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Predictors of reading in children with Chinese as a first language: a developmental and cross-linguistic perspective

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Abstract Measures of phonological and morphological awareness of Chinese were administered to 94 third-grade students of Chinese in Taiwan to evaluate their relative contributions to current and prospective prediction of early reading in Chinese L1 and English L2. Phonological awareness made a significant unique contribution to Chinese character reading concurrently at grade 3 and subsequently at grade 5 beyond controls and morphological awareness. Morphological awareness contributed no additional unique variance to character reading at grade 3 beyond phonological awareness, but became significant at grade 5 beyond phonological awareness and the autoregressor. Phonological and morphological awareness of Chinese also predicted unique variance in English word reading at grades 3 and 5, though only phonological awareness remained significant at grade 5 beyond the autoregressor. These results suggest that phonological and morphological awareness differs in their relative importance at different stages of learning to read different scripts among children in Taiwan, but their effects in reading are persistent longitudinally and pervasive cross-linguistically.

Keywords Morphological awareness · Phonological awareness · Reading Chinese · Second language reading · Transfer

Introduction

What determines reading success in logographic learners has captured growing attention in reading acquisition research given its potential importance for understanding the similarities and specificities in children's reading development

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across orthographies. The most interesting finding in the past decade is, perhaps, the finding that phonological awareness is implicated not only in learning to read an alphabetic orthography but also in reading acquisition of Chinese, a deep orthography where phoneme-size units are not explicitly represented in written forms. Different levels of phonological awareness have been found to be associated with reading Chinese, such as syllable awareness (Chow, McBride-Chang, & Burgess, 2005; McBride-Chang & Kail, 2002; Shu, Peng, & McBride-Chang, 2008), tone awareness (Shu et al., 2008), and sub-syllabic awareness (Ho & Bryant, 1997; Hu & Catts, 1998; Leong, Cheng, & Tan, 2005; Newman, Tardif, Huang, & Shu, 2011; Siok & Fletcher, 2001).

Apart from the phonological awareness, morphological awareness is also an important predictor of learning to read Chinese (e.g., Ku & Anderson, 2003; McBride-Chang, Shu, Zhou, Wat, & Wagner, 2003; Shu, McBride-Chang, Wu, & Liu, 2006). Morphological awareness refers to the ability to reflect on and manipulate minimal linguistic forms that represent meanings. Different measures of morphological awareness, such as morphological construction (Chen, Hao, Geva, Zhu, & Shu, 2009; McBride-Chang et al., 2003; Wang, Yang, & Cheng, 2009) and homophone sensitivity (Chung & Hu, 2007; McBride-Chang et al., 2003), have been linked to Chinese reading independently of phonological awareness.

Given the importance of phonological and morphological awareness in Chinese reading, a growing body of studies has begun to consider the relative importance of phonological and morphological awareness as predictors of Chinese reading in typically developing children (Chen et al., 2009; Li, Shu, McBride-Chang, Liu, & Peng, 2010; McBride-Chang et al., 2005; Tolchinsky, Levin, Aram, & McBride-Chang, in press; Tong & McBride-Chang, 2010a; Wang et al. 2009) and in children at risk of dyslexia (e.g., Lei et al., 2011). The general finding emerging from this body of research is that morphological awareness plays a more important role than phonological awareness in predicting Chinese reading (but see Tolchinsky et al., in press). Most of the studies that evaluated the relative contributions of phonological and morphological awareness to Chinese reading are conducted among monolingual children in Hong Kong or Mainland China or among Chinese–English bilinguals. Much less is known about the time course of the predictive patterns among children in Taiwan.

Taiwan differs from Mainland China and Hong Kong in several important aspects of reading acquisition. First, Taiwan adopts a traditional, non-simplified script like Hong Kong, as opposed to the simplified script in Mainland China. Traditional and simplified scripts encompass differential phonetic and semantic cueing information children may use in decoding or remembering characters (Zhang & McBride-Chang, 2011). Second, formal reading teaching begins with intensive instruction in a phonetic transliteration system, Zhuyin Fuhao in Taiwan and Pinyin in Mainland China. In contrast, children in Hong Kong receive no instruction in phonetic symbols to aid character pronunciation, and they learn to read Chinese through a whole-word, look-and-say approach (Zhang & McBride-Chang, 2011). Zhuyin Fuhao comprises 37 symbols taken from the constituents of Chinese characters, representing onsets and rimes of spoken Chinese in a one-to-one manner. Pinyin uses Roman letters to represent Mandarin Chinese at a more fine-grained,

phonemic level (Shu et al., 2008). Zhuyin Fuhao, as well as Pinyin, is used as a pedagogical aid for learning character pronunciations, printed alongside characters in textbooks from grade 1 to grade 4, after which only new characters in the glossary are annotated with phonetic symbols. Early experience with Zhuyin Fuhao or Pinyin in reading and writing sensitizes children to sub-syllabic spoken units (Cheung, Chen, Lai, Wong, & Hills, 2001; Huang & Hanley, 1995; Siok & Fletcher, 2001) and facilitates pseudoword reading as well as real word reading (Chen & Yuen, 1991; Leong et al., 2005). Differences in the way the phonetic symbols represent characters can have differential effects on children's phonological sensitivity. For example, children and college students in Mainland China tend to segment a spoken syllable into a larger number of units than the subjects in Taiwan (Wang, 2009). Moreover, the affinity between Pinyin and English spelling in terms of letter-sound correspondences has led to the suggestion that Pinyin facilitates English learning in China (Jin & Cortazzi, 2002). Given the differences in scriptal representations and reading instruction approaches, the relative importance of phonological and morphological awareness in learning to read Chinese may vary in different learning environments (Luo, Chen, Deacon, & Li, 2011; Tong & McBride-Chang, 2010b; Zhang & McBride-Chang, 2011). The present longitudinal study seeks to complement the considerable body of research in Hong Kong and Mainland China by investigating the relative importance of the two linguistic awareness skills in Chinese reading among children in Taiwan.

Another goal of the study is to evaluate the concurrent and longitudinal roles of phonological and morphological awareness in predicting the variability in reading English as L2. Understanding the roles of Chinese-based skills in predicting English reading has important implications in early identification of at-risk L2 readers from early-acquired L1 linguistic awareness. In fact, studies on L2 learning difficulties have repeatedly documented that success in L2 depends on language-learning mechanisms that affect both L1 and L2, a view sometimes dubbed as the linguistic coding differences hypothesis (Ganschow, Sparks, & Javorsky, 1998; Sparks, Patton, Ganschow, & Humbach, 2009). These earlier studies examined L1–L2 relationship among alphabetic readers. The present study helps understand whether the L1–L2 relationship holds longitudinally between two typologically distinct languages, that is, Chinese and English.

