

REVISITING A LONG-LASTING LEGACY: INFLUENCES OF MANDARIN CHINESE CHARACTERS ON ENGLISH READING DEVELOPMENT

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Abstract

This review of literature will address the influences of knowledge of Chinese characters on the reading development of English. This question arises because an increasing number of children of Chinese heritage are enrolling in school in the U.S. and wish to gain biliteracy in English and Chinese. On the one hand, bilingualism is acknowledged to be beneficial to young readers' language and cognitive development. On the other hand, the logographic nature of Mandarin Chinese makes it difficult for many educators in the country, who only know alphabetic languages like English and Spanish, to understand how Chinese-English bilingual readers reconcile two different systems and envision what support they may need.

This review will primarily focus on the basics of Mandarin Chinese and developmental models of the two languages to examine how proficiency in Chinese can transfer to and facilitate the reading development of English. Departing from the comparison and contrast between linguistic features and developmental models of the two languages, this review will investigate contributions of Chinese characters to English word reading at the levels of cognition, morphology, and phonology. While Chinese characters as logograms demand predominantly more morphological knowledge than phonological awareness from readers, it is phonological awareness that contributes most to reading English words among beginning readers in kindergarten and first grade.

Introduction: Why Does Mandarin Chinese Matter?

Chinese, a language that has been living for over 3,000 years, is one of the oldest languages in the world. Its ancient writing system has been well preserved and evolved into the modern one of Mandarin Chinese, in which there are still traces that resemble the logosyllabic features of Sumerian, the earliest written system using cuneiform scripts (Wolf, 2007). Given the longevity of the language and its significance in research on ancient languages both in the East and the West, it may not be surprising that people of Chinese heritage work hard to gain proficiency in their heritage language wherever they are on the planet (Liu, Li, & Teng, 2008).

Chinese people's determination to preserve their native language while striving for a successful life in the U.S. can be traced back to the 1970s (Crawford, 1989). Following the Bilingual Education Act of 1968, the 1974 Supreme Court case *Lau v. Nichols* marked a turning point in education access. In the case, 1,800 Chinese students declared that the San Francisco Unified School District failed to provide necessary instruction to students with limited knowledge of English and thus was in violation of Title VI of the Civil Rights Act of 1964 (*Lau v. Nichols*, 1974). Teitelbaum and Hiller (1977) argue that the *Lau* decision not only "raised the nation's consciousness of the need for bilingual education," but also "legitimized and gave impetuous movements for equal educational opportunity for students who do not speak English" (p. 139).

At present, Chinese—including Mandarin, Cantonese, and six other dialects—has become the second most spoken foreign language at home in the United States with a population of 2,896,766 (U.S. Census Bureau, 2015). Moreover, nearly half of the population speaking Chinese at home claimed they were able to speak English "very well" (U.S. Census Bureau, 2018). Although no available data can show how many of the Chinese-speaking population are school-aged, Chinese-English bilingual children—whether they are Chinese-born immigrants or American-born Chinese—are entering K-12 classrooms nationwide with the need to develop biliteracy in both languages.

While there are still prevailing concerns that children learning their native languages would use English less frequently, inevitably leading to their limited development of English literacy, research on linguistic analysis of languages and cognitive development along with reading instructions has shown the opposite (Ovando, 2003). In this literature review, I will focus on the basic unit of the two languages—Chinese characters and English words—and address how knowledge of Mandarin Chinese characters might aid the English reading development of kindergarten and first grade bilingual children in the United States. I will first explain the basics of Mandarin Chinese characters and English words. Then, I will discuss how similarities and differences in the morphological formation, phonological cueing systems, and orthographic processing may lead to divergent developmental approaches to reading Chinese characters and English words. Next, I will analyze how knowledge of Mandarin Chinese characters might influence children's ability in recognizing and learning English words from the cognitive, morphological, and phonological perspectives at those phases of reading development. Finally, I will address implications for instruction and further research needed for a deeper understanding of biliteracy development in Chinese and English.

