Longitudinal predictors of very early Chinese literacy acquisition

Xiuli Tong and Catherine McBride-Chang
Department of Psychology, The Chinese University of Hong Kong, Hong Kong

Anita M.-Y. Wong
Faculty of Education, The University of Hong Kong

Hua Shu
State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, China

Pieter Reitsma
Vrije Universiteit Amsterdam, the Netherlands

Judith Rispens
Centre for Language and Communication, University of Amsterdam, the Netherlands

This 2-year longitudinal study examined both concurrent and longitudinal relations of a variety of reading-related cognitive tasks and Chinese word reading and word dictation among 187 Hong Kong Chinese kindergarteners aged 4–6. Homophone awareness, visual skills and syllable awareness were all uniquely associated with Chinese word reading across time, with age, vocabulary knowledge and nonverbal IQ statistically controlled. Only visual skill and syllable deletion uniquely explained early Chinese word dictation, however. Results extend previous research on cognitive correlates of Chinese literacy and highlight the small but unique contribution of homophone awareness for early reading acquisition in Chinese.

Given the nature of Chinese, it may be important to explore cognitive correlates of Chinese literacy acquisition beyond the realm of phonological processing, where most work on literacy acquisition in alphabetic orthographies has focused (e.g. Castles & Coltheart, 2004; Wagner & Torgesen, 1987). For example, relatively few studies have investigated the association of morphological awareness to early literacy development across writing systems. One of the striking features of Chinese, that it contains more homophones than other languages, may make the ability to distinguish different meanings of homophones an important facet of morphological awareness for early literacy.
acquisition in this language and orthography (e.g. McBride-Chang, Shu, Zhou, Wat & Wagner, 2003; Shu, McBride-Chang, Wu & Liu, 2006). In addition, the complexity of the Chinese orthography, consisting of intricately inter-related strokes, may highlight the importance of the ability to discriminate or memorise graphic symbols for helping children to recognise characters sharing slightly different visual-orthographic patterns or identical sounds (e.g. Ho & Bryant, 1997b; Siok & Fletcher, 2001). The present 2-year longitudinal study extended past research on Chinese literacy acquisition by investigating the role of homophone awareness, in addition to lexical compounding skill, visual skill and phonological awareness, in the development of both word reading and dictation among Hong Kong Chinese kindergarteners. The unique features of Chinese highlight the need to consider multiple cognitive constructs, particularly homophone awareness and visual skills, for understanding the very early development of Chinese literacy acquisition.

Word reading and spelling are two core components of early literacy acquisition (Conrad, 2008; Quellette & Senechal, 2008; Rieben, Ntamakiliro, Gonthier & Fayol, 2005). Both word reading and spelling involve phonology, morphology and orthography (Craig, 2006; Ehri, 1997; Perfetti, 1997) although there may be variation in the routes of these constituents to word reading and spelling (Perfetti, 1997). Interestingly, there is no exact counterpart to word spelling, as defined for alphabetic orthographies, in Chinese (Perfetti, 1997), as the primary written units of Chinese are characters rather than letters or other alphabetic symbols. Despite differences in orthographies, the process of retrieving graphic symbols, particularly representing spoken language in print, is universal across writing systems. Thus, in the present study, we defined the process of retrieving written word constituents and representing spoken language units in print as word spelling for convenience, but this designation refers to word dictation. Below, we discuss the potential importance of morphological awareness, particularly homophone awareness, visual skills and phonological awareness for Chinese literacy acquisition, including both word recognition and word dictation, or spelling.

**Morphological processing and Chinese literacy acquisition**

The importance of homophone awareness in relation to word reading and writing is contingent upon the unique properties of a given script. Chinese is a morphosyllabic (DeFrancis, 1989; Leong, 1973; Mattingly, 1972) system and each morpheme or character represents a spoken syllable. There are a limited number of spoken syllables in Chinese, but these syllables are mapped onto a larger number of regularly used words with different meanings. In Cantonese, there are around 1,700 tonal syllables that are mapped onto 4,500 regularly used characters (Liu, Chuang & Wang, 1975; Qian, Lee & Soong, 2004). Tonal syllables refer to single spoken syllables with a specific lexical tone. In Cantonese, a single syllable can have up to six different meanings, depending on the tone it carries. For example, a single spoken syllable /fu/ can be distinguished via tone with up to six different variations of tones representing different meanings, that is /fu1/膚 (skin), /fu2/虎 (tiger), /fu3/裤 (trousers), /fu4/符 (symbol), /fu5/婦 (woman) and /fu6/父 (father). Thus, on average, one tonal syllable approximately corresponds to three regularly used characters representing different meanings and graphic forms in Cantonese (Chow, McBride-Chang, Cheung & Chow, 2008), making homophones relatively common. As another example, one monosyllable pronounced as
/laan4/ in Cantonese can represent several different characters including (block), (column), (orchid), (waning) and (wave), with different meanings. Therefore, one essential goal of Chinese children as they learn to read must be to distinguish among characters with different visual-orthographic forms and meanings but the same pronunciation.

Two strategies are most often used by Chinese children for solving the problem of distinguishing homophones (Mair, 1991). One is to rely on the cues of word context to access the specified meaning of the morpheme within a word. For example, for the single syllable /laan4/, children can readily distinguish the speech segment /laan4/ in /lann4 lu1/ (block the way) from the speech segment /laan4/ in /zhuan1 laan 4/ (special column). However, it is not sufficient to distinguish the correct morpheme from among all possible homophones when two or more homophonic characters are appropriate to a given word context, as in the four-syllable Cantonese phrase /kei4 zung1 haau2 si3/ (middle final exam) and /kei4 zung1 haau2 si3/ (final exam). Without sufficient contextual information, it is difficult to distinguish which character /zung1/ was referred to in this four-spoken syllable phrase. Given this ambiguity, the other strategy for distinguishing homophones is to rely on the graphic forms of homophones in writing. Thus, the written forms of the characters (middle) and (final) are totally different, despite their identical pronunciations in Cantonese. In this instance, visual skills reflecting children’s ability to correctly identify, store and retrieve varying graphic forms might be effective for distinguishing homophones. Thus, homophone awareness may facilitate both recognition and writing of Chinese words.

