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Morphological Awareness Uniquely Predicts Young Children's Chinese Character Recognition

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Two unique measures of morphological awareness, along with other reading-related tasks, were orally administered to 100 kindergarten and 100 2nd-grade Hong Kong Chinese children. These morphological awareness tasks were developed on the basis of 2 special properties of Chinese: (a) the relatively large number of homophones requires speakers to distinguish unique meanings in syllables with identical sounds, and (b) complex vocabulary words are often built from 2 or more previously learned morphemes. Both tasks of morphological awareness predicted unique variance in Chinese character recognition in these children, after controlling for age, phonological awareness, speeded naming, speed of processing, and vocabulary. Developmentally, both tasks of morphological awareness improved with age. Results demonstrate that morphological awareness is uniquely important for early Chinese character recognition.

The importance of two aspects of morphological awareness for reading development in Chinese is addressed in this study. Our working definition of morphological awareness comes from Carlisle (1995), who defined it as "children's conscious awareness of the morphemic structure of words and their ability to reflect on and manipulate that structure" (p. 194). Chinese is an important language in which to explore morphological awareness because of its unique morphology (Packard, 2000). In Chinese language, each morpheme is generally represented as a single syllable. Likewise, Chinese script is sometimes described as morphosyllabic, because each character represents both a syllable and a morpheme. We focused on the fact that there are many homophones in Chinese, forcing Chinese speakers to distinguish and keep track of various possible meanings of any given spoken syllable. In addition, the Chinese language is analytic: More complicated words are often built from morphemes that have been previously learned. This characteristic may be important in fostering Chinese children's attention to building meaning within language. Below, we review previous research on morphological awareness, which has been explored relatively rarely in the reading-development literature.

Morphological awareness implies either implicit or explicit understanding of morphemes. Morphemes represent the smallest unit of meaning. For example, two morphemes are contained in the word *socks*. *Sock* represents the first morpheme, and *s* represents the second, because it indicates that *sock* is represented in plural form. *Sunrise* also represents two morphemes, *sun* and *rise*. There are a number of ways in which morphological awareness has been conceptualized, undoubtedly influenced in part by the characteristics of the language and orthography under study. For example, English-speaking children's morphological awareness is often conceptualized as English speakers' understanding of derivational suffixes (e.g., Carlisle, 1988; Champion, 1997; Singson, Mahony, & Mann, 2000; Tyler & Nagy, 1989). Understandings of such morphemic structures in English distinguish good from poor readers (e.g., Leong, 1989).

In Chinese, radical awareness has been an important emphasis of reading development (Shu & Anderson, 1997). Most Chinese characters are comprised of two components, a phonetic radical, which might give some indication of the pronunciation of the character, and a semantic radical, which sometimes offers a clue to the character's meaning. Shu and Anderson (1997) demonstrated that third and fifth graders were sensitive to the meanings of semantic radicals; they could select from one of four unfamiliar characters the one that best completed a word or phrase. Children who were proficient in this task clearly made selections based on their sensitivity to the semantic radical embedded within the character choices. This skill, termed *radical awareness* (Li, Anderson, Nagy, & Zhang, 2002; Shu & Anderson, 1997), indicates sensitivity to the morphemic structure of Chinese characters, an important aspect of morphological awareness. However, although Chinese characters are often used to study the Chinese language (Packard, 2000), print and language are distinguishable. In the

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present study, we created morphological tasks that focused specifically on language, rather than print, structure. These tasks tapped children's (a) ability to distinguish among meanings in homophones and (b) morpheme construction skills.

The fact that there are a large number of homophones in Chinese means that those learning to read Chinese must distinguish characters that have very different written forms but which sound identical. In Mandarin, there are approximately 7,000 characters representing morphemes in daily use (Li et al., 2002). However, there are only approximately 1,300 different spoken syllables (Chao, 1976). Thus, on average, Mandarin has over five homophones per syllable. A major task for Chinese readers, then, is to learn what character is associated with what spoken syllable in context. For example, a common occurrence among Chinese adults meeting for the first time is to learn each other's names by inquiring as to which Chinese character represents the individual's spoken name. In Cantonese, for instance, if someone tells you his name is *ho6 yin4*, you need to decide which *yin4* is being used in his name by choosing from among four different homophones (all pronounced *yin4* but meaning either *worthy*, *promise*, *beautiful*, or *string*) for that sound. Although the context in which the character occurs provides some hints as to which of the homophones is the correct one, there is no way to tell exactly except by asking the person directly. Thus, a major task in early Chinese character acquisition is clarifying a given meaning from among several choices for a single sound. Children initially process homophones via oral language only, but with development, Chinese characters are helpful for distinguishing among them.