As shall be revealed in the following discussion, it is hypothesized that the relative contributions of phonological and morphological awareness to predicting Chinese reading change developmentally as the skills required for reading are progressively modulated by reading experience. Specifically, phonological awareness should be important for early stages of reading acquisition when children engage in decoding characters by linking them to the primary spoken lexicon. Morphological awareness should play an important role not only in early reading of Chinese but also at later stages when the texts children encounter are rife with novel words with new combination of morphemes. Phonological awareness of Chinese is hypothesized to play a similar role in English reading regardless of the phonological properties of the languages. The role of Chinese morphological awareness in learning to read English, on the other hand, awaits empirical examination.

Phonological awareness in the context of learning to read Chinese

Mandarin Chinese has around 400 syllables with relatively simple syllable structures. Approximately 62% of Chinese syllables are open syllables. Only 38% are closed syllables, containing either of the only two final consonants /n/ or /ŋ/ (Wang & Cheng, 2008). Given the high frequency of open syllables and the low variety of final consonants, young Chinese-speaking children show a strong preference for CV units in explicit awareness tasks (Chen, in press; Wang & Cheng, 2008), though they are able to manipulate subunits of CV with a wide range of individual differences (Newman et al., 2011; Siok & Fletcher, 2001).

The basic orthographic unit in Chinese is a character, which virtually maps onto a morpheme in spoken language and cannot be pronounced via grapheme–phoneme correspondence rules. A character corresponds to a syllable but does not consistently transcribe a syllable. A syllable can be represented by different characters depending on its meanings. Strictly speaking, Chinese characters represent morphemes, which happen to be syllables.

About 80–90% of Chinese characters are ideophonetic compound characters, composed of a semantic radical and a phonetic radical. The phonetic radical provides information about the pronunciation of the character, though the information is not as reliable as that in an alphabetic orthography. According to an analysis of the characters taught in elementary schools in mainland China, only 39% of ideophonetic characters contain phonetic radicals providing full information about character pronunciations (Shu, Chen, Anderson, Wu, & Xuan, 2003). It is noteworthy, however, that even an "irregular" phonetic radical provides partial information about a character's pronunciation. Some radicals (e.g., 青 /qīng/ *green*) rhyme with the characters containing them (e.g., 睛 /jīng/ *eye*) and differ only in the aspiration of the onset. Others (e.g., 白 /bái/ *white*) shared onsets with the compound characters (e.g., 伯 /bó/ *uncle*). Still others (e.g., 古 /gǔ/ *ancient*) differ from the characters only in tone (e.g., 姑 /gū/ *aunt*).

Despite the low reliability of phonological information in Chinese characters, teachers of Chinese often note that beginning readers of Chinese explore and exploit phonetic cues in the script and develop a working hypothesis about the pronunciation of an unknown character. They sound out any familiar part of a character as an approximate pronunciation for the whole character. Such overgeneralization errors are the most dominant type of errors in reading Chinese among first- and second-grade students (Ho & Bryant, 1997). Young readers of Chinese, normal or dyslexic, tend to use phonetic radicals in learning new characters (Ho, Chan, Tsang, Lee, & Chung, 2006). Finding ways to recode written forms into phonological codes to access the primary spoken lexicon appears to be a universal process in the early stages of reading acquisition, no matter how obscure or indirect phonological information is coded in written forms (Koda, 2007; Share, 1995; Ziegler & Goswami, 2005).

There is some initial evidence that phonological awareness is associated with the ability to decode characters via phonetic radicals (Ho & Bryant, 1997) and the ability to identify positional regularity of radicals in compound characters (Luo et al., 2011). Theoretically, how well phonetic radicals are used in decoding

characters depends to a large extent on how sensitive a child is to the sound relationship between a radical and the character containing it. Suppose a child encounters an unfamiliar character 睛 in a word like 眼睛 /yiǎn-jīng/ *eye*. Children may construct the pronunciation of the unfamiliar character by using the partial information of the phonetic radical 青 /qīng/ to identify a registered word /yiǎn-jīng/ in the primary spoken lexicon. Children who are more sensitive to the sub-syllabic overlapping between /jīng/ and /qīng/ are expected to be better in using the partial information of the phonetic radical to recognize the word (Ho & Bryant, 1997; Li et al., in press). Alternatively, children may derive the pronunciation of the unfamiliar word by analogy to known characters containing the same phonetic radical 精 and 菁, pronounced as /jīng/. This process is available to children who have known an array of characters sharing the same phonetic radical, and it may require syllable awareness rather than sub-syllabic awareness.

In the present study, phonological awareness was measured at the onset–rime level in third-grade Taiwanese children for several reasons. First, although many studies involving Hong Kong children have demonstrated that syllable awareness, but not sub-syllabic awareness, is related to Chinese reading (e.g., McBride-Chang, Bialystok, Chong & Li, 2004; McBride-Chang et al., 2008), sub-syllabic awareness (onsets, rimes, and phonemes) has been shown to be associated with Chinese reading among children in Mainland China (Li et al., in press; Siok & Fletcher, 2001) and children in Taiwan (Hu & Catts, 1998; Huang & Hanley, 1997 for typically developing children; Jen, 2007 for children with ADHD). Given that Taiwanese third-grade students have learned to read Zhuyin Fuhao for at least 2 years, their performances in tasks involving syllable awareness are expected to be at ceiling. Moreover, one recent study on Taiwanese children has found that performance involving segmenting a cohesive CV syllable into subunits (e.g., onset and rime) is a better predictor of English L2 reading than performance involving no manipulation of the subunits of a CV syllable (Chen, in press). Second, as noted earlier, a syllable in Chinese is virtually a morpheme. It is sometimes hard to tell whether it is the phonological or the morphological knowledge or both that children have relied on to cope with a task involving manipulation of a morpho-syllabic unit.

Morphological awareness in the context of learning to read Chinese

In contrast to the seemingly elusive role of phonological awareness, the role of morphological awareness in learning to read Chinese appears self-evident given that a morpheme is a distinct Chinese character. In fact, morphemes in Chinese are more distinctly represented in written forms than in spoken forms. For example, the homophonic morphemes such as *new*, *heart*, or *acrid* are distinguished by characters 新, 心, and 辛, respectively. Most words in Chinese are polysyllabic and polymorphemic compounds, composed of two or three morphemes (Packard, 2000). Words like *television*, *movie*, or *lightning* are literally *electricity-vision*, *electricity-image*, and *flash-electricity* in Chinese. Thus, the ability to construct new compound words based on known morphemes is one essential aspect of morphological awareness in Chinese. Given the specific features of Chinese orthography, learning to read Chinese

essentially involves a discovery that a character refers to a morpheme in speech, which can be combined with another character also representing a morpheme to form a word. Significant associations between morphological awareness and early reading have been obtained in many studies conducted among preschoolers or young elementary school children in Hong Kong and Mainland China (e.g., Chen et al., 2009; Li et al., in press; McBride-Chang et al., 2003), though there is also evidence in Taiwanese preschool children that the association may be mediated by vocabulary and preexisting reading ability (Chung & Hu, 2007).