The Basics of Mandarin Chinese

As Barac and Bialystok (2012) argue, the similarities and distance between two languages are crucial to investigations of bilingual children's verbal performance. To understand how biliteracy may contribute to reading English words, an understanding of the basics of Mandarin Chinese is a necessity.

Morphological Structures of Chinese

Mandarin Chinese is a logographic language: different from an alphabetic language like English in which each word consists of one or several letters, the basic unit of the Chinese morphology is strokes, the smallest unit of a Chinese character. A stroke is a dot or line that is created in one single, continuous movement of a writing hand (based on McBride, 2016). For instance, the letter “f” in English contains two strokes, a short horizontal line “-” and a curvy vertical line “f”. There are 5 basic strokes and 29 subordinate strokes in Mandarin Chinese (Fu et al., 2001; Fu et al., 1999). A radical, which can be one single stroke or contain more strokes, is a conceptual counterpart of a syllable in an alphabetic language—each Chinese character consists of one radical or more, similar to the way there is one syllable or more in an English word. Figure 1 shows a comparison and contrast between the morphological formation of Chinese characters and English words.

Figure 1: Comparison of the Morphological Formation of Chinese Characters and English Words

Numbers of radical(s) / syllable(s)	One	
Character / Word	木	wood
Stroke(s)	一, , 丿, 丶	
Letter(s)		w, o, o, d
Radical(s) / Syllable(s)	木	wood
Pronunciation	mù	wood
Definition	wood	the hard fibrous material that forms the main substance of the trunk or branches of a tree or shrub
Examples of Words	积木: building block 木板: wood panel 木已成舟: the wood is already made into a boat; what is done cannot be undone	

Figure 1 (cont.)

Numbers of radical(s) / syllable(s)	Two	
Character / Word	奇	wonder
Stroke(s)	一, 丿, 丶, 一, 丨, ㇀, 一, 丨	
Letter(s)		w, o, n, d, e, r
Radical(s) / Syllable(s)	大, 可	won·der
Pronunciation	qí / jī	'wən-dər
Definition	wonder	a feeling of surprise mingled with admiration, caused by something beautiful, unexpected, unfamiliar, or inexplicable
Examples of Words	奇 (qí) 迹: miracle 奇 (qí) 怪: strange 奇 (jī) 数: odd numbers	

Numbers of radical(s) / syllable(s)	Three	
Character / Word	椅	wonderland
Stroke(s)	一, 丨, 丿, 丶, 一, 丿, 丶, 一, 丨, ㇀, 一, 丨	
Letter(s)		w, o, n, d, e, r, l, a, n, d
Radical(s) / Syllable(s)	木, 大, 可	won·der·land
Pronunciation	yǐ	'wəndərˌland
Definition	wonder	a land or place full of wonderful things
Examples of Words	奇迹 (miracle) 奇怪 (strange) 扶手椅 (armchair)	

In addition to a comparison between the morphological formation of Chinese characters and English words, Figure 1 also reveals one major structure of Chinese characters: compounds. The three-radical character “椅” is a combination of the character “木” on the left and the character “奇” on the right. The radical “木” (wood) on the left is called a semantic radical, as the character “椅” (chair) can be a wooden one; the compound radical “奇” (qí / jī) is a phonetic radical, as the consonant “i” of the character is the same with the consonant of “椅” (yǐ). “椅” is therefore a semantic-phonetic compound character. Shu et al. (2003) analyzed 2,570 characters that were required to be explicitly taught in elementary schools, which means first to sixth grade in most regions of China, and found that 72% of those characters are semantic-phonetic compounds.