Chinese also differs from English in that each Chinese character simultaneously represents both a syllable and a morpheme. There are at least two implications of this difference in written languages that may be important for morphological awareness. First, the basic unit of written language is the syllable, rather than the phoneme. Second, morphemes are relatively flexibly combined in Chinese to form different words or concepts, as considered below.

The importance of morphemes in building words is a particularly interesting aspect of Chinese (Packard, 2000). Meanings of new vocabulary concepts in Chinese are generally more transparent than they are in English because more sophisticated concepts may be built from simpler (previously learned) ones. For example, the meaning of the word *adult* in English is opaque. In contrast, in Chinese, *adult* is comprised of two characters which, separately, mean *big* and *person*. In this case, both characters partially indicate the meaning of the concept *adult*. Relative to English, then, Chinese is more analytic. The fact that Chinese vocabulary may be more semantically transparent than English vocabulary suggests that Chinese children may make use of this transparency to learn new concepts or to recognize associations among words.

Along with differences in languages and orthographies, the importance of morphological awareness for reading may also depend on a child's developmental level. Carlisle (2000, p. 173) has asserted that "developmental trends suggest relatively limited awareness of the structure and meaning of derived forms until after the fourth grade" (Carlisle, 1995; Carlisle & Nomanbhoy, 1993). Shu and Anderson (1997) similarly noted that knowledge of morphology appeared to be relatively limited in first-grade Chinese children though fairly clear in those of third grade and above. Nevertheless, early language researchers recognize that children evidence sensitivity to morphological structure from about the age of 2 years. For example, children have been observed creating compound words to indicate meaning (e.g., *plant-man* for *gardener*) or changing the grammar of a word to reflect a change in meaning (e.g., *crayoner* to indicate one who uses crayons; Clark, 1995).

Thus, although previous studies have found little evidence for morphological awareness in younger children, this appears to be more a function of the way in which it has been measured rather than its nonexistence per se. For example, two recent studies have successfully measured morphological awareness in relatively young children (Casalis & Louis-Alexandre, 2000; Li et al., 2002). One possible explanation for previous claims that certain aspects of morphological awareness are difficult to measure in young children is that the majority of past studies on morphological awareness have measured this construct using print itself.

From a developmental perspective, it would be particularly useful to demonstrate that morphological awareness predicts reading if morphological awareness itself could be measured in the absence of print. Such a demonstration would suggest that morphological awareness might conceivably be a cause of, rather than merely a consequence of, literacy. This has been demonstrated in one study of French children followed from kindergarten to second grade (Casalis & Louis-Alexandre, 2000). Measuring morphological awareness without reading has been done occasionally with older readers as well (Carlisle, 2000; Singson et al., 2000). However, as readers become more sophisticated, the blur between sensitivity to print and literacy problem solving apart from print becomes greater. For example, in the phonological awareness literature, Stuart (1990) found that older children tended to rely on knowledge of spelling to demonstrate phonological awareness (claiming to hear four phonemes in *pitch* and three in *rich*). Thus, older children may use their knowledge of print to make inferences about language. In the present study, we tested morphological awareness among relatively young Chinese children with two tasks that did not involve print.

To be practically important, morphological awareness should be distinguishable from phonological processing as well. The majority of the published research in Western journals on literacy development has thus far been done on English, a script for which phonological processing is clearly essential. Overall, tasks of phonological and morphological awareness do, in fact, tend to be strongly associated in alphabetic languages (e.g., Casalis & Louis-Alexandre, 2000). This fact prompted Mann (2000) to assert, in reference to English, that "Being aware of morphemes must surely presuppose an awareness of phoneme- and syllable-sized units, thus an important question is whether morphological awareness makes a special contribution to reading that can be separated from the well-known contribution of phonological awareness" (p. 144). The plethora of homophones in Chinese offers one possible route by which awareness and access to meaning (morphological awareness) and speech sounds (phonological awareness) can be distinguished.