In addition to its primary role in the initial process of reading acquisition, morphological awareness could play an even more prominent role in later elementary years when children see a significantly greater number of novel complex words that they do not know from the acquisition process of spoken language. These novel words may have new combinations of familiar morphemes, such as 近況 *recent situation*, or be made up of a new morpheme plus a familiar morpheme, such as 仰望 *rely on* or 皎潔 *bright*. Children who are better equipped with knowledge in morphological analysis and composition are expected to be better in construing the meanings for the novel words and store them in an efficient manner for future use.

Although the relationship between morphological awareness and Chinese reading is understandable, it is sometimes difficult to interpret given that morphological awareness and Chinese reading can be reciprocally facilitative (McBride-Chang et al., 2003), much as the reciprocal relationship between phonological awareness and reading in English (Castles & Coltheart, 2004). To reduce the confounding effect of reciprocity in data interpretation, the present study employed a longitudinal design, following children from third grade to fifth grade, to chart the path from early morphological awareness to later reading ability by controlling for the autoregressive effects of reading ability on itself. In addition, the present study employed a morphological construction task to assess morphological awareness, as opposed to homophone sensitivity, another common measure of morphological awareness. The relationship between homophone sensitivity and Chinese reading has been found to be modulated by extant knowledge of characters in Taiwanese preschool children (Chung & Hu, 2007). Given that homophonic morphemes are distinctly represented by Chinese characters, it is not inconceivable that orthographic information can be used to assist performance in discriminating or matching homophonic morphemes. In contrast, morphological construction involves creation of new words, which should be less mediated by children's extant reading ability than homophone sensitivity. Morphological construction has been shown to be a better predictor of Chinese reading than other measures of morphological awareness (Chen et al., 2009; Li et al., in press; McBride-Chang et al., 2003).

Awareness of Chinese as predictors of English reading

A relevant question in the present study is whether Chinese-based linguistic awareness predicts variance in learning to read in a typologically different language. Evidence from cross-linguistic studies has indicated that cross-language transfer

occurs at the phonological level. For example, phonological awareness of Chinese has been found to predict variance in English reading (e.g., Chow et al., 2005; Gottardo, Yan, Siegel, & Wade-Woolley, 2001). Chinese reading ability correlates more highly with the ability to utilize phonetic cues in printed English than the ability to capitalize on visual cues (McBride-Chang & Treiman, 2003). These cross-language associations indicate that phonological awareness represents, at least partially, a general ability to extract phonological prototypes from speech, independently of the phonological properties of a language.

Less is known about the cross-language role of morphological awareness in reading, especially pertaining to its long-term contribution in typologically distinct languages. Among the few studies involving morphological transfer, there is some indication that transfer of morphological awareness is restricted, affected by the morphological structure of the languages. For example, Tong and McBride-Chang (2010a) found that awareness of compound construction and homophonic morphemes, specific to Chinese, did not account for unique variance in reading English as L2 among Hong Kong second- and fifth-grade students. Wang and her colleagues (Wang, Cheng, & Chen, 2006; Wang et al., 2009) found that awareness of Chinese compound structure was not a unique predictor of English word reading, though awareness of English compound structure made a unique contribution to Chinese word reading. Similar findings have been obtained by Pasquarella, Chen, Lam, Luo, and Ramirez (2011) in a cross-sectional study on Chinese–English bilingual children. Cross-language transfer of morphological knowledge appears possible when the tasks require similar types of morphological knowledge. For example, Zhang et al. (2010) found that after receiving explicit instruction in Chinese or English compound morphology, Chinese fifth-grade students were able to apply the knowledge they had acquired about structural relations of compounds in one language to analyze the structure of compounds in the other.

Though the earlier studies have revealed some roles that phonological and morphological awareness may play in predicting Chinese L1 and English L2 reading, there is still much to be learned about the way phonological and morphological awareness interacts with reading development. What are the relative contributions of early-acquired phonological and morphological awareness to predicting reading over the course of development? Do the linguistic awareness skills developed from one's native language predict later reading in another language? Studies on readers of alphabetic English as L1 generally found that phonological awareness plays an important role at earlier stages of reading acquisition, and morphological awareness demonstrates a greater impact at later stages (Singson, Mahony, & Mann, 2000). Because linguistic awareness is subject to orthographic influences, the developmental relationship between linguistic awareness and reading may differ across orthographies.

Overview of the present study

Two research questions are addressed in the present study. First, what are the relative contributions of phonological and morphological awareness to Chinese

reading over the course of 2 years in Taiwanese children? Do their contributions to reading change developmentally? Second, do the Chinese-based skills predict variability in English reading concurrently and longitudinally? A longitudinal study of children from grade 3 throughout grade 5 was carried out to examine the questions. As indicated earlier, as children's reading experience becomes more sophisticated, it becomes more difficult to disentangle the effect of morphological awareness from the effect of reading experience. To complicate the matter further, morphological awareness is correlated with phonological awareness in Chinese (McBride-Chang et al., 2003, 2005). One way to resolve the problem is to tease apart the contributions of phonological and morphological awareness to reading from a developmental perspective. Any relationship found between morphological awareness and Chinese reading would be compelling if morphological awareness measured at an earlier time predicts reading at a later time after taking phonological awareness and earlier reading ability into account.

Both phonological and morphological awareness skills were assessed in an oral form in grade 3. Chinese and English reading abilities were assessed in grade 3 and later in grade 5. Third grade was chosen as an initial assessment point for several reasons. First, average third-grade students in Taiwan begin to recognize a necessary number of words for being independent readers, and the variability in the number of words recognized by Taiwanese children significantly increases in grade 3 (Wang, Hung, Chang, & Chen, 2008). Second, according to the results of an analysis of elementary school textbooks in Mainland China, characters introduced in the first or second grade are less regular and transparent than characters introduced in higher grades (Shu et al., 2003). This pattern is presumably similar in Taiwan given that the elementary school textbooks in both areas adopt high-frequency characters and words. For these reasons, it is more likely to identify the reciprocal relationship between reading and the linguistic awareness variables in the third grade or above than in lower grades, especially morphological awareness.

Finally, the present study sought to control the variance due to digit span to ensure that individual differences in phonological or morphological awareness were not due to the variance in memory span (Castles & Coltheart, 2004). Raw scores in PPVT, an estimate of verbal intelligence, served to control individual differences in oral vocabulary, which has been shown to mediate the relationship between morphological awareness and Chinese reading (Chung & Hu, 2007). Children's ability in comprehending basic Taiwanese, a major local dialect in Taiwan, was also controlled given that additional exposure to a dialect may facilitate better phonological awareness (Chen et al., 2004).