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The Orthography of Chinese

There is an overlap between morphology and orthography when it comes to Chinese characters. At the level of characters, morphology (the forms of characters) and orthography (the conventional spelling system) can be perceived as one in the same thing. A morphologically meaningful unit of a character is also an orthographic unit, which, in most cases, is a radical. Researchers have been using these two terms interchangeably. For instance, Wang et al. (2006) indicate that “morphemes represent both meanings and pronunciations” when discussing the significance of morphological awareness of Chinese readers (p. 544). Cheung et al. (2007) claim that orthographic units can function as “either a meaning or pronunciation cue” (p. 473). Both groups of researchers were analyzing Chinese characters at the level of radicals, though different terms were employed.

The key reason that morphological units can also be recognized as orthographic units is that one single Chinese character can also form a word. However, while orthography, the spelling system, functions the same at the character and the word levels, morphology becomes more complex when it comes to words of two characters or more. For example, the character “师” (shī), used in many multi-character words that describe vocations, such as “教师” (teacher), “工程师” (engineer), “医师” (doctor), is defined as a person skilled in a certain profession. In fact, the morphological structure of “教师” is cognate with that of the English word “teacher.” Both the Chinese and English words contain two morphemes: “教” (jiào) means “teach-” and “师” (shī) is a counterpart of “-er.” That is to say, “师” can be morphologically analyzed both as a single character and as part of a multi-character word.

To clarify, as this review of literature will focus exclusively on Chinese characters, I use the term morphology/morphological to refer to the visual form and structure of a character; the term orthography/orthographic then refers to the processing that takes place in reading when readers activate the phonological and/or morphological cues to recognize and comprehend characters.

The Phonology of Mandarin Chinese

The three components of the sound of a Mandarin Chinese character are initials, finals, and tones. All characters in Chinese are monosyllabic. In Mandarin Chinese, there are 23 initials (the conceptual counterpart of consonants) and 39 finals (the conceptual counterpart of vowels). While the sound of a character can begin with an initial or a final, it has to end with a final. No characters ending with a consonant, such as “hat” or “wood,” exist officially in Chinese. Moreover, Mandarin Chinese has five tones: each character is read in a specific tone that denotes the pitch of its sound. Besides, the character “奇” (qí / jī) in Figure 1 demonstrates that a character can have more than one sound: unlike the shift of stress among syllables in English words that are read in more than one way, the initial, final, and tone of a Chinese character may be completely or partially different in the multiple pronunciations of a Chinese character. Furthermore, homophones are common in Chinese, whereas each syllable is estimated to have five homophones (Packard, 2000).

One of the most significant differences between an alphabetic and a logographic language is the extent to which the phonology relates to the morphology of the language. As shown in Figure 1, while a letter in English represents a sound, a stroke in Chinese is nothing but a morphological shape constituting part of a character. The connections between forms and sounds in Chinese are largely arbitrary. Even in the cases of semantic-phonetic compound characters, a phonetic radical in a character can at most give partial clues about its pronunciation. A study of

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the phonetic regularity, which is defined as “contribution of a phonetic [radical] to the pronunciation of a semantic-phonetic compound character,” shows that only 39% of the semantic-phonetic compound characters explicitly taught in elementary schools have either exactly the same sound and tone as the phonetic radical or the same sound in a different tone (Shu et al., 2003, p. 34). That is to say, over 80% of the semantic-phonetic compound characters share only one or two features of the three—initials, finals, and tones—with their phonetic radicals. With such a low phonetic frequency, it is difficult to predict the sound of a character by only looking at its phonetic radical (McBride, 2016).

Developmental Models of Reading in Chinese and English

Children are exposed to the oral form of their mother language—English, Chinese, or both—long before they start learning the visual/written symbols. The morphological and phonological features of Chinese and English result in different models of literacy development and therefore different instructional goals of the two languages.

Models of Reading Development in English

A rich body of studies has investigated the issue of how humans learn to read English. While researchers give different names to cueing systems in their models, reading words in an alphabetic language like English generally involves understandings of sounds, letters, words, and sound-form correspondences.

Ehri (1994) maps out four phases of development in learning to read English words. In the first, logographic phase of word recognition, readers rely heavily on visual cues—the exact shape of letters—to recognize a word’s meaning and pronunciation. Letters in a word are not viewed as phonological cues; instead, they are processed holistically as a picture. At this phase, recognizing or reading a word is a process of readers pulling up their memory of the word as a visual cue.