At least three correlational studies have demonstrated that homophone awareness is associated with early Chinese reading skills. Two of these, one on first and fourth graders (Li, Anderson, Nagy & Zhang, 2002) and one on fifth graders (Shu et al., 2006) examined homophone awareness in Mandarin, and one on beginning readers (McBride-Chang et al., 2003) focused on homophone awareness in Cantonese. These studies were cross-sectional only. That is, they investigated the concurrent, rather than longitudinal, relations between homophone awareness and Chinese word reading. Moreover, they explored the role of homophone awareness for word recognition only, rather than dictation skills as well. Thus, the present study extended these prior studies by including word dictation or spelling and focused on very early homophone awareness in relation to children’s subsequent reading and dictation performance. An investigation that includes both early reading and writing may help identify the ways in which metalinguistic skills such as the ability to distinguish homophones in language may similarly or differently facilitate subsequent word recognition and dictation development.

In addition to homophone awareness, we also included a measure of lexical compounding as an aspect of morphological awareness in the present study. Chinese has a relatively transparent semantic structure, and lexical compounding is fairly common for new word formation. For example, the single morpheme (book) can be combined with different morphemes for forming a variety of additional words such as (bookshelf), (textbook) or (bookmark). Moreover, the meanings of these compound words formed by (book) in this example are all related to the meaning of the single morpheme (book). Hence, sensitivity to the morphemic structure of Chinese...
might facilitate children’s ability to read and write Chinese words because it might facilitate partial recognition of words based on known morphemes in multi-morpheme words (e.g. McBride-Chang et al., 2003).

Visual skills and Chinese literacy acquisition

Visual skills might also be important for very young Chinese children learning to read and write because of the unique visual-orthographic features of the Chinese script. The Chinese character is the basic unit of written Chinese, and it is composed of unpronounceable strokes written according to a set of conventional rules and appearing as a square shape with both a horizontal and vertical dimension, emphasising visual–spatial relationships. Moreover, many single Chinese characters learned at an early stage are composed of repeated strokes that may be laid out in slightly different visual patterns. For example, the single Chinese character 田 (field) can be changed to reflect different simple Chinese characters 田 (cause), 今 (first), 田 (old) and 田 (dawn) representing different meanings simply by moving one stroke in different directions in space. Hence, the extent to which children memorise or distinguish visual-orthographic patterns might be related to children’s reading progress in beginning literacy. Moreover, the linkage of sound and meaning with a specific visual-graphic pattern is largely arbitrary (Weekes, Davies & Chen, 2002). For example, the nearly similar visual-orthographic patterns such as /si6/ (soldier), /tou2/ (soil), /soeng5/ (up) and /gung1/ (work) represent totally different meanings with distinct sounds and these single characters are usually encountered by young children at an early stage of reading. In addition, some Chinese complex characters are also composed of less visually distinct strokes and components, for example 书 (book) and 画 (picture) or 聆 (listening) and 读 (reading), and these may require children to be aware of the specific visual and spatial structures of individual characters. Thus, visual cues themselves may be helpful particularly in the early stages of reading development. Ideas about visual cues as important for early literacy development have been linked to English by Gough and Juel (1991) and to Hebrew by Share and Gur (1999). However, the striking visual-orthographic features of Chinese characters make visual skills particularly important for identifying and retrieving words in Chinese script from their stored visual-orthographic patterns. There is some evidence of the importance of visual skills for very early Chinese reading acquisition (Ho & Bryant, 1997b; Huang & Hanley, 1997; McBride-Chang, Chow, Zhong, Burgess & Hayward, 2005; McBride-Chang, Cho, et al., 2005; Siok & Fletcher, 2001). However, fewer studies have reported the relationship of visual skill to Chinese word dictation. The present study extended this work by examining visual skills in relation to both reading and dictation in Chinese longitudinally.

Phonological awareness and Chinese literacy acquisition

Phonological awareness has also been linked to reading development in Chinese children (e.g. Chen et al., 2004; Ho & Bryant, 1997a; Siok & Fletcher, 2001). In the present study, we measured phonological awareness using syllable awareness because the importance of different psycholinguistic units in relation to word reading depends upon the way in which speech is represented in a given orthography (e.g. Ziegler & Goswami, 2005).
Chinese, syllable awareness is a strong correlate and longitudinal predictor of reading acquisition in young children because the syllable maps directly onto a character or morpheme, the basic functional writing or meaning unit of Chinese (e.g. Chow, McBride-Chang & Burgess, 2005; McBride-Chang, Bialystok, Chong & Li, 2004; McBride-Chang & Ho, 2000; McBride-Chang & Kail, 2002). However, few, if any, studies have examined this syllable awareness in relation to word dictation as we did in an extension of this research in the present study. Presumably, Chinese children’s abilities to segment words into syllables can also facilitate early spelling abilities. Although Chinese children make a variety of errors at the character level in spelling words (e.g. Shen & Bear, 2000), some of the first errors beginners in Chinese make are simply forgetting how to write one or another character comprising a multi-morpheme multi-syllable Chinese word.