Methods

Participants

Participants were 106 children recruited from five third-grade classrooms in a large middle- to upper-middle-class elementary school (about 1,400 students) in Taipei, Taiwan. The mean age of the participants when first tested in third grade was 8 years

and 9 months, with a range from 7 years and 11 months to 9 years and 3 months. The participants had been receiving formal Chinese L1 and English L2 education since grade 1. Formal literacy instruction of Chinese begins with instruction in Zhuyin Fuhao, a phonetic transliteration system with one-to-one relationship between a symbol and a sound. Zhuyin Fuhao is taught in isolation for reading and writing during the first 10 weeks in grade 1, after which Zhuyin fuhao is printed alongside with characters in the textbooks till grade 4. From grade 5 on, Zhuyin fuhao only appears in the glossary of new characters. According to the curriculum guidelines by Ministry of Education, beginning third-grade students in Taiwan are expected to recognize about 800 characters. Beginning fifth-grade students recognize about 1,800 characters. English learning in Taiwan took place mostly in classrooms and for some children, also in after-class tutoring programs. Children had very little chance to use English in their daily interaction with others. Prior to the implementation of the study, informed, written consent was obtained from the parents of all the children who participated. The participants in the study had no known language, emotional or physical problems as reported by classroom teachers. Owing to the dropout during the 2-year investigation, 94 participants remained in the study for the second assessment. There were no significant differences in age and all grade 3 measures between the dropouts and the participants included in grade 5 (all $ps > .05$).

Background measures

Taiwanese

The child was asked five questions uttered in Taiwanese by the test-giver, whose native language was Taiwanese. The questions were designed in such a way that the child could answer the questions without resorting to complete sentences. The five questions were the following: (1) Do you understand Taiwanese? (2) What fruit do you like? (3) Which is longer, a snake or a worm? (4) What time do you usually go to bed? and (5) How many fingers do you have? A stringent procedure was adopted to score the answers. One point was awarded to an oral response in Taiwanese which indicated an understanding of the question. There were occasions where the child gave a correct answer but in Mandarin Chinese or where the child indicated that he or she understood the question but could not answer in Taiwanese. In those occasions, no points were awarded given the ambiguous nature of the answers. The test had an internal consistency reliability of .75.

Digit span

The test-giver read a sequence of digits (from 4 to 12 digits) to each child at the rate of one digit per second, after which the child was to repeat the sequence of digits in the same order. There were two consecutive trials at each sequence length. The task ended when the child failed to repeat digits of the same length in two consecutive trials. A score was the maximum number of digits recalled in a correct sequential order.

Oral vocabulary

The Chinese version of the Peabody Picture Vocabulary Test-Revised (PPVT-R) was used to measure the child's receptive vocabulary in his or her native language (Lu & Liu, 1981). The PPVT-R consists of a series of 175 plates, each containing four line drawings of objects or actions. For each plate, the test-giver provided a stimulus word orally. The child was asked to respond by pointing to the line drawing on the plate that best illustrated the meaning of the stimulus word. Test administration proceeded until the test error criterion was reached. Internal consistency reliabilities reported in the test manual range from .90 to .97.

Awareness measures

Phonological awareness

Children's phonological awareness was assessed via two measures: sound oddity and deletion. In the sound oddity test, the child chose from a set of three words (e.g., *bi*, *ban*, *gou*), the one that sounded differently from the others (*gou*). There were 14 trials. The trials differed in the type of the sounds the child had to contrast. Half of the 14 trials required him or her to contrast the stimulus words according to the initial consonants and the other half according to the rimes. The test-giver read three words aloud to the child. The child listened carefully to the designated part of each word and chose the one having a beginning sound or rime that was different from the others (Max = 14). The reliability coefficient for the sound oddity test (Spearman–Brown) was .78. In the deletion test, the test-giver read a disyllabic word twice and asked the child what was left if the initial consonant of the word was deleted. For example, "*Mi-feng*, *mi-feng*, what would it sound like after /m/ is removed from the beginning of *mi-feng*?" There were 10 trials (Max = 10). The estimated reliability coefficient for the test (Spearman-Brown) was .93. Performances on the two tests of phonological awareness were converted into percentage scores and then averaged, yielding a composite score for phonological awareness.

Morphological awareness

Morphological awareness was assessed by a new word construction task, in which the child was asked to invent a new word for each of the 20 scripted scenarios orally described by the test-giver. Half of the scenarios required the child to construct new words through compounding, six through derivation, and four through reduplication. For example, in one scenario, the child was told, "When we want to have more *lü* green plants in our environment, we say we will *lü-hua* green-ify our environment. If we want to have more *xiang* fragrance in our environment, what would we say we do to our environment?" The form *-hua* is a derivational suffix in Chinese, with which a verb form derives from an adjective. In this scenario, the child was expected to construct a new word *xiang-hua* based on the clue word *lü-hua*. An analogous example of English was to create a new word *fragranten* based

on the clue word *fragrant*. The 20 scenarios were preceded by four practice items, in which corrective feedback was given. The test had an internal consistency reliability of .89.

Reading measures

Chinese reading

A standardized test, *Graded Chinese Character Recognition Test* (Huang, 2004), was used to measure the participant's Chinese character reading ability. There are 200 Chinese characters arranged from high to low frequency. Each child read each character aloud from high to low frequency till the child made 20 consecutive errors. The test manual reports internal consistencies .99 and test–retest reliabilities from .81 to .95.

English reading

A standardized English word recognition test, developed for EFL children from third grade to ninth grade in Taiwan, was used to examine children's English word recognition ability (Hong et al., 2006). The word recognition test contains 100 words, arranged according to their frequency. The child read each of the words aloud and supplied meanings for each word. Each test item received two scores: oral reading accuracy and meaning accuracy. The maximum score for the test was 200 (100 for oral reading accuracy plus 100 for meaning accuracy). Test administration in oral reading proceeded until the child made 20 consecutive errors. Similarly, test administration in meaning continued until the child failed to supply meanings for 20 words consecutively. Internal consistency reliabilities reported in the test manual for each grade range from .991 to .994.

Procedure

The participants were individually given the measures in a quiet room of the school during the first and the second semesters of each academic year. Measures of Taiwanese, oral vocabulary, and phonological awareness were given during the first semester of grade 3. Measures of digit span, morphological awareness, and the two reading measures were given during the second semester of grade 3. In the first semester of grade 5, the two reading measures were re-administered to the participants.