For an alphabetic language like English and Spanish, one major instructional goal is to help children establish the connection between sounds and words. Emergent readers start from building up links between a sound and a word. The second phase of reading words is novice alphabetic (Ehri, 1994). At this phase, readers start to gain knowledge of letter sounds and names as phonetic cues and are able to draw partial connections between sounds and letters. While beginning and ending sounds/letters are salient features that readers can grasp, the middle sounds/letters are more likely to be ignored.

The third phase is mature alphabetic, in which readers establish a thorough knowledge of letter-sound correspondence and can use phonetic cues as “a means of reading unfamiliar words accurately” (Ehri, 1994, p. 11). Phonics instruction at this phase focuses on the development of phonological awareness, including knowledge of rhymes and abilities to isolate, identify, categorize, blend, add, delete, substitute, and segment phonemes (McKenna & Stahl, 2015; Ehri & Nunes, 2002; Pinnell & Fountas, 2011).

The fourth phase of reading words is the orthographic at which readers consolidate their phonemic knowledge and become able to orthographically process multiple letters in a word at the level of “morphemes, syllables, or subsyllabic units” (Ehri, 1994, p. 19). Readers gain a growing knowledge of spelling patterns.

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Models of Literacy Development in Mandarin Chinese

Similar to the development of reading English words, the ability to read Mandarin Chinese characters also involves three significant aspects: morphology, phonology, and orthography. However, because of the logographic nature of Mandarin Chinese, Chinese readers experience different models of development when learning to read Chinese characters and words.

At the kindergarten level, Chinese readers perceive the visual form and the pronunciation of a character as a joint, single construct. In a study of more than 500 children across grade levels in Hong Kong, Tong and McBride-Chang (2010) concluded a bifactor model that involves metalinguistic and orthographic processing can best describe how beginning readers read. The fact that all Chinese characters are monosyllabic further facilitates beginning readers' perception that the sound and meaning of a character are linked integrally without even realizing the arbitrariness of the sound-form-meaning connection. The mode of reading characters requires readers to activate knowledge of vocabulary, phonological awareness, and visual discrimination skills, all of which are predictive factors of their initial levels (Hulme et al., 2019). The orthographic processing of beginning readers involves more whole-character recognition without an understanding of morphemes and phonemes. Characters that readers learn to read at this phase are the simple characters usually consisting of only one radical that cannot be further segmented into meaningful morphemes. Those characters are more likely to be simple pictographs and ideographs, which make up 26% of the characters explicitly taught in first grade and 7% of the characters required in second grade (Shu et al., 2003).

Readers gain knowledge of structures and rules of character formation as they get exposed to more characters at school. While kindergarteners read characters as wholes, second graders can analyze characters at various levels. Morphologically, Chinese characters can be perceived at four different levels: first, characters, such as simple pictographs and ideographs, can be read as wholes; second, semantic and phonetic radicals can be identified in characters; third, combinations of several strokes, also called subcomponents, that form part of radicals and convey neither semantic nor phonetic meanings can be separate from characters; and fourth, characters, especially those that contain only one radical, can be read at the level of strokes (Anderson et al., 2013). Second graders are more likely to adopt a four-factor reading model that involves phonological awareness, morphological awareness, orthographic processing, and sub-character processing (Tong & McBride-Chang, 2010).

It is worth noting that the developmental model of reading Chinese is more about how children gain morphological knowledge to recognize characters, whereas in English, it focuses on how people's increasing knowledge of phonology and orthography helps them read. However, it does not indicate that phonological awareness is unimportant to the development of reading Chinese. In fact, all children attending schools in Mainland China receive explicit instruction on Pinyin, a system using alphabets to denote character pronunciation. As a significant component of one's phonological awareness, knowledge of Pinyin thus influences the person's word reading ability (Hulme et al., 2019). Children who have not been taught Pinyin may have great trouble blending, segmenting, or substituting phonemes, because they cannot distinguish the initial from the final in one syllable and do not know how to name those phonemes.