The present study

As more is learned about cognitive correlates of reading in Chinese, our exploration of early literacy skills required to learn to read and write in Chinese expands. In the present study, we administered a fairly comprehensive battery of tasks to Chinese children in order to examine how these tasks predicted subsequent word reading and dictation. The battery of tasks included measures of morphological awareness, visual skill and phonological awareness. Few previous studies have tapped such a wide range of cognitive abilities in young Chinese children, particularly longitudinally. We hypothesised that measures of all three areas would uniquely predict subsequent reading and dictation for young Hong Kong Chinese children, underscoring the importance of a wide range of different cognitive abilities for mastering the Chinese script, a script that, at least on the surface, differs appreciably in morphological, visual and phonological characteristics from alphabetic orthographies.

Method

Participants

One hundred and eighty-seven children (102 girls, 85 boys) attending second year kindergarten in Hong Kong were tested three times between 2004 and 2006. Children were initially tested in September–December 2004, when their mean age was 4 years 4 months (SD = 3 months). Children’s word recognition skills were then re-tested in June–August 2005, as part of a larger study. At the second testing time, children’s mean age was 5 years 2 months (SD = 3 months). Children were tested a third time in June–August 2006 when their mean age was 6 years 1 month (SD = 3 months). All children were native Cantonese speakers, and all of them were of normal health and intelligence, without any developmental delays, according to parental reports. These participants were part of a larger longitudinal project, and they were all recruited from Cantonese-speaking families spanning across the New Territories, Kowloon and Hong Kong Island, three districts of Hong Kong.

Our sample was relatively homogeneous in terms of the family’s social economic status, home literacy and language exposure: to begin with, these children were drawn from a fairly similar socioeconomic background family. For example, in over 89.3% of the families, the father’s income was around 20,000–40,000 HK dollars, and in 51%
of the families, the mother’s income was around 10,000–40,000 HK dollars. According to the Hong Kong population by census, these incomes are in the medium-level range (Hong Kong Census and Statistics Department, 2006). In addition, over half of the children’s mothers and fathers had received some college and university education. From the perspective of home literacy, the present sample was also homogeneous: over 76% of these families reported that they had between 11 and 100 books at home, 9% of the families reported that the number of children’s books at home was over 100 and 5% of these families reported that they had between 5 and 10 books. In addition, 80.7% of the parents reported that they read storybooks with their children. Moreover, 85% of the parents chose toys with Chinese characters on them for their children to play with, and 68% of the families claimed to play games involving combining Chinese characters to make words. Finally, in terms of language learning experience, 96% of the families reported that their home language was Cantonese. Also, 89% of the parents reported that they had started teaching their children to recognise or read words around the age of 2–3 years old, and 72.7% of the families had chosen to teach children how to write characters at home around age 3–4.

All participating children in our sample received a standard Hong Kong curriculum in a school with Cantonese as the medium of instruction. In these schools, in contrast to what goes on in other Chinese societies (e.g. Mainland China, Singapore, Taiwan), no phonetic training was given to children as an aid to word recognition. Rather, children were taught to learn Chinese words via the ‘look and say’ method in which the teachers read aloud the whole word and children are encouraged to memorise it. Moreover, across Hong Kong, children begin to learn to write in Chinese formally at school at around the age of 4–5 (Cheung, Chan & Chong, 2007), relatively early compared with other Chinese societies. This also makes it feasible to test Hong Kong kindergarteners’ early reading and writing.

**Measures**

**Chinese character recognition.** A 61-item character recognition test and 150 items test adopted from the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD; Ho, Chan, Tsang & Lee, 2000) were combined together for assessing Chinese children’s word reading. The first test (e.g. McBride-Chang & Ho, 2000) was composed of 27 single Chinese characters and 34 two-character words and the second test consisted of all two-character words. The items in both tests were arranged in order of increasing difficulty and the children were asked to read out the words from left to right and the top to the bottom. If the children continued through the end of the first 61-item list, the second test consisting of 150 two-character words was given. The testing stopped either when the children failed 10 consecutive items in the first test or 15 items in the second test. The first test and second test were administered at both time 1 and time 2. At time 3, only the second test was given because children had reached ceiling on the first test. The maximum possible score of the combined task was 211 and of the second test was 150.

**Chinese word dictation.** This task was administered at time 3 only because pilot testing of the children involved in this study suggested that they were too young to participate until this time, and recognition skills (i.e. Chinese character recognition) typically precede production skills (i.e. word dictation) in development. The task consisted of 20 two-character words adopted from HKT-SpLD (Ho et al., 2000). The items were ranked by increasing difficulty. In the testing, the experimenter individually read aloud each
word, and the children were asked to write each in the blank space. Each correctly written character was given 1 mark. That is, within every two-character word, children could get up to 2 points for a correct answer. Testing stopped when the children failed to write five consecutive words. The maximum score was 40.

Raven’s Progressive Matrices. The book form of the Raven’s Coloured Progressive Matrices (RCPM; Raven, Court & Raven, 1995) was used to measure children’s nonverbal reasoning ability at time 1 only. This study only used set A and set B, with 12 items for each set, respectively. Each item consisted of a big figure with one part of the complete pattern removed. Children were asked to find the correct portion of the pattern among six choices to complete the figure. The maximum score of this task was 24.