Given the centrality of phonological processing abilities in the reading-development literature, both in English (e.g., Wagner, Torgesen, Rashotte, & Hecht, 1997) and Chinese (Ho & Bryant, 1997; Hu & Catts, 1998; McBride-Chang & Ho, 2000), we controlled for these skills in the present study. We measured phonological awareness using both a syllable deletion task previously demonstrated to predict Chinese character recognition in Hong

Kong Chinese kindergarteners (McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002) and initial phoneme deletion, which was significantly associated with Chinese character recognition in previous studies of Chinese children (Huang & Hanley, 1997). We also included two tasks of rapid automatized naming, proxies for speeded phonological access, which have been shown to be associated with Chinese character recognition in previous studies (Ho & Lai, 1999; McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002). In addition, because our primary purpose was to examine the effect of two types of morphological awareness on Chinese character recognition once other abilities had been statistically controlled, we included other measures we thought might be predictive of it. These were vocabulary knowledge and measures of general speed of processing (e.g., McBride-Chang & Kail, 2002).

Carlisle (2000) asserted that "Morphological awareness, as it contributes to reading, must have as its basis the ability to parse words and analyze constituent morphemes for the purpose of constructing meaning" (p. 170). Accordingly, our tasks of morphological awareness in Chinese tested both parsing and meaning construction skills. We tested two hypotheses about morphological awareness in the present study. First, we anticipated, on the basis of previous research (Carlisle, 1995; Shu & Anderson, 1997), that both types of morphological awareness would improve with age. Second, we hypothesized that both aspects of morphological awareness would uniquely predict Chinese character recognition among young readers.

Method

Participants were 100 kindergartners (mean age = 5.25 years) and 100 second-grade students (mean age = 7.25 years), all of whom were native speakers of Cantonese. Of these, there were 42 female and 58 male kindergarteners and 47 female and 53 male second-grade students, from two kindergartens and three primary schools in Hong Kong. The two kindergartens and one primary school were in Tai Po, New Territories. The other two primary schools were in Yau Ma Tei and Kowloon Tong, Kowloon.

Kindergartens are separate schools in Hong Kong, and 95% of Hong Kong children attend these schools, which last 3 years, roughly from ages 3 to 6 years. Reading instruction typically begins around the second semester of the first year of kindergarten in Hong Kong. Students included in the present study were Year 3 kindergartners, that is, in their last year of kindergarten. Primary school begins with first grade at age 6. Hong Kong is unique among Chinese cities in that, unlike the rest of Mainland China or Singapore, which use Pinyin, or Taiwan, which uses Zhuyin-Fuhao, no phonemic coding system is used to teach children to read Chinese. Rather, children are taught to read using only the "look and say" method. In this method, the emphasis is on repetition of the character's name paired with the printed character. The educational standards of the kindergartens and primary schools from which the children in this study were drawn were roughly average in Hong Kong. Testing sessions took place in February through April of 2002.

Measures

Chinese character recognition. Two Chinese reading tasks were combined to make this task sufficiently broad so that both kindergarten and second graders could be given the same character recognition list. The list began with 27 single Chinese characters and 34 two-character words, increasing in difficulty, which has previously been used successfully among Hong Kong Chinese kindergartners (Ho & Bryant, 1997; McBride-Chang & Ho, 2000). If children progressed beyond this list, they were given additional items adapted from The Hong Kong Test of Specific Learning Difficulties in Reading and Writing (Ho, Chan, Tsang, & Lee, 2000), which includes 150 two-character words. Across grade levels, children were asked to read from the beginning of the test. The task was stopped when the child failed to read 15 consecutive items. The maximum score of the combined task was 211.

Speed of processing. The Visual Matching and Cross Out subtests from the Woodcock–Johnson Tests of Cognitive Ability (Woodcock & Johnson, 1989) were administered to all children across two separate testing sessions. In the Visual Matching subtest, children were asked to circle two identical numbers in a row of six numbers. In the Cross Out subtest, children were asked to cross out five figures that were identical to the target figure. A 3-min time limit was imposed on both subtests. Raw scores of total number of items correct on each, obtained within the 3-min period, are presented in the Results section.

Vocabulary. The Stanford-Binet Intelligence Scale vocabulary subtest (Thorndike, Hagen, & Sattler, 1986), which was translated and adapted for Hong Kong children, was used to measure vocabulary knowledge of the children. In this task, children were asked orally to explain concepts and objects of increasing conceptual difficulty. Scores were obtained by referring to the standardized marking scheme. The task was stopped when the child obtained zero marks for five consecutive items and the maximum score of the task was 64.