Results

Table 1 displays means and standard deviations of all the measures at grades 3 and 5. The correlations among the variables at both test times are shown in Table 2. The results of zero-order correlations were in accordance with previous findings in that both phonological awareness and morphological awareness were significantly correlated to Chinese reading measured concurrently at grade 3 and subsequently at

Table 1 Descriptive statistics for the variables

	M	SD
Age (months)	104.77	4.08
Digit span	8.93	1.30
Taiwanese	2.16	1.56
Oral Vocabulary	90.72	8.77
Phonological awareness	79.60	17.08
Morphological awareness	43.79	21.61
Chinese reading (grade 3)	91.55	23.39
Chinese reading (grade 5)	124.27	20.61
English reading (grade 3)	33.37	26.83
English reading (grade 5)	122.82	50.73

Table 2 Bivariate correlations among the principal variables

	1	2	3	4	5	6	7	8	9	10
1. Age										
2. Digit span	−.03									
3. Taiwanese	.05	−.02								
4. Vocabulary	.19	−.02	.05							
5. PA	.07	.14	.06	.23*						
6. MA	.03	.17	.09	.37***	.31***					
7. Chi-RD3	.21*	.12	.03	.37***	.41***	.33***				
8. Chi-RD5	.11	.20*	.11	.38***	.40***	.45***	.69***			
9. Eng-RD3	.12	.04	−.04	.22*	.34***	.40***	.37***	.46***		
10. Eng-RD5	.09	−.01	−.03	.25**	.40***	.42***	.41***	.55***	.82***	

PA phonological awareness, *MA* morphological awareness, *Chi-RD3* Chinese reading at grade 3, *Chi-RD5* Chinese reading at grade 5, *Eng-RD3* English reading at grade 3, *Eng-RD5* English reading at grade 5

* $p < .05$; ** $p < .01$; *** $p < .001$

grade 5 (r ranging from .33 to .45). They were also significantly correlated with English reading across grades 3 and 5 (r ranging from .34 to .42). Consistent with findings in alphabetic languages (e.g., Casalis & Louis-Alexandre, 2000) and in Chinese (McBride-Chang et al., 2003, 2005), phonological awareness was correlated with morphological awareness ($r = .31$). Finally, the two Chinese reading measures were correlated with each other ($r = .69$) and so were the two English reading measures ($r = .82$). Chinese reading was correlated with English reading across times, and the highest intercorrelation was the concurrent correlation at grade 5 ($r = .55$).

Unique predictors of Chinese reading

To examine the concurrent and longitudinal contributions of the two awareness variables to Chinese reading, hierarchical regression analyses were conducted.

Chinese reading scores at the two grade levels were analyzed separately, entered as dependent variables. The two awareness variables were entered as predictors at the last two steps in each of the regression models to examine their independent contributions for predicting the variability in Chinese reading.

For Chinese reading at grade 3, two sets of regression analyses were run. The first set assessed the uniqueness of phonological awareness. The four background measures, age, digit span, Taiwanese, and oral vocabulary, were entered in steps 1 to 4. Morphological and phonological awareness were entered in steps 5 and 6, respectively. In the second set of regression analysis, morphological and phonological awareness were entered in reverse order at the last two steps, to assess the uniqueness of morphological awareness. As shown in Table 3, when entered at the last step, morphological awareness did not account for any additional variance in Chinese reading at grade 3 beyond the contributions of phonological awareness and other relevant variables. In contrast, phonological awareness accounted for 8% of unique variance in Chinese reading beyond the contributions of morphological awareness and the background variables ($p < .01$).

For Chinese reading at grade 5, four sets of regression analyses were run. In the first two sets of analyses, the predictor variables were entered in the same order as that for Chinese reading at grade 3 to examine the relative contributions of earlier phonological and morphological awareness to later Chinese reading. As shown in Table 3, when entered at the last step, phonological awareness accounted for 5% of unique variance after accounting for the variance due to morphological awareness and background variables ($p < .05$). Morphological awareness accounted for additional 5% of variance in grade 5 reading after accounting for the variance in phonological awareness and background variables ($p < .01$).

In the next two sets of analyses for grade 5 reading, the autoregressor, grade 3 reading scores, was added to the longitudinal regression models, entered one step prior to phonological awareness and morphological awareness, to control for the variance due to children's initial reading ability. After the autoregressor was included in the longitudinal regression model, only morphological awareness remained as a significant predictor, accounting for 3% of the variance in grade 5 reading ($p < .05$). The variance associated with phonological awareness was no longer unique.

Unique predictors of English reading

The second focus of the study was to examine whether the two Chinese awareness variables predicted English reading when other L1 factors had been controlled. Hierarchical regression analyses were conducted with English reading scores at grades 3 and 5 entered as dependent variables in separate analyses. Like the analyses for Chinese reading at grade 3, the order of entry for predicting English reading at grade 3 was age, digit span, Taiwanese, and oral vocabulary. The two awareness variables were entered as predictors at the last two steps in each of the regression models. As shown in Table 4, when entered at the last step, phonological awareness accounted for additional 5% of the variance in English reading at grade 3

Table 3 Regression analyses for unique variance of phonological and morphological awareness predicting Chinese reading

Criterion variables	Steps	Predictors	*df*	Multiple *R*	*β*	R^2 change
Chi-RD 3	1	Age	1, 92	.21	.15	.05*
	2	Digit span	1, 91	.25	.06	.02
	3	Taiwanese	1, 90	.25	−.02	.00
	4	Vocabulary	1, 89	.42	.23	.12***
	5	MA	1, 88	.46	.14	.04*
	6	PA	1, 87	.54	.30	.08**
	5	PA	1, 88	.53	.30	.10***
	6	MA	1, 87	.54	.14	.02
Chi-RD 5	1	Age	1, 92	.12	.05	.01
	2	Digit span	1, 91	.23	.13	.04*
	3	Taiwanese	1, 90	.26	.06	.01
	4	Vocabulary	1, 89	.45	.22	.14***
	5	MA	1, 88	.54	.26	.08**
	6	PA	1, 87	.58	.24	.05*
	5	PA	1, 88	.54	.24	.08**
	6	MA	1, 87	.58	.26	.05**
	1	Age	1, 92	.12	−.04	.01
	2	Digit span	1, 91	.23	.12	.04*
	3	Taiwanese	1, 90	.26	.08	.01
	4	Vocabulary	1, 89	.45	.15	.14***
	5	Chi-RD 3	1, 88	.72	.58	.31***
	6	PA	1, 87	.72	.10	.01
	1	Age	1, 92	.12	−.03	.01
	2	Digit span	1, 91	.23	.10	.04***
	3	Taiwanese	1, 90	.26	.08	.01***
	4	Vocabulary	1, 89	.45	.10	.14***
	5	Chi-RD 3	1, 88	.72	.58	.31***
	6	MA	1, 87	.74	.20	.03*

PA phonological awareness, *MA* morphological awareness, *Chi-RD3* Chinese reading at grade 3, *Chi-RD5* Chinese reading at grade 5, *Eng-RD3* English reading at grade 3, *Eng-RD5* English reading at grade 5. β*s* are from the final model at step 6

* $p < .05$, ** $p < .01$, *** $p < .001$

after taking into consideration the variance due to morphological awareness and background variables ($p < .05$). Morphological awareness of Chinese accounted for 9% of the variance in grade 3 English reading beyond the contribution of phonological awareness and the background variables ($p < .01$).