Vocabulary definitions. In order to control for general verbal reasoning, a vocabulary definition task was used to measure children’s vocabulary knowledge at time 1. Forty-six vocabulary words ranked according to increasing difficulty levels were selected from Hong Kong Chinese children’s reading books (Zhuang, 2000), and they were initially piloted with children of the same age. The marking scheme for the task was adopted from the Stanford–Binet Intelligence Scale vocabulary subtest (Thorndike, Hagen & Sattler, 1986). A scoring scheme for each word was designed with reference to a Chinese dictionary (Lau, 1999). Sample answers for zero to 2 points per item were included in the scoring scheme. Scores of 0, 1 or 2 were given for children’s answers for each question. The children were asked to give an oral explanation of each concept or object. After the pilot testing, two well-trained research assistants coded children’s answers and the inter-rater reliability was 69%, $\kappa (N=506) = .69, p < .001$ from the pilot data. Testing stopped when the children failed to give the correct answer across five consecutive words. The maximum possible score for this task was 92.

Homophone identification. A homophone identification task consisting of four practice items and nine test items was also administered at time 1 only. For each item, children’s task was to identify the homophone, from among four choices, with an identical meaning to the target morpheme. In the testing, children were visually presented with four pictures representing four different two-syllable objects or concepts for each item. Three of these included the same homophone; the fourth choice was a semantic-related distractor. In one item, for example, the child saw a spider 蟻 /zi1 zyu1/, a piglet 豬仔 /zyu1 zai2/, a water ball (literally, a drop of water) 水球 /seoi2 zyu1/ and an ear 聽 /ji5 do2/. The target word was /ngaan5 zyu1/眼珠 (eyeball). The first three of these choices all included an identical tonal syllable /zyu1/ representing three homophones (pig, ball and spider). The other one was a semantic-related distracter of the target morpheme, in this case a different part of the face. For each item, experimenters first orally labelled the four pictures, and the participants were required to repeat these. Then, a two-syllable word containing the target tonal syllable or morpheme was orally presented to the children, for example /ngaan5 zyu1/眼珠 (eyeball). Children were then asked to choose from among the four pictures the one that best represented the meaning of the target morpheme (e.g. / zyu1/珠). The correct answer for the above example was the picture showing a waterball 水球 /seoi2 zyu1/ because the syllable /zyu1/ represented the same meaning, ball, when it was used within two words, that is waterball vs eyeball. An example of this task from English would be similar to the morphological identification task used in a previous study of vocabulary knowledge (McBride-Chang, Wagner, Muse, Chow & Shu, 2005). In that
task, children were orally presented with pictures that were labelled (e.g. ‘the wind blew’ vs ‘blue sky’) and then asked to select the picture that best represented the ‘blue’ in the word ‘blueberries’ (the answer in this case is ‘blue sky’ because this is the colour homophone of the word found in ‘blueberries’). This task was identical to the one used in the present study except for the fact that in the present study there were four choices for each targeted homophone rather than two. Each correct answer was allotted 1 point. Testing discontinued when children failed in five consecutive items. The maximum score of this task was 9.

**Morphological construction.** A 20-item morphological construction measure, successfully used in previous studies of Chinese literacy skills (e.g. McBride-Chang et al., 2003) was administered at time 1 only. It consisted of two practice items and 20 test items. For each item, children were orally presented with a three-sentence scenario describing one object or concept, and children were asked to actively compound morphemes for a newly described object or concept based on the prior illustration of the scenario. For example, ‘There is one type of oil made using peanuts; we call it peanut oil (faa1 saang1 jau4). What would we call a type of oil that is made using mushrooms?’ The correct answer would be *mushroom oil* (mo4 gu1 jau4). In order to ensure that the first several items were as easy to understand as possible for kindergarteners, two practice items were accompanied with picture illustrations. However, test items consisted of more abstract items and no pictures were used to aid understanding. The maximum score on this task was 20.

**Visual–spatial relationships.** A subtest from Gardner’s (1996) Test of Visual-Perceptual Skills (n-m) Revised (1996) was used to measure children’s visual skills at time 1 only. It was composed of one practice item and 16 test items. For each test item, five line drawings were presented to the children, of which one target drawing or part of one target drawing was different from the others. Children were asked to compare line drawings and detect a target one. One mark was given for each correct answer. Testing stopped if children failed on four consecutive items. The maximum possible score was 16.

**Syllable deletion.** This phonological awareness measure consisted of 15 real three-syllable Cantonese words, from which the first, middle and last syllable, respectively, were required to be deleted by children (e.g. in Cantonese, hung4 luk6 dang1 without luk6 would be hung4 dang1). One point was allotted for each correct answer. Testing stopped if children failed on five consecutive items. The maximum score of the task was 15.

**Procedure**

Consent was obtained from parents of children in this study and a convenient testing time was arranged for all the children and their caregivers. The children, located all over Hong Kong, were individually tested on all measures at home by trained psychology majors. All the tests in the study were administered in a single session with a 15-minute break in between. Thus, testing lasted about 1–1.5 hours.

**Results**

Means, standard deviations, ranges and reliabilities for the measures of vocabulary, nonverbal IQ, phonological awareness and morphological awareness, visual skills, along
with the measures of word reading and word dictation across time are summarised in Table 1. As noted, the reliabilities of all the word reading-related tasks included in this study ranged from .51 to .99. As indicated in Table 2, Chinese word reading at time 1 strongly correlated with the same measure at time 2 (r = .81) and time 3 (r = .63), as well as with the Chinese word dictation measure at time 3 (r = .48). Moreover, all the other time 1 measures were significantly correlated with Chinese word reading across time and Chinese word dictation at time 3. Thus, homophone identification and morphological construction were consistently correlated with reading outcome measures across time. The visual–spatial relationships and Chinese word reading measures were also moderately correlated across time, ranging from .30 to .43. In addition, the association of syllable deletion at time 1 to Chinese word reading across times 1, 2 and 3 was quite stable, with correlation coefficients of .40, .41 and .34, respectively. All of these four theoretically interesting constructs were moderately correlated with Chinese word dictation at time 3, with coefficients ranging from .17 to .35.