Phonological awareness. Phonological awareness was tested using two separate tasks administered in separate testing sessions. The first one was the syllable deletion task in which children were asked to take away one syllable from three-syllable phrases (e.g., *dai6 mun4 hau2* without *mun4* would be *dai6 hau2*). A similar task has been used successfully in past research to demonstrate syllable awareness among Hong Kong Chinese kindergartners (McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002). To maximize task difficulty level, we arranged for half of the items to consist of real words and phrases and half to consist of nonsense syllables that conformed to the phonological constraints of Cantonese. Across both conditions, eight items were administered (for 16 items in all). Of these, two items required taking away the first syllable, two involved deleting the last syllable, and four items required taking away the middle syllable of the phrase. The second task of phonological awareness was the onset phoneme deletion measure, in which children were asked to take away the initial phoneme of one-syllable Cantonese words (For example, *tsa1* without the initial sound would be *a1*). Ten items were real words, and ten were Cantonese nonwords.

Rapid automatized naming. Rapid automatized naming (Denckla & Rudel, 1976) was measured using both the Rapid Picture-Naming Test and the Rapid Number-Naming Test, administered in separate testing sessions. In the Rapid Picture-Naming Test, three rows of five pictures having two-syllable Cantonese names were presented. Across rows, the five pictures were arranged in different orders. Children were required to name all three rows of pictures as quickly as possible. In the Rapid Number-Naming Test, five rows of five digits, arranged in different orders, were presented. Children were again asked to name all digits at the fastest speed possible for them. Across both tasks, children were given two naming trials each.

Morphological awareness. Two tests of morphological awareness in the absence of print were developed for this study, the Morpheme Identification Test and the Morphological Construction Test.

The Morpheme Identification Test consisted of 19 test items. For each item, three different pictures were presented simultaneously to the child. Each of the three pictures was then carefully labeled orally for the child by the experimenter. The child was then given a two-syllable word containing the target morpheme and was asked to choose, from among the three pictures, the one that best corresponded to the meaning of that morpheme. For example, in one test item, three pictures showing a basketball (*laam4 kou1*), a boy (*laam4 hai4*), and the color blue (*laam4 cik1*) were presented. The target morpheme was *laam4*, and the child was asked to select from the three pictures the one that corresponded best to the meaning of boy and girl (*laam4 lui3,* which is a common phrase in Cantonese), which was the picture with the boy. All test items are available from Catherine McBride-Chang on request.

In the Morphological Construction Test, 20 scenarios were orally presented in three-sentence stories. To make the initial items as easy to understand as possible, we aided the first nine scenarios with illustrations, whereas the remaining items consisted of more abstract scenarios that were not accompanied by pictures. One example of a more abstract item is this: "If we see the sun rising in the morning, we call that a sunrise (*yat6 ceot1*). What should we call the phenomenon of the moon rising?" The correct answer, in this case, is moonrise (*yuet6 ceot1*). Thus, children were asked to actively construct new compounds for newly presented objects or concepts based on previously acquired morphemes. The maximum score for this task was 20. This task is available from Catherine McBride-Chang on request.

The overall internal consistency reliabilities for each of the experimental measures (except for the speeded naming measures, for which reliabilities are test–retest statistics) are displayed after each variable label in Table 1. Generally, all measures had reliabilities of .70 or greater. The only exception to this was the number-naming test–retest reliability, which was .61.

Procedure

All measures were administered to the children individually by trained psychology majors. Each child participated in two separate testing sessions, each lasting about 45 min, on 2 separate days to avoid fatigue. Tasks were carefully ordered so that those measuring the same psychological construct were separated by other tasks, and each of the two tasks measuring phonological awareness, morphological awareness, rapid automatized naming, and speed of processing, respectively, were administered on separate testing days.

Results

Means and standard deviations on all tasks are displayed separately for kindergartners and second graders in Table 1. Generally, skills on all measures presented as raw scores improved across grade levels. Older children were quicker on the rapid automatized naming tasks and better on total scores for all other measures. Of particular interest were the morphological awareness tasks. The means for both of these tasks were significantly greater among the second graders as compared with the kindergartners.

Table 2 shows intercorrelations among all measures included in the study, partialing for children's ages, separately for the kindergarten and second-grade children. As shown in Table 2, both morphological awareness variables were strongly associated with reading among the kindergartners. In this group, the association of character recognition with morpheme identification was .41, and its association with morphological construction was .52. Among the second graders, only the morphological construction measure was significantly associated with character identification ($r = .40$), probably because the morpheme identification measure was relatively easy for these children. All measures included in the study to predict Chinese character recognition were significantly associated with it, either among the kindergartners, the second graders, or both groups.