For predicting English reading at grade 5, the order of the predictors was the same as that for Chinese reading at grade 5 to ensure comparability of the predictive patterns across the two reading abilities. When entered at the last step, phonological awareness accounted for additional 8% of variance in grade 5 English reading after

Table 4 Hierarchical regression analyses for unique variance of phonological and morphological awareness predicting English reading

Steps	Predictors	*df*	Multiple *R*	*β*	R^2 change
Eng-RD 3					
1	Age	1, 92	.13	.10	.02
2	Digit span	1, 91	.13	−.04	.00
3	Taiwanese	1, 90	.14	−.09	.00
4	Vocabulary	1, 89	.25	.03	.04*
5	MA	1, 88	.43	.33	.12***
6	PA	1, 87	.48	.24	.05*
5	PA	1, 88	.39	.24	.09**
6	MA	1, 87	.48	.33	.09**
Eng-RD 5					
1	Age	1, 92	.09	.05	.01
2	Digit span	1, 91	.09	−.11	.00
3	Taiwanese	1, 90	.10	−.08	.00
4	Vocabulary	1, 89	.26	.05	.06*
5	MA	1, 88	.44	.33	.13***
6	PA	1, 87	.53	.30	.08**
5	PA	1, 88	.44	.30	.13***
6	MA	1, 87	.53	.33	.08**
1	Age	1, 92	.09	−.03	.01
2	Digit span	1, 91	.09	−.06	.00
3	Taiwanese	1, 90	.10	−.00	.00
4	Vocabulary	1, 89	.26	.05	.06*
5	Eng-RD 3	1, 88	.83	.77	.62***
6	PA	1, 87	.84	.14	.02*
1	Age	1, 92	.09	−.02	.01
2	Digit span	1, 91	.09	−.06	.00
3	Taiwanese	1, 90	.10	−.00	.00
4	Vocabulary	1, 89	.26	.05	.06*
5	Eng-RD 3	1, 88	.83	.79	.62***
6	MA	1, 87	.83	.10	.01
1	Age	1, 92	.09	−.00	.01
2	Digit span	1, 91	.09	−.08	.00
3	Taiwanese	1, 90	.10	−.06	.00
4	Vocabulary	1, 89	.26	.09	.06*
5	Chi-RD 3	1, 88	.43	.27	.12***
6	PA	1, 87	.50	.28	.07**
1	Age	1, 92	.09	.02	.01
2	Digit span	1, 91	.09	−.10	.00
3	Taiwanese	1, 90	.10	−.07	.00
4	Vocabulary	1, 89	.26	.01	.06*

Table 4 continued

Steps	Predictors	*df*	Multiple *R*	*β*	R^2 change
5	Chi-RD 3	1, 88	.43	.31	.12***
6	MA	1, 87	.50	.34	.09**

PA phonological awareness, *MA* morphological awareness, *Chi-RD3* Chinese reading at grade 3, *Chi-RD5* Chinese reading at grade 5, *Eng-RD3* English reading at grade 3, *Eng-RD5* English reading at grade 5. *β*s are from the final model at step 6

* $p < .05$, ** $p < .01$, *** $p < .001$

controlling the variance due to morphological awareness and background variables ($p < .01$). Morphological awareness also accounted for 8% of variance after accounting for the variance due to phonological awareness and background variables ($p < .01$). In the next two sets of analyses, the autoregressor, earlier English reading scores (grade 3), was added to the longitudinal regression models at step 5, one step before phonological awareness and morphological awareness, to control for the variance due to children's initial reading ability. After the autoregressor was included in the longitudinal regression model, only phonological awareness remained as a significant predictor, accounting for 2% of the variance in grade 5 English reading ($p < .05$). The variance associated with morphological awareness was no longer unique.

Finally, the uniqueness of phonological and morphological awareness was evaluated against children's earlier Chinese reading ability. After controlling age and all the other Chinese-based skills measured at grade 3 (i.e., digit span, Taiwanese, oral vocabulary, and Chinese reading), phonological awareness accounted for 7% of the variance ($p < .01$) and morphological accounted for 9% in grade 5 English reading ($p < .01$).

Discussion

The study examined the independent contributions of phonological and morphological awareness to predicting variability in reading Chinese as L1 and English as L2 over 2 years among children in Taiwan. The developmental approach adopted in the present study permitted a fine-grained investigation of the specific interplay between early-acquired linguistic awareness and reading. To identify the uniqueness of phonological and morphological awareness in predicting variability in reading, the effect of each was assessed in the presence of the other in addition to background variables. For Chinese reading, it is hypothesized that phonological awareness plays an important role in early reading of Chinese and morphological awareness is essential from the initial to the more advanced stages of reading acquisition. The results partially support the hypothesis in that phonological awareness contributes unique variance to predicting Chinese reading at grade 3, whereas the uniqueness of morphological awareness is evident in grade 5 but not in grade 3. For English reading, the results support the linguistic coding difference

hypothesis that L1 coding skills provide the basic foundation for L2 learning. The two Chinese-based awareness variables account for unique variance in English reading in grade 3 and grade 5, though only phonological awareness is a significant predictor of English reading at grade 5 beyond the autoregressive effect of prior reading ability.

Phonological awareness and learning to read Chinese

In the present study, phonological awareness was concurrently related to Chinese reading assessed at grade 3 and prospectively associated with reading at grade 5. The association was not attributable to differences in age, digit span, early dialectal experience (Taiwanese), and the variance associated with lexical-meaning knowledge measured by oral vocabulary and morphological awareness.

Not all studies have found a unique association between phonological awareness and Chinese reading beyond morphological awareness (e.g., Tong & McBride-Chang, 2010a), probably due to differences in the way Chinese characters are taught or the way by which phonological awareness is measured. As indicated earlier, children in Taiwan learn a phonetic transliteration system, Zhuyin Fuhao, to aid in the study of Chinese characters. Although the participants did not see Zhuyin Fuhao printed alongside the characters when they took the Chinese reading test in the present study, learning Zhuyin Fuhao might have prompted Taiwanese children to take a more phonological approach in reading or decoding characters than children who did not learn a phonetic coding system to support character reading.

Additionally, the difference in the results of the present study and previous studies is likely attributable in part to the way by which phonological awareness is measured. Studies conducted in Hong Kong generally found that syllable awareness is a reliable predictor of early success in Chinese reading in 3- to 6-year-olds (Chow et al., 2005; McBride-Chang et al., 2004), and its contribution to prediction is better than sub-syllabic awareness (McBride-Chang et al. 2004, 2008). A dominant interpretation of the role of syllable awareness in Chinese reading has been that a character is virtually a syllable in Chinese (McBride-Chang et al., 2004). However, studies on children in Mainland China or in Taiwan have shown that while syllable awareness is associated with Chinese reading in younger children, sub-syllabic awareness emerges as a better predictor, particularly in older, elementary school children (Li et al., in press; Luo et al., 2011; Newman et al., 2011; Hu & Catts, 1998; Huang & Hanley, 1997). Thus, sub-syllabic awareness may play an essential, but indirect, role among children in Taiwan or Mainland China because it facilitates, and develops with, the acquisition process of the phonetic transliteration system. Thus, phonological awareness tasks involving sub-syllabic units may be more sensitive or tap greater variability than tasks involving manipulation at the syllable level to children who have learned a phonetic coding system. Nevertheless, it is noteworthy that although the experience with the phonetic transliteration system might explain the differential predictive patterns in different Chinese societies, it could not fully account for the documented association between sub-syllabic awareness and Chinese reading. At least one study has shown that sub-syllabic

awareness is associated with Chinese reading after controlling for the variance due to Zhuyin Fuhao reading (Hu & Catts, 1998).