Importantly, Pinyin is not a conceptual counterpart of phonological awareness in English. One major difference between the two is that, in English, phonological awareness helps explain rules of grapheme-phoneme connections, whereas Pinyin cannot help readers decode Chinese

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characters. Moreover, while children's phonological awareness develops gradually over years, Pinyin instruction typically takes a handful of weeks.

To sum up, Figure 2 shows a comparison between the developmental phases of the word/character reading development of English and Mandarin Chinese in relation to school instruction in kindergarten and first grade.

Figure 2: Comparison of Developmental Phases of Character/Word Reading of English and Chinese in Kindergarten and First Grade

	Kindergarten		First Grade	
	English	Chinese	English	Chinese
Phonological Awareness	– word boundaries – rhymes – syllables recognition – onsets and rimes of single-syllable words – phoneme manipulation		– long vs. short vowels – syllable blending – phoneme manipulation	Pinyin instruction that includes: – initials – finals – tones
Morphological Awareness	– many upper- and lower-case letters – inflectional endings of regular noun plurals	– one-radical characters	– all upper- and lower-case letters – words with inflectional endings	– characters containing multiple characters – compound awareness – phonetic and semantic radicals – recognition of 1600 characters by the end of 2nd grade
Orthographic Processing	– one-to-one letter sound correspondence – spelling of five vowels in the long and short sounds – CVC pattern	– arbitrary sound-character connections	– letter-sound correspondence for consonant digraphs – one-syllable words decoding – knowledge of final “-e” – word patterns: VC, CVC, CVCe, VCC.	– arbitrary sound-character connections – sub-character processing – writing 800 characters by the end of 2nd grade

Figure 1 based on NGACBP & CCSSO, 2010; Pinnell & Fountas, 2011; Ehri, 1994; MOEPRC, 2010; Tong & McBride-Chang, 2010; Anderson et al., 2013; Hulme et al., 2019).

Influences of Chinese Characters on English Word Reading

Apart from the differences between the two languages, there are similarities in how the brain functions when reading alphabetic and logographic languages, indicating the possibility of bilingual readers using their knowledge of L1 to support their development of reading in L2 at the cognitive level. Results of a fMRI study have demonstrated that a common brain network, including “the inferior frontal, the middle, and inferior temporal gyri, the inferior and superior parietal lobules, and the extra striate areas,” is activated when people read both alphabetic and logographic scripts (Chen et al., 2002, p. 1088). That is to say, the same regions of the brain will function when people read alphabetic and non-alphabetic scripts, though some regions are more associated with one type of language. The difference lies in the extent to which a particular region is active, rather than the region being engaged when people read alphabetic scripts and remaining inactive when people read logographic scripts.

Studies of eye movements have demonstrated results consistent with what fMRI research revealed. After examining eye fixations and saccades—the rapid movements of eyes between fixation points—of participants when they read English, Chinese, and Finnish, Liversedge et al. (2016) concluded that the patterns of eye movements are similar in all three languages. The finding adds to the literature addressing the universality of cognitive processing across languages. Moreover, despite the linguistic features of the three languages, the research shows that the similar processing patterns are mostly related to two lexical factors, “namely word length and word frequency” (p. 18). It indicates that the two factors have more influence on the level of brain region activation than phonological and morphological cues.

With this understanding of brain function and eye movements, further research investigates whether bilingual children can gain a flexibility when they cognitively process languages of different features. While readers depend more on visual-semantic PAL (paired associated learning) to learn Chinese and more on visual-phonological PAL to learn English, Chow (2014) argues that, regardless of the two pathways, the ability to make connections between two stimuli and to shift between pathways flexibly is crucial to bilingual children’s reading development. In other words, the fact that bilingual children are capable of using multiple cueing systems is more important than whether they rely on the phonological or the morphological system.