Unfortunately, with the exception of the speed of processing construct, associations among tasks purportedly measuring the same construct were relatively weak across samples. These constructs should be considered separately because the reasons for these weak convergences across tasks may differ. For example, correlations among phonological awareness tasks were relatively modest ($r = .30$ and $r = .26$ for the second graders and kindergartners, respectively), perhaps because they focus on different phonological units of analysis. Syllable awareness tends to develop early across languages (e.g., McBride-Chang & Kail, 2002). In contrast, children who receive reading instruction that makes phoneme awareness explicit typically learn to identity phonemes earlier than do those who do not (e.g., Huang & Hanley, 1994). Onset deletion was significantly associated with Chinese character recognition among the second graders only. Onset awareness is typically stressed in Chinese phonology and sometimes used in Chinese dictionaries (see Siok & Fletcher, 2001, for a review). Sensitivity to the onset of syllables was, thus, predictive of character recognition in second graders, who had developed an under-

Table 1
Reliabilities, Means, Standard Deviations, and F Tests for Differences Between Kindergarten (K3) and Second-Grade (P2) Children for All Nonstandardized Measures

Measure	Reliability	K3 *M*	K3 *SD*	P2 *M*	P2 *SD*	$F(1, 198)$***
Chinese word reading (211)	.99	76.10	31.00	145.40	23.00	321.72
Age[a]	—	5.25	0.29	7.25	0.61	954.63
Visual matching (60)	—	21.45	4.22	34.62	4.81	423.12
Cross out (30)	—	10.35	2.28	16.16	3.33	206.77
Vocabulary (64)	.82	8.80	5.00	15.10	5.40	75.71
Syllable deletion (16)	.81	11.70	3.30	14.60	1.50	61.82
Onset phoneme deletion (20)	.98	3.30	5.90	8.30	7.90	25.70
Rapid number naming[b]	.61	16.70	6.40	11.00	7.20	−35.85
Rapid picture naming[b]	.82	19.10	6.10	13.80	3.14	−62.06
Morpheme identification (19)	.78	13.70	3.80	17.40	1.50	86.32
Morphological construction (20)	.84	11.50	3.60	16.90	2.50	154.69

Note. Numbers in parentheses represent the maximum score for each measure. — = reliability estimates were not computed because the tasks are standardized.
[a] In years. [b] In seconds.
*** $p < .001$.

Table 2
Intercorrelations Among Different Measures Partialling for Children's Age

Measure	1	2	3	4	5	6	7	8	9	10
1. Chinese reading	—	.22*	.16	.48***	.36***	.16	−.32**	−.35***	.41***	.52***
2. Visual matching	.42***	—	.47***	.19	.34**	−.01	−.21*	−.32**	.27**	.34**
3. Cross out	.22*	.52***	—	.23*	.22*	.05	−.02	−.14	.24*	.38***
4. Vocabulary	.36***	.25*	.03	—	.28**	.24*	−.11	−.35***	.32**	.46***
5. Syllable deletion	.14	.25*	.27**	.22*	—	.26*	−.17	−.29*	.21*	.48***
6. Onset phoneme deletion	.33**	.23*	.15	.21*	.30**	—	−.12	−.08	.13	.34**
7. Rapid number naming	−.22*	−.10	−.22*	.00	−.12	−.06	—	.18	−.09	−.22*
8. Rapid object naming	−.33**	−.31**	−.20	−.11	−.14	−.13	−.24	—	−.25*	−.34**
9. Morpheme identification	.17	.04	.11	.29**	.04	.17	−.06	−.07	—	.36***
10. Morphological construction	.40***	.24*	.17	.41***	.30**	.39***	−.04	−.15	.21*	—

Note. Correlations above the diagonal represent associations among the kindergartners; correlations below the diagonal represent associations among the second graders.
* $p < .05$. ** $p < .01$. *** $p < .001$.

standing of how to manipulate onsets of syllables despite the fact that they were not explicitly taught how to do this. However, onset deletion was not associated with reading in kindergartners because these children had not grasped this level of phonological sophistication in the absence of phonemic instruction. In contrast, syllable deletion was predictive of reading in kindergartners only, presumably because syllable deletion was at ceiling for many second graders.

