, TN: Center for Research in Educational Policy, University of Memphis. Retrieved from [http://rti.pearsoned.com/docs/RTIsite/Reliability\\_and\\_Validation\\_Study\\_Report.pdf](http://rti.pearsoned.com/docs/RTIsite/Reliability_and_Validation_Study_Report.pdf)
- Taft, M. (2003). Morphological representation as a correlation between form and meaning. In G. H. Assink & D. Sandra (Eds.), *Reading complex words: Cross language studies* (pp. 113-137). New York: Kluwer Academic.
- Templeton, S. (2003). Spelling. In J. Flood, D. Lapp, J. R. Squire, & J. M. Jensen (Eds.), *Handbook of research on teaching and the English language arts* (2<sup>nd</sup> ed., pp. 738-751). Mahwah, NJ: Lawrence Erlbaum Associates.
- Templeton, S., & Bear, D. (Eds.). (1992). *Development of orthographic knowledge and the foundations of literacy: A memorial Festschrift for Edmund H. Henderson*. Hillsdale, NJ: Lawrence Erlbaum.
- Templeton, S., & Bear, D. (2018). Word study research. In Lapp, D. and Fisher, D. (Eds.), *Handbook of Research in the Teaching of English* (4<sup>th</sup> ed., pp. 207-232). NY: Routledge.
- Templeton, S., & Morris, D. (2000). Spelling. In M. Kamil, P. Mosenthal, P.D. Pearson, & R. Barr (Eds.), *Handbook of Reading Research: Vol. 3* (pp. 525-543). Mahwah, NJ: Lawrence Erlbaum Associates.
- Thompson, I. (2001). Japanese speakers. In M. Swan & B. Smith (Eds.), *Learner English* (2<sup>nd</sup> ed., pp. 296-309). Cambridge, United Kingdom: Cambridge University Press.
- Treiman, R., & Cassar, M. (1997). Spelling acquisition in English. In C.A. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell: Research theory, and practice across languages* (pp. 61–80). Mahwah, NJ: Lawrence Erlbaum Associates.
- Walter, C. (2001). French speakers. In M. Swan & B. Smith (Eds.), *Learner English* (2<sup>nd</sup> ed., pp. 52-72). Cambridge, United Kingdom: Cambridge University Press.
- Wang, M. & Geva, E. (2003a). Spelling acquisition of novel English phonemes in Chinese children. *Reading and Writing: An interdisciplinary Journal*, 16(4), 325–348. doi:10.1023/A:1023661927929
- Wang, M. & Geva, E. (2003b). Spelling performance of Chinese children using English as a second language: Lexical and visual-orthographic processes. *Applied Psycholinguistics*, 24(1), 1–25. doi:10.1017/S0142716403000018
- Wang, M., Koda, K., & Perfetti, C.A. (2003). Alphabetic and nonalphabetic L1 effects in English word identification: A comparison of Korean and Chinese English L2 learners. *Cognition*, 87(2), 129–149. doi:10.1016/s0010-0277(02)00232-9
- Wang, M., Perfetti, C.A., & Liu, Y. (2005). Chinese-English biliteracy acquisition: Cross-language and writing system transfer. *Cognition*, 97(1), 67–88. doi:10.1016/j.cognition.2004.10.001
- Wolf, M. (2007). *Proust and the squid: the story and science of the reading brain*. New York, New York: Harper.

- Wu, C-Y., Ho, M-H. R., Chen, & S-H. A. (2012). Congruent with alphabetic language networks, but subnetworks that are language specific: A meta-analysis of fMRI studies on Chinese orthographic, phonological, and semantic processing. *NeuroImage* 63(1), 381-391. doi:10.1016/j.neuroimage.2012.06.047
- Yeong, S. H. M., Fletcher, J., Bayliss, D. M. (2014). Importance of phonological and orthographic skills for English reading and spelling: A comparison of English monolingual and Mandarin–English bilingual children. *Journal of Educational Psychology*, 106(4), 1107–1121. doi.org/10.1037/a0036927
- Yeung, P., Ho, C.S., Chan, D.S., & Chung, K.K. (2013). Modeling the relationships between cognitive-linguistic skills and writing in Chinese among elementary grades students. *Reading and Writing*, 26(7), 1195-1221. doi:10.1007/s11145-012-9411-6.

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