Table 1. Means, standard deviations, ranges and reliabilities for all of the variables used across time.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Mean</th>
<th>SD</th>
<th>Reliability</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>T3 Chinese word reading</td>
<td>31.34</td>
<td>26.16</td>
<td>.99</td>
<td>0–112</td>
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<tr>
<td>T3 Chinese word dictation</td>
<td>15.82</td>
<td>7.15</td>
<td>.51</td>
<td>0–36</td>
</tr>
<tr>
<td>T2 Chinese word reading</td>
<td>48.63</td>
<td>21.85</td>
<td>.98</td>
<td>1–121</td>
</tr>
<tr>
<td>T1 Chinese word reading</td>
<td>26.10</td>
<td>16.17</td>
<td>.97</td>
<td>0–87</td>
</tr>
<tr>
<td>T1 vocabulary definitions</td>
<td>13.82</td>
<td>6.83</td>
<td>.91</td>
<td>0–56</td>
</tr>
<tr>
<td>T1 Raven’s Progressive Matrices</td>
<td>11.03</td>
<td>2.40</td>
<td>.51</td>
<td>5–20</td>
</tr>
<tr>
<td>T1 syllable deletion</td>
<td>7.45</td>
<td>4.92</td>
<td>.92</td>
<td>0–15</td>
</tr>
<tr>
<td>T1 homophone identification</td>
<td>5.44</td>
<td>1.83</td>
<td>.53</td>
<td>0–9</td>
</tr>
<tr>
<td>T1 morphological construction</td>
<td>6.71</td>
<td>4.14</td>
<td>.84</td>
<td>0–18</td>
</tr>
<tr>
<td>T1 visual–spatial relationships</td>
<td>8.02</td>
<td>4.84</td>
<td>.90</td>
<td>0–16</td>
</tr>
</tbody>
</table>

Note: N = 187. The capitalised T and its numeral at the end of each variable represent the time in which it was measured.

Table 2. Inter-correlations among all of the variables controlling for age.

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. T3 Chinese word reading</td>
<td>–</td>
<td>.62***</td>
<td>–</td>
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<td></td>
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<tr>
<td>2. T3 Chinese word dictation</td>
<td>.62***</td>
<td>–</td>
<td>.57***</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. T2 Chinese word reading</td>
<td>.63***</td>
<td>.48***</td>
<td>.81***</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>4. T1 Chinese word reading</td>
<td>.19***</td>
<td>.28***</td>
<td>.18***</td>
<td>.27***</td>
<td>–</td>
<td></td>
<td></td>
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<tr>
<td>5. T1 vocabulary definitions</td>
<td>.18***</td>
<td>.22***</td>
<td>.35***</td>
<td>.15**</td>
<td>–</td>
<td></td>
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<tr>
<td>6. T1 Raven’s Progressive Matrices</td>
<td>.34***</td>
<td>.41***</td>
<td>.40***</td>
<td>.36***</td>
<td>.25**</td>
<td>–</td>
<td></td>
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<tr>
<td>7. T1 syllable deletion</td>
<td>.22***</td>
<td>.17***</td>
<td>.24***</td>
<td>.14***</td>
<td>.17**</td>
<td>.10**</td>
<td>.12**</td>
<td>–</td>
<td></td>
<td></td>
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<tr>
<td>8. T1 homophone identification</td>
<td>.30***</td>
<td>.28***</td>
<td>.34***</td>
<td>.45***</td>
<td>.34***</td>
<td>.31***</td>
<td>.55***</td>
<td>.12</td>
<td>–</td>
<td></td>
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<tr>
<td>9. T1 morphological construction</td>
<td>.35***</td>
<td>.30***</td>
<td>.38***</td>
<td>.43***</td>
<td>.46***</td>
<td>.38***</td>
<td>.05</td>
<td>.45***</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>10. T1 visual–spatial relationships</td>
<td>.35***</td>
<td>.30***</td>
<td>.38***</td>
<td>.43***</td>
<td>.46***</td>
<td>.38***</td>
<td>.05</td>
<td>.45***</td>
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</tr>
</tbody>
</table>

Note: The capitalised T and its numeral at the end of each variable represent the time in which it was measured. p < .05; ** p < .01; *** p < .001.
regression equations, vocabulary definitions, Raven’s Progressive Matrices and age, were entered as control variables in the first step in order to control for basic verbal and nonverbal reasoning as well as age. To examine the independent contribution of each measure involving morphological awareness, phonological awareness and visual skill to Chinese word reading and Chinese word dictation across times, syllable deletion, morphological construction, homophone identification and visual–spatial relationships were each entered at the final step. Specifically, to examine the unique contribution of phonological awareness to word reading and dictation, the morphological construction, homophone identification and visual–spatial relationship tasks were entered first, and then syllable deletion was entered in the final step. Similarly, to examine the independent roles of homophone awareness and visual skills, they were entered as the fifth step after the other variables were entered into the equation. These analyses are reported in Tables 3 and 4, with coefficients of standardised $\beta$, $R^2$ and $R^2$ changes shown there.

### Table 3. Hierarchical regression predicting Chinese word reading across times 1–3, and time 3 Chinese word dictation from all time 1 measures without controlling time 1 word reading.