Tasks of speeded naming also showed relatively low convergence with one another ($r = .24$ and $r = .18$ for second graders and kindergartners, respectively). Both were significantly associated with Chinese character recognition and were correlated with tasks of speed of processing, suggesting some consistency in patterns of associations similar to those in past studies of Hong Kong kindergartners (e.g., McBride-Chang & Kail, 2002). In future studies including speeded naming, more tasks of both graphological (e.g., letters, numbers, Chinese radicals) and nongraphological (e.g., pictures, blocks of color) should be administered to determine whether the low correlations of the naming speed tasks in the present study are attributable to the different types of stimuli used.

The tasks of morphological awareness were also only moderately correlated with one another ($r = .21$ and $r = .36$ in the second graders and kindergartners, respectively). This result suggests that these tasks may be tapping different aspects of morphological awareness. Given that relatively few studies have examined a wide variety of measures of morphological awareness in relation to reading, this result should perhaps be explored in future research. Phonological processing abilities are intercorrelated moderately to strongly, theoretically linked, and conceptualized as associated but distinct (e.g., Wagner et al., 1997). It is likely that the same is true of morphological skills. Different types of morphological abilities may have different associations with Chinese character recognition. Both morphological skills were significantly associated with vocabulary as well, suggesting that both may be linked to vocabulary development.

To test the unique contributions of both morpheme identification and morphological construction to Chinese character recognition, we included both in a hierarchical regression equation. In this equation, we entered all measured variables in order of hypothesized contribution to reading. Age was entered first, followed by the speed of processing variables. These followed previous arguments by Kail and colleagues (Kail & Hall, 1994; McBride-Chang & Kail, 2002) that age and speed are fundamental predictors of all tasks of cognitive development. Vocabulary was entered at the third step as a proxy for verbal intelligence. Both syllable deletion and phoneme onset deletion were entered at Step 4, because phonological awareness has been clearly demonstrated to predict early Chinese character recognition in previous studies (Ho & Bryant, 1997; Hu & Catts, 1998; Huang & Hanley, 1997; McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002). At Step 5, rapid automatized naming was included, because this phonological processing skill has gained increasing attention in recent studies of reading development both in more regular orthographies such as German (Wimmer, 1995) and in Chinese (e.g., Ho & Lai, 1999) as a strong predictor of reading. Finally, at Step 6, both morphological awareness skills were included to test our main hypothesis that these abilities would predict unique variance in character recognition.

Hierarchical regression equations showing each step separately for kindergarten, second-grade, and the combined sample separately are displayed in Table 3. The table demonstrates that age was strongly predictive of reading in the combined sample but not in either sample separately. At the next step, speed of processing predicted significant unique variance in the primary school students but not in the kindergartners. In Step 3, vocabulary was a strong predictor of reading skill across groups. The phonological awareness tasks were not significantly predictive of unique variance in reading at Step 4 in either group separately, but did significantly predict reading in the combined sample only. Interestingly, across all samples, the speeded naming tasks predicted unique variance in reading skill in Step 5. Most important for the present study, the measures of morphological awareness predicted almost 9% of unique variance in the kindergarten sample. It also predicted over 3% of the variance in the second-grade sample, but this difference was nonsignificant ($p < .10$), because the effects of the morpheme identification task depressed the overall predictive effects of the morphological construction task, as demonstrated by the final beta weights in Table 4, discussed below. In the combined sample, the combined tasks of morpheme identification and morphological construction predicted a significant 3% of unique variance in reading.

Table 3
Hierarchical Regression Equation Predicting Chinese Character Recognition for Kindergarten (K3), Second-Grade (P2), and Combined Sample

Step and variable	K3		P2		Combined sample	
	ΔR^2	R^2	ΔR^2	R^2	ΔR^2	R^2
1. Age	.022	.022	.002	.002	.540***	.540
2. Visual matching, cross out	.054	.076	.174***	.175	.092***	.631
3. Vocabulary elaboration	.188***	.263	.072**	.247	.050***	.681
4. Syllable deletion, onset phoneme deletion	.042	.306	.045	.292	.018**	.699
5. Rapid number naming, rapid object naming	.065*	.371	.056*	.347	.025***	.724
6. Morpheme identification, morphological construction	.087**	.457	.034	.381	.031***	.756

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

We also examined the final beta weights of all variables in their contribution to reading in Table 4 separately for kindergarten, second-grade, and the combined sample of children. Across all three groups, the morphological construction task was a significant predictor of Chinese character recognition. Of all the reading-related variables included in this final equation, only the morphological construction task was consistently associated with character recognition across ages. In addition, in both the kindergarten and combined samples, the morpheme identification task was significantly predictive of reading.