If experience with Zhuyin Fuhao reading cannot completely account for the relationship between sub-syllabic awareness and Chinese reading, what other potential connections can be? Some researchers have suggested that sub-syllabic awareness is related to Chinese reading because it is related to decoding characters by phonetic radicals (Ho & Bryant, 1997; Li et al., in press). In Chinese, phonetic radicals and characters may have identical pronunciations or share either onsets or rimes. Awareness of sub-syllabic onsets or rimes may be important for Chinese readers to successfully capitalize on phonetic radicals in decoding characters, just as onset–rime awareness is important for making analogies between English words that share spelling patterns of rimes (Goswami & Mead, 1992). The design of the present study does not allow us to determine whether the unique association between sub-syllabic awareness and Chinese reading among children in Taiwan is due to the mediating experience with the phonetic transliteration system, the properties of phonetic information in Chinese characters, or both. To understand the mechanism by which phonological awareness plays a role in Chinese reading, future studies should compare the developmental patterns in Chinese reading among children from Mainland China, Taiwan, and Hong Kong with measures of phonological awareness at various levels and examine how various levels of phonological awareness in these children emerge as predictors of the ability to read real words and, particularly, the ability to decode unknown words with partial phonetic cues.

In the present study, the contribution made by phonological awareness faded with ages at grade 5. Phonological awareness failed to predict variability in grade 5 reading beyond the prediction provided by prior Chinese reading (i.e., the autoregressor). Caution should be taken in interpreting the null effect of phonological awareness in the autoregressor model. By including the autoregressor in the regression model, we were able to control for all effects upon Chinese reading prior to grade 3 and measure only the independent contributions of the two awareness variables to the change in Chinese reading since grade 3. In the present study, Chinese reading at grade 3 was uniquely associated with phonological awareness. When it was included as an autoregressor for grade 5 reading, the variance associated with phonological awareness would be represented by the autoregressor in the regression model.

Morphological awareness and learning to read Chinese

In contrast to phonological awareness, morphological awareness was not a unique predictor of Chinese reading at grade 3 when the variance due to phonological awareness was taken into account. However, it accounted for unique variance in reading at grade 5 beyond phonological awareness and an additional control of reading since grade 3. These findings partially support the hypothesis that morphological awareness plays a prominent role in later stages of reading acquisition among Taiwanese children when the texts children read are rife with novel morphologically complex words.

The finding that morphological awareness plays a lesser unique role in early stages of Chinese reading acquisition when gauged against phonological awareness is not in accordance with results from many previous studies (e.g., Ku & Anderson, 2003; McBride-Chang et al., 2003; Tong & McBride-Chang, 2010a). Previous studies generally found that morphological awareness is strongly predictive of early Chinese reading. Nevertheless, the zero-order correlations between morphological awareness and Chinese reading in the present study ($r = .33$ and .45 at grade 3 and grade 5, respectively) were similar to those found in other studies. For example, in a cross-sectional study by Tong and McBride-Chang (2010a), the correlations between morphological awareness and Chinese reading were .35 and .41 for second-grade and fifth-grade students in Hong Kong, respectively. It appears that studies in different Chinese societies converge in identifying simple correlations between morphological awareness and Chinese reading but differ in demonstrating the uniqueness or strength of morphological awareness over a developmental course.

Several reasons might account for the different patterns of findings. First, some studies which assess the role of morphological awareness in reading development are cross-sectional whereas some are longitudinal. Prospective correlations obtained in longitudinal studies reveal more of the pathways from children's early abilities and experiences through to subsequent reading; concurrent correlations, potentially, reveal hand-in-hand growth or reciprocal relationship of two variables. It is not uncommon in the literature that concurrent and longitudinal predictors vary over the course of reading development (e.g., Chow et al., 2005; Muter & Snowling, 1998).

Second, different approaches in reading instruction may affect the relative importance of morphological awareness and phonological awareness in reading development. Most of the studies which found the uniqueness of morphological awareness in early reading are conducted in Hong Kong, where children learn to read Chinese characters by rote without learning alphabets or other phonetic symbols to assist reading acquisition. Learning to read Chinese characters as holistic units may benefit from morphological awareness in the early stages of reading acquisition as Chinese characters represent distinct morphemes rather than distinct phonological units. Learning Zhuyin Fuhao, on the other hand, may foster the development of the insight that printed symbols can represent sounds independently of meanings, and this insight may be carried over to learning to read characters (Chen & Yuen, 1991). Or alternatively, children read characters in a similar manner whether they have been exposed to a phonetic transliteration system. Early experience with a phonetic system may have only impacted on the development of phonological awareness, not on character reading itself (Cheung et al., 2001; Leong et al., 2005; Siok & Fletcher, 2001). The different predictive patterns could simply be a consequence of differential statistical contributions of phonological awareness to reading performance in relation to morphological awareness rather than a consequence of differences in reading characters per se. However, this possibility is less likely. There has been evidence that children who have been trained with the phonetic transliteration system in mainland China or Taiwan are better in naming pseudowords than children in Hong Kong (Chen & Yuen, 1991).

The lesser role of morphological awareness in early reading, in fact, echoes the findings from an experimental study employing a character learning task in

Taiwanese children (Chung & Hu, 2007). In that study, although the obtained zero-order correlation between morphological awareness and character reading was significant, Taiwanese preschoolers with better morphological awareness did not demonstrate better ability in a character learning task. According to the researchers and others (e.g., Carlisle, 2003), beginning learners would be more able to apply their morphological analysis skills in support of reading after they have a larger amount of exposure to written words. The need of exposure to a sufficient number of written words for morphological awareness to take effect might also, in part, explain why morphological awareness plays a relatively crucial and unique role in predicting early reading ability among children in Hong Kong, where formal Chinese character teaching begins at age three (Li & Rao, 2000), but less so among children in Taiwan, where formal instruction in characters does not begin after 10-week focused instruction in Zhuyin Fuhao at age six.

Despite the relatively lesser role in predicting early reading, the results of the present study highlight the lasting role of morphological awareness in Chinese reading among children in Taiwan, after controlling for the variance due to phonological awareness, oral vocabulary, and earlier Chinese reading ability, among others. Morphological awareness in the present study was orally given at grade 3. Its unique association with reading at grade 5 was not attributable to the reciprocal facilitation effect between morphological awareness and reading and/or reading-related practices in the classroom that took place between grade 3 and grade 5. Rather, the unique association might be due to increasing reliance on morphological knowledge in reading texts that are rife with novel words that do not appear in children's daily spoken language. Constructing meaning for novel words and learning them should draw substantially upon morphological analysis. Given that novel morphologically complex words continue to increase in elementary years, the relative contribution of morphological knowledge to reading should continue to increase as well.