<table>
<thead>
<tr>
<th>Step and variables</th>
<th>T1 word reading</th>
<th>T2 word reading</th>
<th>T3 word reading</th>
<th>T3 word dictation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Delta R^2$</td>
<td>$\beta$</td>
<td>$\Delta R^2$</td>
<td>$\beta$</td>
</tr>
<tr>
<td>1. T1 controlled variables</td>
<td>.186***</td>
<td>–</td>
<td>.085**</td>
<td>–</td>
</tr>
<tr>
<td>2. T1 morphological construction</td>
<td>.089***</td>
<td>.190*</td>
<td>.066***</td>
<td>.065</td>
</tr>
<tr>
<td>3. T1 homophone identification</td>
<td>.015*</td>
<td>.135</td>
<td>.043***</td>
<td>.219***</td>
</tr>
<tr>
<td>4. T1 visual–spatial relationships</td>
<td>.034**</td>
<td>.212**</td>
<td>.060***</td>
<td>.270***</td>
</tr>
<tr>
<td>5. T1 syllable deletion</td>
<td>.011*</td>
<td>.135</td>
<td>.037**</td>
<td>.244***</td>
</tr>
<tr>
<td>2. T1 syllable deletion</td>
<td>.068***</td>
<td>–</td>
<td>.109***</td>
<td>–</td>
</tr>
<tr>
<td>3. T1 visual–spatial relationships</td>
<td>.039***</td>
<td>–</td>
<td>.047**</td>
<td>–</td>
</tr>
<tr>
<td>4. T1 morphological construction</td>
<td>.025**</td>
<td>–</td>
<td>.005</td>
<td>–</td>
</tr>
<tr>
<td>5. T1 homophone identification</td>
<td>.017</td>
<td>–</td>
<td>.044**</td>
<td>–</td>
</tr>
<tr>
<td>2. T1 syllable deletion</td>
<td>.068***</td>
<td>–</td>
<td>.109***</td>
<td>–</td>
</tr>
<tr>
<td>3. T1 visual–spatial relationships</td>
<td>.039**</td>
<td>–</td>
<td>.047**</td>
<td>–</td>
</tr>
<tr>
<td>4. T1 homophone identification</td>
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<td>–</td>
<td>.047**</td>
<td>–</td>
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<tr>
<td>5. T1 morphological construction</td>
<td>.021</td>
<td>–</td>
<td>.002</td>
<td>–</td>
</tr>
<tr>
<td>2. T1 syllable deletion</td>
<td>.068***</td>
<td>–</td>
<td>.109***</td>
<td>–</td>
</tr>
<tr>
<td>3. T1 morphological construction</td>
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<td>4. T1 homophone identification</td>
<td>.013*</td>
<td>–</td>
<td>.038**</td>
<td>–</td>
</tr>
<tr>
<td>5. T1 visual–spatial relationships</td>
<td>.027**</td>
<td>–</td>
<td>.044**</td>
<td>–</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.335</td>
<td>–</td>
<td>.290</td>
<td>–</td>
</tr>
</tbody>
</table>

**Note:** The capitalized T and its numeral at the end of each variable represent the time in which it was measured.

$p < .10$; $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Explaining concurrent and subsequent word reading

The first question focused on whether phonological awareness, morphological awareness and visual skills had an independent impact on Chinese word reading across time. We first examined these associations without controlling time 1 word reading in order to see the concurrent associations of these cognitive/linguistic skills with time 1 word reading, as well as their longitudinal associations with word reading and dictation in Table 3, and subsequently further controlled time 1 reading in Table 4.

As shown in Table 3, homophone identification, morphological construction and visual skills all contributed additional variance to Chinese character recognition at time 1 and...
they explained approximately 2%, 2% and 3% of the variance of Chinese word reading, respectively, when age, vocabulary knowledge, nonverbal IQ and other reading-related constructs were statistically controlled. However, the pattern of the relationship of each of the measures to Chinese word reading was different across time. The analysis revealed that syllable deletion made an independent contribution to subsequent word reading, as shown in Table 3. It explained approximately 4% and 2% of the variance in Chinese word reading at time 2 and time 3, respectively, after controlling for age, vocabulary, nonverbal IQ, phonological awareness and visual skills. Similarly, homophone identification also uniquely explained 4% of the variance of Chinese word reading for both time 2 and time 3, after accounting for effects of age, vocabulary, nonverbal IQ, phonological awareness and visual skills. However, morphological construction did not. In addition, visual skills appeared to account for unique variance in subsequent word reading, approximately 4% of the variance in Chinese word reading for both time 2 and time 3.

The final standardised βs reported in Table 3 further supported the idea that the patterns of association of each of the morphological awareness measures with Chinese word reading across time were somewhat different. Although both homophone identification and morphological construction were uniquely associated with concurrent Chinese word reading, only homophone identification was a unique predictor of subsequent word reading. Across equations, visual–spatial relationships also emerged as a unique predictor of Chinese word reading apart from homophone identification, syllable deletion, verbal knowledge, nonverbal IQ and age. In addition, syllable deletion was significantly associated with subsequent Chinese word reading even after statistically controlling for the effects of all other variables. In a more stringent test of the unique effect of homophone awareness, morphological construction and visual skills, as well as...
phonological awareness, on reading, we also controlled for time 1 Chinese word reading in additional regression analyses shown in Table 4. As indicated in Table 4, syllable deletion only explained approximately 1% of variance of Chinese word reading at time 2, after accounting for the variance of the auto-regressor and the controlled variables including vocabulary, nonverbal IQ and other reading-related constructs. However, its contribution decreased and was nonsignificant for Chinese word reading at time 3. Only homophone identification consistently explained approximately 2% and 1% of variance of Chinese word reading across time 2 and time 3. As the standardised βs show in Table 4, only homophone identification survived as a unique predictor of Chinese word reading across both time 2 and time 3. In contrast, syllable deletion was only uniquely associated with Chinese word reading measured 1 year later but not for the reading measures 2 years later. Similarly, the effects of the visual–spatial relationship measure on subsequent reading became nonsignificant when the effects of the auto-regressor and other reading-related variables were partialled.