Discussion

Results of this study have demonstrated that tasks designed to measure two aspects of morphological awareness were strongly associated with Chinese character acquisition among young Hong Kong students. Both tasks of morphological awareness were developmentally sensitive. They were also moderately associated with other reading-related tasks previously demonstrated to predict reading. Most important, both tasks predicted significant variance in character recognition once the effects of all other reading-related tasks were statistically controlled in a combined sample. These results are strong evidence of the apparently unique role of morphological awareness in early reading development. We review the importance of each of these aspects of morphological awareness, morpheme identification, and morpheme construction below.

Morpheme Identification: Homophone Awareness

The great number of homophones in Chinese forces young Chinese readers to learn to distinguish among characters that have very different meanings but sound identical in speech from the very beginning. Previous studies in alphabetic languages (e.g., McBride-Chang, Manis, Seidenberg, Custodio, & Doi, 1993; Sprenger-Charolles, Siegel, & Bechennec, 1998) have demonstrated that sensitivity to spellings of homophones are associated with reading. However, few previous studies have examined whether early sensitivity to the meanings of homophones is associated with word recognition. One exception to this is Li et al. (2002), who administered to Chinese children an odd-word-out task in which children were asked to identify the two-syllable word that did not belong from among four alternatives, all of which consisted of the same homophone. As part of a larger morphological construct, this task also predicted word recognition in first-grade Chinese children. Thus, the task of distinguishing homophones in Chinese requires effortful processing and may relate more strongly to the task of reading itself than in languages with few homophones such as Spanish or English.

Table 4
Standardized Betas for Regression Equations Predicting Chinese Character Recognition From Predictor Variables

Variable	K3		P2		Combined sample	
	β	t	β	t	β	t
Age	.02	.26	.00	−.04	.23	3.80***
Cross out	−.06	−.65	−.02	−.20	−.04	−.60
Visual matching	−.06	−.56	.26	2.39*	.20	2.69**
Vocabulary elaboration	.25	2.67**	.18	1.79	.13	2.70**
Syllable deletion	.12	1.23	−.11	−1.16	.03	.55
Onset phoneme deletion	−.08	−.87	.16	1.66	.04	.97
Rapid number naming	−.20	−2.47*	−.15	−1.69	−.12	−2.96**
Rapid object naming	−.08	−.88	−.17	−1.87	−.08	−1.84
Morpheme identification	.21	2.44*	.03	.31	.12	2.67**
Morphological construction	.27	2.47*	.22	2.16*	.22	3.61***

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

Morpheme identification is clearly an aspect of morphological awareness that is useful for beginning reading. In a sense, this task taps a skill that, theoretically, is a mirror opposite of a phonological awareness measure. In phonological awareness measures, the task of a child is to manipulate or identify a speech sound regardless of the meaning of the word in which it is embedded. That is, meaning need not be explicitly tapped in such a task; phonological awareness can be demonstrated using nonsense words. In contrast, the morpheme identification task requires that a child identify meaning from among several syllables that share an identical sound. Thus, a given speech sound by itself cannot help in attaining a correct answer on this task; only attention to meaning will help in solving the problem.

Our task of morpheme identification was only significantly predictive of Chinese character recognition in the combined sample and in the kindergarten sample. Among second graders, this task was not significantly associated with reading. The reason for this lack of association is likely that these second graders were at ceiling on this task. Thus, we obtained limited variability among second-grade children on it. Because this was a first attempt to design such a measure, we cannot rule out the possibility that this sort of a task may be associated with reading in primary school children if it is tested with more difficult items. One of our goals for future research is to design a more difficult version of this task and test its association with reading in a similar age group of students.

Morphological Construction: Meaning Awareness

The morphological construction task was a uniformly strong predictor of character recognition in these children. This task reflects the importance of avoiding the confound of vocabulary knowledge in measuring children's abilities to construct meaning (e.g., Singson et al., 2000). Pilot testing demonstrated that all of the individual syllables administered to the children were familiar to them. However, the ways in which children were required to combine these syllables were novel. The task required flexibility in combining morphemes together to create new concepts. This task was an excellent predictor of Chinese character recognition across age groups even when other tasks previously demonstrated to predict Chinese character recognition were included in a regression equation. Its strong association with reading both across and within age groups attests to its relative utility as a predictor of early reading.