Awareness of Chinese and learning to read English

In the present study, Chinese-based linguistic awareness also explained unique variance in English reading concurrently and longitudinally, indicating that long-term prediction of reading is possible in typologically distinctive languages. When the relative contributions of phonological and morphological awareness were considered, each of the two awareness variables explained a unique portion of variance in English reading across times in the presence of the other even after taking into account the background variables or earlier Chinese or English ability in the case of predicting grade 5 reading. These results are in accordance with findings from previous cross-sectional studies regarding the uniqueness of phonological awareness (Tong & McBride-Chang, 2010a), but not with respect to the unique role of morphological awareness (Tong & McBride-Chang, 2010a; Pasquarella et al., 2011; Wang et al., 2009). The cross-language prediction of morphological awareness might be more detectable in a longitudinal study than in a cross-sectional study due to differential amount of the variance shared by variables

measured at different times. For example, vocabulary lays the foundation for developing morphological awareness (Chung & Hu, 2007). Controlling for vocabulary is expected to take away a larger amount of variance shared by morphological awareness and/or reading in a model with variables measured simultaneously than in a longitudinal model.

How do we explain the longitudinal, cross-language transfer of phonological and morphological awareness in predicting English reading? The explanation has to accommodate two observations. First, the measure of Chinese morphological awareness adopted in the present study does not tap the derivational and inflectional morphology characteristic of the English language and thus precludes using shared structure from explaining the cross-language transfer of morphological awareness. Second, unlike the case of predicting Chinese reading, the relative contributions of phonological and morphological awareness to English reading did not change over the course of reading development in English. One possible way to accommodate these two observations is to conceptualize each of the L1 awareness skills as general facility for gaining insight into structural properties of language, modulated by specific L1 experience to some extent. Theoretically, individual differences in language-learning facility reflect how well a child can abstract away internal structure from L1 as well as from L2. For these two awareness variables, it might be the variance associated with the general language-learning facility, rather than the variance associated with the specific knowledge of Chinese, that accounted for individual differences in English reading. When predicting variability of reading in the same language, phonological and morphological awareness differed in their importance as reading developed and required different aspects of knowledge specific to that language. When predicting the variability of reading in another language, they were relatively consistent in their contributions to reading across times because it was the general facility for language learning that accounted for the variance in reading another language rather than the specific knowledge about Chinese.

Interpreting the cross-language associations as transfer at the more abstract level (i.e., general facility for language learning) rather than as transfer of specific structural knowledge is consistent with the linguistic coding differences hypothesis that L1 and L2 learning depends on language-learning mechanism affecting both L1 and L2 (Ganschow et al., 1998; Sparks et al., 2009). The new contribution of the present study is the finding that structural awareness of L1 can be a better predictor of L2 reading than the general linguistic knowledge of L1 across two typologically distinct orthographies. In the present study, phonological and morphological awareness of Chinese explained unique variance in English reading across a 2-year time span over and above Chinese oral vocabulary or reading ability. Although not shown in the analyses, further examination of the data revealed that when phonological or morphological awareness was entered in step 4 and vocabulary in one step later, vocabulary failed to predict English reading in either grade 3 or grade 5. It is not clear why structural awareness of L1 explained unique variance in L2 reading over general vocabulary knowledge but not vice versa. A tentative explanation might be that vocabulary knowledge reflects more of the individual differences in input availability, whereas structural awareness of L1 taps more of the

individual differences in language facility for gaining insight into the structure of a language. A certain amount of input is needed for the development of structural awareness, beyond which the amount of input may be less crucial.

While both phonological and morphological awareness were found to predict reading in typologically distinct languages, the results of the present study also revealed script–specific roles of the early-acquired linguistic awareness skills. The predictor that survived the control of the autoregressor in English reading was phonological awareness; it was morphological awareness in Chinese reading. Phonological awareness explained 2% of unique variance in subsequent English reading beyond the autoregressor, even when previous English reading had already accounted for 62% of variance in grade 5 English reading. In contrast, morphological awareness explained 3% of unique variance in subsequent Chinese reading after previous Chinese reading had accounted for 31% of variance in grade 5 Chinese reading. The differential predictors in the autoregressor models of Chinese and English seem to reflect the unique characteristics of the respective scripts. Nevertheless, this script–specific relationship does not preclude the common roles that the two awareness skills play in reading the two typologically different languages.

In summary, the results of the current investigation add to our understanding of the developmental course of early linguistic awareness in predicting Chinese L1 and English L2 reading. Like in the prediction of Chinese reading among children in Mainland China and Hong Kong, the effect of early phonological and morphological awareness could be persistent longitudinally and pervasive cross-linguistically among children in Taiwan, though the relative contributions of the two awareness skills may vary over the course of reading development in different learning environments. In Taiwan, the developmental shift in the relative contributions to Chinese reading ability is similar to the developmental trajectory in learning to read English as L1. In Taiwan where formal reading instruction begins with a phonetic transliteration system, phonological awareness plays a more crucial role in early reading but its unique role fades when the phonetic system has been mastered and when it is removed from most reading materials in later reading development. Morphological awareness becomes more important in prediction of Chinese reading over time when children begin to encounter an increasing number of novel, polymorphemic words in later elementary years. Finally, the predictive values of L1 phonological and morphological awareness in English L2 reading suggest that awareness of structural relationship in one's native language may also have a long-term effect in reading another language even in the case of typologically distinct languages.

Though the present study is longitudinal, it is still correlational in nature. The correlational nature of the present study cannot answer questions about the mechanisms behind the associations. Given that the predictive patterns of Chinese reading obtained in the present study are not identical to those obtained in other Chinese societies, comparing intra-language predictive patterns might be a potential way to understand the nature of the association between early-acquired linguistic awareness and reading. The diversity in Chinese literacy acquisition (Zhang & McBride-Chang, 2011) provides a good test case to tease apart the effects of early-acquired speech-based skills and learning environments on Chinese reading across

the stages of reading development. The investigations of intra-language variations are not only important for understanding how the effect of phonological and morphological awareness in predicting reading can be modulated by learning environments, but also crucial for providing insight into the nature of inter-language similarities and differences in children's reading development. Future studies might go beyond the correlational design and examine how children in different Chinese societies differ in the various levels of awareness and how they extract phonological, morphological, or orthographic patterns from L1 or L2 data in support of reading acquisition. Also interesting would be to see whether children with better structural awareness of one language (e.g., compounding) are better at learning similar or dissimilar structural relationship of another language (e.g., compounding or derivation with or without phonological shift) that affects reading. Future studies are also called for to investigate the efficacy of including phonological and morphological awareness in screening batteries for identifying children who are at risk of reading difficulties in another language (see McBride-Chang, Liu, Wong, Wong, & Shu, in press for a recent study on this issue).

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