Contributions of Phonological Awareness in Chinese to English

While it has been acknowledged that phonological awareness plays a less important role than morphological awareness when it comes to learning Chinese characters (Wang et al., 2006; McBride, 2016; Luo et al., 2017), there are debates on how phonological awareness can be transferred across languages and whether phonological knowledge of Chinese may contribute to the development of phonological awareness in English. Some researchers argue that bilingualism does not have salient and consistent effects on the development of English phonological awareness; Chinese-English bilinguals have notable difficulty in performing tasks of phoneme manipulation (Bialystok et al., 2003; Luo et al., 2017). In contrast, other researchers claim that phonological awareness in Chinese is beneficial to that in English at various levels.

First, since Chinese has five tones, Chinese-speaking children are found to be more auditorily sensitive than English monolinguals (McBride, 2016; Lin et al., 2018). Their stronger tone awareness also heightens their attention to stress when reading in English. In a study with 55 Chinese-English bilingual children in Washington D.C., Lin et al. (2018) discovered that

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Chinese tone awareness also contributes to the participants' ability to make distinctions among English polysemes, words with more than one meaning (see Figure 3). The direct effects that Chinese tones have on English word reading may result from the fact that when the tone of a Chinese syllable changes, it can no longer represent the same character. For instance, “tiān” could resemble the character “天” (sky), whereas “tián” would mean “甜” (sweet). Therefore, Chinese-speaking children are more likely to “differentiate polysemous words in English with same segments but different meanings” (Lin et al., 2018, p. 120).

Second, Chinese finals, which may also be called vowels, vowel combinations, or rimes in some literature, have direct effects on English phonological awareness, word recognition, and reading comprehension (see Figure 3). One major contribution of knowledge of Chinese finals is that children who are used to reading each final as one syllable gain the ability to analyze sounds at a smaller grain size. Moreover, their manipulation of small sound units helps them identify derivational and inflectional suffixes that are usually pronounced similarly in different words (Lin et al., 2018).

Third, at a whole-character/syllable level, Chinese phonology helps bilingual children navigate the inconsistent orthography of English, which may be a tremendous challenge to English monolinguals as well. As the inconsistency of letter-sound correspondences in English is much higher than correspondences in other Indo-European languages, young children need many orthographic strategies and thus have a slow rate learning English as beginning readers (Ziegler & Goswami, 2006). In this situation, Chinese-speaking children may feel more comfortable with the arbitrariness of letter-/word-sound connections and deal with the inconsistency with more flexibility.

Figure 3: Contributions of Phonological Awareness in Chinese to English Word Reading and Comprehension