Children initially approach the task of reading with the idea that meaning is represented by print (Byrne, 1996). For example, in one experiment on English-speaking children (Byrne, 1996), prereaders found it easier to recognize the *er* in *smaller*, given *small*, than to recognize the *er* in *corner*, given *corn*. This difference indicates that children were more sensitive to the semantic relation between *small* and *smaller* than the phonological association between *corn* and *corner*. Flexibility in constructing meaning may also be helpful as Chinese children map meanings from oral language to Chinese characters. It is possible that sensitivity to meaning is particularly helpful for reading development in Chinese relative to other orthographies because phonological cues are less reliable and explicit in Chinese as compared with alphabetic orthographies. Thus, distinguishing morphemes in oral language and mapping them onto print is an efficient way to learn to read.

Models of Morphological Awareness and Reading

It is likely that reading, vocabulary development, and morphological awareness are bidirectionally associated with one another with development. Clearly, reading contributes to vocabulary development (Cunningham & Stanovich, 1997), which is associated with morphological skills (Wysocki & Jenkins, 1987). In the present study, morphological skills and vocabulary were strongly correlated, suggesting that vocabulary ability may promote morphological skill, morpheme knowledge may help expand vocabulary knowledge, or they are bidirectionally associated. It may also be the case that, with advanced reading skills, morphological awareness becomes more sophisticated. For example, in English, spelling knowledge facilitates morphological awareness (Derwing, Smith, & Wiebe, 1995). Similarly, as Chinese students gain reading experience, they learn to recognize more characters and begin to link semantic radicals to the meanings of different characters, an important aspect of morphological awareness (Shu & Anderson, 1997). The precise mechanisms by which reading, vocabulary development, and morphological awareness affect one another await further studies across children of different ages learning to speak and to read in different languages. However, given the importance of both vocabulary knowledge and word recognition for early reading comprehension, it is likely that morphological awareness as measured in the present study will be a strong predictor of reading comprehension in future studies.

Limitations and Future Directions

The present study is, of course, limited in the questions it can answer about reading development. Our sample of Chinese students was administered a large battery of reading-related tasks simultaneously. Thus, the data cannot address directions of causality between morphological awareness and Chinese character recognition. In addition, we constructed tasks of only two types of morphological awareness that we thought might be related to initial reading of Chinese. It is possible that there are other aspects of morphological awareness that are also strong predictors of Chinese reading that have yet to be tested, in addition to those already tested that involve radical or character knowledge itself (e.g., Li et al., 2002). As mentioned previously, the morpheme identification task was too easy for the older children included in the present study. In future research, we must make such items more difficult to determine whether this ability continues to be important for Chinese character acquisition beyond beginning reading. The extent to which these measures of morphological awareness predict other aspects of Chinese reading, such as radical awareness (Shu & Anderson, 1997), is also unclear.

Future research should also examine the extent to which these phenomena can be demonstrated in other orthographies. It is likely that morphological identification is limited in its utility for predicting reading development in languages with few homophones. However, it may be useful in other orthographies that have a large number of homophones, such as Japanese. In contrast, the morphological construction task may be more or less predictive of reading across languages. It can easily be designed to tap children's flexibility with morphemes in their native language. Berko (1958), for example, demonstrated that English-speaking children, ages 4 to 7 years, vary in their abilities to apply their knowledge of morphemes to new concepts using both real and nonsense words. Given children's initial approach to print as a direct representation of meaning (Byrne, 1996), an approach similar to Berko's, tapping children's early knowledge of aspects of both derivational and inflectional morphology may be useful for future studies of reading development across orthographies.

A final set of questions suggested by these results centers on the role of these measures of morphological awareness beyond character recognition. In future research, it will be particularly important to explore the extent to which measures of morphological awareness, focused on constructions of meaning based on familiar concepts, predict vocabulary growth and, more broadly, reading comprehension, across scripts.

Despite these remaining questions, the results of this study offer an exciting new angle on early reading development. They suggest that it is possible to disentangle phonological processes from morphological awareness. More important, they demonstrate that morphological awareness can indeed predict unique variance in reading, which is distinguishable from that of phonological awareness and other types of phonological processing. Finally, this study demonstrates that morphological awareness can be measured reliably and effectively in the absence of print in Chinese.

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