**Predicting subsequent Chinese word dictation**

To examine the unique contribution of measures of homophone identification, morphological construction, visual–spatial relationship and syllable deletion to subsequent Chinese word dictation (administered at time 3 only), regression analyses explaining Chinese word dictation without controlling auto-regressive effects are reported in Table 3. The analysis revealed that syllable deletion made a contribution of approximately 2% to Chinese word dictation, and visual–spatial relationships uniquely explained about 3% of the variance in Chinese word dictation when age, vocabulary knowledge, nonverbal IQ and other reading-related constructs were statistically controlled. Moreover, the standardised βs presented in Table 3 further suggested that both syllable deletion and visual–spatial relationships were uniquely associated with Chinese word dictation even after the effects of verbal knowledge, nonverbal IQ, age and all the other variables were removed. However, the independent effects of syllable deletion and homophone identification on Chinese word dictation did not persist after controlling for the auto-regressor, vocabulary knowledge, nonverbal IQ and other reading-related constructs, as shown in Table 4. To summarise, syllable deletion, visual–spatial relationships and homophone identification were all associated with Chinese word reading, though the role of syllable deletion in word reading decreased as children developed. Only homophone identification and syllable deletion persisted as significant predictors of Chinese word reading after controlling for time 1 word reading and other reading-related measures. In contrast, both syllable deletion and visual–spatial relationships explained unique variance in Chinese word dictation beyond vocabulary knowledge, nonverbal IQ and other constructs. However, neither of these was significantly associated with subsequent Chinese word dictation once the effect of time 1 Chinese word reading was statistically controlled. No unique significant association was found between homophone identification and Chinese word dictation longitudinally.

**Discussion**

The present study sought to examine the extent to which homophone awareness, morphological construction, visual skills and syllable awareness would independently
explain both concurrent and subsequent Chinese word reading and subsequent word dictation. In most of these analyses, homophone awareness, visual skills and syllable awareness were uniquely associated with Chinese word reading, but the strength of each construct in predicting word reading varied across time. Perhaps most impressive, homophone awareness was consistently uniquely associated with Chinese character recognition. Surprisingly, however, none of these cognitive abilities was strongly linked to early word dictation/writing in Chinese. Findings on these different patterns of cognitive/linguistic measures with word reading and word dictation might reflect the variation in requisite skills for early reading and writing. Results imply that the development of word reading and writing in Chinese not only reflects overlapping processes but also differences or separation across these two processes.

Our findings on homophone awareness move beyond previous research on homophones and concurrent reading (Li et al., 2002; McBride-Chang et al., 2003; Shu et al., 2006) to demonstrate its early importance for reading development in young Chinese children. Moreover, this particular morphological awareness task, based on the linguistic structure of Chinese, showed little or no correlation with measures of phonological awareness. Thus, measuring morphological awareness in this way may avoid confounding morphological awareness with measures of phonological awareness, a concern in previous research on alphabetic languages (Mann, 2000). Homophones are particularly salient for Chinese word reading, mainly because there are such a large number of homophones in the Chinese language system. Moreover, children’s sensitivity to the homophone, an identical syllable with different meanings and different written forms, may facilitate children’s ability to map specific sounds with specific morphemes. Hence, learning to read Chinese likely requires the ability to keep track of many morphemes sharing identical sounds.

In contrast, the morphological construction task used in this study was not longitudinally associated with Chinese word reading with other reading-related abilities controlled. These results are likely attributable to the fact that this task was relatively highly associated with the syllable deletion \((r = .55)\) and vocabulary \((r = .34)\) tasks, important covariates in the present study. This overlap may have diminished the importance of this task relative to the phonological awareness measure in subsequent regression analyses. Nevertheless, this task has been demonstrated to be uniquely associated with word reading in previous research (e.g. McBride-Chang, Cho, et al., 2005), and it was significantly moderately associated with reading as well in the present study. Therefore, it may be useful to continue to explore this task of morphological awareness in future studies, both as a direct predictor of Chinese word reading and as an indirect predictor of reading through its association with vocabulary knowledge.

Interestingly, visual skill also emerged as a unique concurrent predictor of word reading among young Hong Kong children. Several previous studies have suggested that visual skill plays an important role in learning to read Chinese in Hong Kong children (e.g. Ho & Bryant, 1997a, 1997b; Huang & Hanley, 1995). For example, one 4-year longitudinal study following up 3–4-year-old young Hong Kong children showed that visual skill is an early precursor of Chinese reading (Ho & Bryant, 1997a). The finding of the present study further supports the importance of visual skill as a predictor of early Chinese reading from a longitudinal perspective. Given the features of the Chinese writing system, the beginner may benefit from using a whole-character strategy to recognise visual forms in print. In addition, given the great number of homophones in
Chinese, apart from making use of context clues to distinguish these homophones, children may gradually begin to discriminate between them by using visual forms to disambiguate them. Hence, visual skill may be necessary for young Chinese children learning to read words.