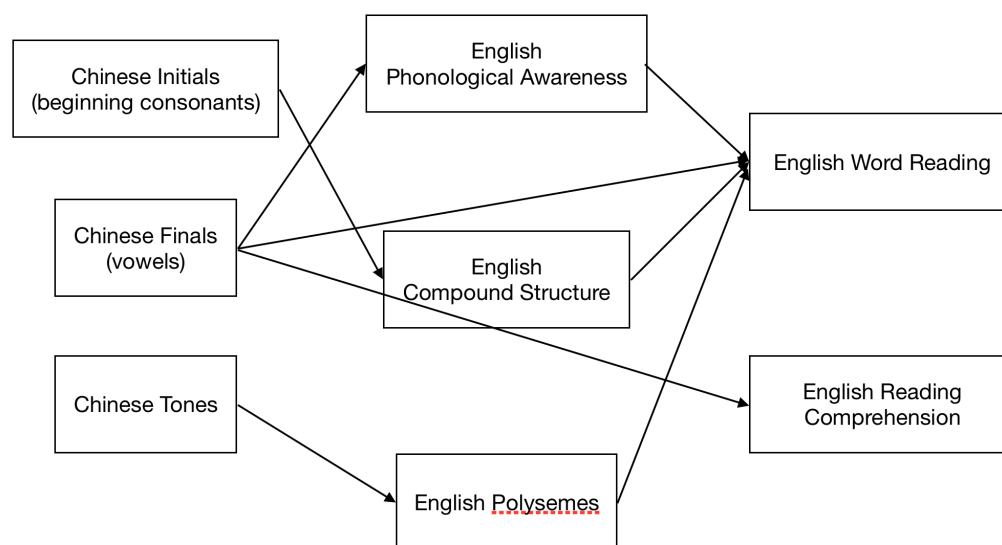


Figure 2. Contributions of phonological awareness in Chinese to English word reading and comprehension (adapted from Lin et al., 2018).

Contributions of Morphological Awareness in Chinese to English

Knowledge of Chinese characters is believed to be beneficial to beginning readers' visual skills because of the complex character forms (McBride, 2016). For instance, the character “末” (mò) and the character “未” (wèi) are not only pronounced differently but also completely unrelated in their meanings, even though the only morphological difference is the length of two horizontal lines in them. Whereas “末” can mean “the end,” “未” is defined as “not yet.” For bilingual children in kindergarten and first grade, the visual skills obtained from Chinese can be helpful when they are at the logographic and novice alphabetic phases of reading development.

Further research on the influence of Chinese morphological awareness on English word reading has focused on three major types of morphological structures that exist in both languages: compound, derivations, and inflections. Studies have demonstrated that the compound structure is where morphological awareness can transfer from Chinese to English (Wang et al., 2006; Chen et al., 2009; Lin et al., 2018). Words that consist of two characters or more are considered to be in a compound structure. It is estimated that over 65% of Chinese words are therefore compounds of more than one character (Tan & Perfetti, 1999). The rules of compound structures in English and Chinese are similar. First, the meaning of a Chinese compound word is an integration of each character's independent meaning in the context. For instance, “blackboard” means a board in a dark color close to black on which people can write. Similarly, the two-character word “白兔” (bái tù) means “a white rabbit” because “白” is “white” and “兔” means “rabbit.” Second, in both languages, “the right morpheme specifies the category, and the left morpheme modifies the meaning and identifies the subcategory” (Chen et al., 2009, p. 617). The word “blackboard” represents an object that is essentially categorized as a “board” rather than the color “black”; similarly, “白兔” falls in the category of rabbits the animal.

While the closeness between compound structures in the two languages explains the possibility to transfer morphological awareness from Chinese and English, it is noteworthy that the scope to which the transfer may happen is rather limited. In fact, quantitative studies indicate that the Chinese-English transfer is much less significant than the English-Chinese transfer. Moreover, the transfer morphological awareness from Chinese to English rarely occurs to derivational and inflectional morphemes, because derivations and inflections in Chinese are formed by adding more characters into the word rather than changing some strokes or radicals of the original character (Ku & Anderson, 2003; Wang et al., 2006; Chen et al., 2009).

Interestingly, the contributions of Chinese morphological awareness to English reading are smaller than those of Chinese phonological awareness, although morphological skills are considered predominant and more important in reading Chinese characters because of the logographic nature of the language (Ku & Anderson, 2003; Hulme et al., 2019). One reason for the disparity may be that kindergarteners and first graders learn to read characters as a whole without sufficient strategies for analysis at the stroke or radical level. In short, contributions of Chinese morphological awareness to English word reading at these two grade levels are insubstantial.

Implications for Instruction

One reason for this inquiry project about the influences of Chinese characters on English reading is my wish to explain the difficulty and complexity of giving classroom teachers advice on how they can support the reading development of their bilingual students in both languages. While there is a great body of literature addressing the topic, most of these works are qualitative case studies, the approaches and strategies of which may not work when it comes to other students who speak the same languages but are from different cultural, socioeconomic, family, and instructional backgrounds. A 6-year-old child who has learned Pinyin in China and is just about to start his/her first year at school in the U.S. would have drastically different funds of knowledge than a 7-year-old American-born Chinese student who speaks Chinese with their parents and goes to a local Chinese school on Saturdays. As a result, instructional goals and approaches that best fit their needs may be completely different.