Syllable awareness, a phonological awareness measure, was fairly consistently associated with early literacy acquisition in the present study. These results are in line with those of previous studies of early reading acquisition (e.g. Ho & Bryant, 1997a; McBride-Chang & Ho, 2000). Such results underscore the importance of phonological awareness at the syllable level among the youngest Chinese readers (McBride-Chang & Ho, 2000; McBride-Chang et al., 2004) because one Chinese character maps onto a single syllable and it is not decomposed into meaningful subsyllabic units (Siok & Fletcher, 2001). The syllable awareness measure was not significantly associated with time 3 Chinese word reading with the auto-regressive effects of previous reading controlled, though it was significantly associated with time 2 reading. Perhaps the importance of syllable awareness diminishes as Hong Kong Chinese children advance in literacy skills, partly as a function of changes in strategies for word reading with development. As children’s reading skills improve, they are likely to have an increased understanding of the Chinese orthography, and they may prefer to rely on different kinds of information, such as morphosyntactic and visual-orthographic context cues, to facilitate word reading. Thus, the role of syllable awareness may become less salient with reading experience. Overall, the associations of homophone awareness, visual skill and syllable awareness with Chinese word dictation were somewhat similar to those with Chinese word reading. Word reading and dictation in Chinese likely share the same processing mechanisms (e.g. Ehri, 1997; Perfetti, 1997), but the associations of metalinguistic skills with each of these might vary across scripts (Koda, 2000; Walker & Hauerwas, 2006) and with development (Carlisle, 2000; Deacon, Wade-Woolley & Kirby, 2007). The fact that our patterns of association of cognitive/linguistic skills with Chinese word reading and word dictation differed is in line with Perfetti’s psycholinguistic theory, which posits that word recognition and spelling follow different routes, as constrained by the properties of a given writing system (Perfetti, 1997). However, because we only measured word dictation at time 3, it was not possible to systematically compare the importance of each construct with Chinese word reading and Chinese word dictation across time in the present study. Moreover, in regression equations, the strengths of association for each individual cognitive ability with word dictation, statistically controlling for other cognitive skills, were small relative to the findings for word reading. Future work may probe further into the importance of additional cognitive skills, such as hand copying or analogical thinking for early Chinese spelling development. The importance of these findings lies in our attention to varied cognitive constructs in relation to early literacy development in Chinese. The unique characteristics of Chinese demand that cognitive skills beyond traditional phonological processing measures typically included in studies of alphabetic literacy development (e.g. Anthony & Lonigan, 2004; Castles & Coltheart, 2004; Ziegler & Goswami, 2005) be considered in understanding reading and writing acquisition in Chinese. Although most effects were modest, the results described here broaden the view of earliest literacy development in Chinese from phonological processing only to include additional aspects of morphological awareness and visual skills. Given that approximately 20% of children worldwide learn Chinese as their first language and script and the increasing popularity of Chinese as a second language around the world,
a continued exploration of constructs beyond phonological processing may be useful for improving Chinese literacy skills in diverse populations.

There were at least two limitations of the present study. First, all measures included represented single indicators of constructs we attempted to measure. A broader array of tasks representing each construct would improve the generalisability of our results. Second, the measures of morphological awareness and phonological awareness included in the present study were centred on the lexical level without considering the effects of subcharacter information. It is well known that most regularly used characters in Chinese are semantic–phonetic compounds, which consist of a semantic radical and a phonetic radical. This subcharacter information has been demonstrated to play a role in how children learn to read and understand Chinese words (e.g. He, Wang & Anderson, 2005). In future research, it might be theoretically interesting to compare the contribution of sub-lexical and lexical information to Chinese literacy acquisition by including measures of sub-lexical or subcharacter awareness. Despite these limitations, however, the results of this study provide additional support for the notion that homophone awareness, visual skill and syllable awareness may be uniquely important in understanding Chinese literacy development, in very beginning readers and writers. We have also demonstrated that, in contrast to many other reading-related skills, which typically share relatively high associations with one another, our homophone awareness task is fairly independent of phonological awareness. The findings of the study highlight the potential importance of diverse cognitive skills for early Chinese literacy acquisition.

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Notes

1. The Cantonese examples used in this paper are presented in the symbols of the Linguistic Society of Hong Kong Cantonese Romanisation Scheme (1993). The numeral at the end of each phonetic transcription indicates the tone of the character.
2. Chinese character recognition is a standardised test assessing Hong Kong Cantonese-speaking children’s word reading. In Chinese, the Chinese character and word are not strictly distinguished. A Chinese character can be a single word itself or a morpheme in a multi-syllable/multi-character word (Cheung et al., 2007). In this paper, Chinese word reading was used consistently to represent the process of Chinese children’s accurate oral recognition of either isolated printed Chinese characters or two-character words.

References


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Lau, B.S. (1999). *中華新詞典 (ZhongHua Xin Ci Dian)*. Hong Kong: Zhonghua shu ju (Xianggang) you xian gong si. you xian gong si.


Xiuli Tong is an assistant professor in the Division of Speech and Hearing Sciences at the University of Hong Kong. She focuses on bilingual environmental-infants’ speech-specific pitch perception, cognitive perspectives of language processing, reading development and reading difficulties across languages.

Catherine McBride-Chang is Professor and Director of the Developmental Centre in the Psychology Department of The Chinese University of Hong Kong. She is particularly interested in reading development and impairment across cultures.

Anita M.-Y. Wong is an Associate Professor at the University of Hong Kong. Her research focuses on language development and disorders in Chinese children. Her current work examines the implications of oral language impairment on literacy development.

Hua Shu is Professor of Cognitive and Developmental Psychology at StateKey Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University. She is especially interested in reading development and impairment in Chinese children.

Pieter Reitsma is professor of developmental psychology at PI Research Amsterdam. His research interest is focussed on the development of reading and spelling skills.

Judith Rispens is a postdoctoral researcher at the Amsterdam Center for Language and Communication at the University of Amsterdam (The Netherlands). Her research focuses on the relation between oral language skills and literacy development in typically developing children and in children with language and reading impairments. Her research furthermore involves comparing language profiles of children with developmental dyslexia with those of children with specific language impairment (SLI).

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Address for correspondence: Catherine McBride-Chang, Department of Psychology, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong. E-mail: cmcbride@psy.cuhk.edu.hk