In response to this complexity, I turned to research that unfolds how beginning readers learn the two languages fundamentally. Several implications can be drawn from the analysis of the two languages' linguistic features, models of reading development, and contributions of Chinese characters to English word reading.

First, instruction on phonological awareness in Chinese should be given more attention and time, because it is crucial to the development of both morphological awareness and word reading proficiency. Phonological instruction in Chinese has long been underestimated, as phonology contributes less to Chinese character reading than its morphology. However, McBride (2016) and Hulme et al. (2019) claim that phonological awareness and oral vocabulary skills are prerequisites for readers' acquisition of complex morphological strategies. In other words, the development of phonological awareness is beneficial to more than just character-/word-learning in both languages.

Second, PAL skills can help connect knowledge and strategies across languages. When students' proficiency in both languages varies, instruction on PAL strategies can allow students to connect any two forms of stimuli, namely cueing systems (Chow, 2014). Students may adopt a visual-semantics pathway when reading English and a visual-phonological pathway to read Chinese. The aim of the practice is to activate multiple modes of cognitive processing so that students can transfer their prior skills flexibly across languages.

Further Research Directions

First, limited by the scope of the project, this review only addresses the influences of Chinese character knowledge on English reading, while the ways in which readers' knowledge and skills in English may reciprocally transfer to and aid the reading development of Chinese remains untouched. Second, staying at the level of English words and Chinese characters, this review does not examine the cross-language transfer that also takes place in the reading and comprehension of larger units like sentences and paragraphs. Consequently, fluency, a significant indicator of children's development of reading, is not tackled. Third, this review does not contextualize biliteracy as a social and cultural practice. The understanding of biliteracy as practice rather than linguistic systems with set boundaries makes it possible to discern "the

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multiplicity of varied and dynamic ways in which bilingual children use language on a daily basis” (Palmer & Martínez, 2016, p. 382).

For that reason, one research pathway is to include both quantitative data showing how biliteracy contributes to the reading development of both languages and qualitative analyses that take in other social, cultural, and instructional factors. Most studies that I have reviewed are quantitative ones that choose to focus on participants at one or two grade levels from one specific city. While it contributes to their validity by eliminating factors that go beyond the cognitive and/or linguistic spheres, it also poses a serious challenge to meta-analyses. It remains unclear that in addition to the participants’ linguistic knowledge and skills, what factors may affect their performance in a specific task of phoneme isolation. Chinese-English bilingual speakers in China and in the U.S. may have drastically different experiences of learning the two languages, including the instruction they receive at school combined with the family, social, and media environments to which they are exposed. The current isolation between qualitative case studies and quantitative linguistic and metalinguistic analyses calls for further research to bridge theories and practices.

Conclusion

This review opens with an examination of linguistic features of Mandarin Chinese in terms of its morphology, phonology, and orthography. Mandarin Chinese is a logographic language, the fundamental unit of which is monosyllabic characters consisting of multiple strokes and radicals. It is also a tonal language that imposes arbitrary connections between characters and sounds. As a result, orthographic processing of Mandarin Chinese involves inconsistently phonological and morphological cues and requires a high degree of memorization.

Regardless of the uniqueness of Chinese as a non-alphabetic language, models of reading development in English and Chinese share many similarities. Beginning readers start from perceiving characters/words as logographs and gradually gain knowledge and skills to process characters/words at smaller grain sizes. The distinction between the two languages is that the development of English reading relies heavily on phonological awareness, whereas Chinese relies more upon morphological knowledge.

Influences of knowing Chinese characters on the reading development in English have also been examined at various levels. Cognitive research on brain functioning and eye movement behaviors has proven some universalities in reading, opening up the possibilities of cross-language transfer. Metalinguistic research further indicates that Chinese phonological awareness is a more salient contributor to the development of English reading than morphological awareness.

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