Phonological Processing Skills and Early Reading Abilities in Hong Kong Chinese Kindergarteners Learning to Read English as a Second Language

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The present 9-month longitudinal study investigated relations between Chinese native language phonological processing skills and early Chinese and English reading abilities among 227 kindergarteners in Hong Kong. Phonological awareness, rapid automatized naming, and short-term verbal memory differed in their relations to concurrent and subsequent Chinese and English word recognition. The significant bidirectional relations between phonological awareness and Chinese reading ability remained even after accounting for the variance due to age, vocabulary, and visual skills performance. When all predictors were considered simultaneously, only phonological awareness remained a significant predictor of Chinese and English reading abilities both concurrently and longitudinally.

Phonological Processing Skills

Phonological processing skills refer to those required in the processing of written and oral language with the use of phonological information (Wagner & Torgesen, 1987). Over past decades, empirical research has demonstrated the importance of phonological processing skills in early reading acquisition (e.g., Bradley & Bryant, 1985; Siok & Fletcher, 2001). The importance of phonological processing skills for reading is not specific to alphabetic orthographies. Rather, there is some evidence that phonological processing skills are also useful for reading nonalphabetic scripts, such as Chinese (Chan & Siegel, 2001; Hu & Catts, 1998).

Wagner and Torgesen (1987) identified three primary phonological processing skills. These were phonological awareness, phonological recoding in lexical access, and short-term verbal memory. Phonological awareness is the awareness of and access to the sound system of one’s language. It can be measured using tasks that involve identification and manipulation of speech sounds, such as tapping out the number of sounds in a word, reversing the order of sounds in a word, or putting sounds together to form a word (Lewkowicz, 1980; Mattingly, 1972). Phonological recoding in lexical access refers to recoding a written word into a sound-based system to retrieve the lexical referent of that written word, and it is typically assessed by tasks of rapid automatized naming of objects, colors, numbers, and other kinds of stimuli (Wagner & Torgesen, 1987). Short-term verbal memory refers to brief verbatim retention of verbal items, and it can be measured by tasks requiring immediate and ordered recall of sequences of verbal items, such as digits and words (Torgesen, Wagner, & Rashotte, 1994). Converging research studies have shown positive relations between reading abilities and phonological awareness (e.g., Bradley & Bryant, 1985; Cunningham, 1990; Ho & Bryant, 1997a; Huang & Hanley, 1997; Mann, 1984; Mann & Liberman, 1984; McBride-Chang & Kail, 2002; Torgesen, Morgan, & Davis, 1992), phonological recoding in lexical access (Ho & Lai, 1999; Hu & Catts, 1998; Manis, Seidenberg, & Doi, 1999; Wagner et al., 1997), and short-term verbal memory (Ho & Lai, 1999; Mann, 1986; Wagner & Torgesen, 1987).

Although there is generality across phonological processing tasks, there is empirical evidence for their distinctness (e.g., Anthony, Lonigan, Driscoll, Phillips, & Burgess, 2003). In a 5-year longitudinal study, Wagner and colleagues (1997) demonstrated different relations between phonological processing abilities and English word reading among 216 children assessed annually from kindergarten through fourth grade. They found that phonological awareness was related to subsequent word-level reading for every time period tested, whereas serial naming was related to subsequent word-level reading initially and its association faded with development (Wagner et al., 1997). Because the relative contribution of phonological processing skills to reading development is greatly affected by the regularity of the grapheme-phonological correspondence of the orthography, the relative contributions of phonological processing skills to reading may differ across scripts (e.g., Wagner et al., 1997). Thus, the relative importance of different phonological facets for reading across scripts is an important
issue for research (Wimmer, 1993, 1995). In the present study, we examined the relative contribution of these three phonological processing skills to early reading abilities in Chinese and English, respectively.

Longitudinal studies have demonstrated that the relationship between phonological processing abilities and reading-related knowledge is bidirectional. From a longitudinal study of 244 children from kindergarten through second grade conducted by Wagner, Torgesen, and Rashotte (1994), the development of phonological processing abilities—indicated by five correlated latent abilities, including phonological analysis, phonological synthesis, phonological coding in working memory, isolated naming, and serial naming—was found to have bidirectional causal relations with reading acquisition. Wagner et al. (1994) found strong causal influences of phonological processing skills on word decoding and demonstrated more modest causal influences of letter-name knowledge on subsequent phonological processing abilities. Later, Burgess and Lonigan (1998) conducted a 1-year longitudinal study on bidirectional relations of phonological awareness and prereading abilities with 97 children aged 4 to 5. They showed that phonological awareness predicted growth in letter knowledge and letter knowledge contributed to growth in phonological awareness when controlling for children’s age and oral language abilities. Given the evidence for reciprocal relations between phonological processing skills and reading abilities in English, the present study investigated whether these reciprocal relations exist in Chinese reading acquisition.

Different associations between phonological processing skills and Chinese reading acquisition have been shown. McBride-Chang and Ho (2000a) examined the contributions of the three phonological processing skills to Chinese character reading among 109 Hong Kong Chinese 3- and 4-year-olds. Phonological awareness significantly predicted Chinese character recognition after controlling for other phonological processing and vocabulary skills, whereas the importance of verbal memory and naming speed in Chinese character-recognition skills was relatively diminished. When phonological awareness was controlled, verbal memory did not predict Chinese character recognition. However, this was a concurrent study and associations of visual skills to character recognition were not examined.

In addition to phonological processing skills (e.g., Chan & Siegel, 2001; Ho & Bryant, 1997a; Hu & Catts, 1998), visual skills (e.g., Huang & Hanley, 1994; Siok & Fletcher, 2001) are also important predictors of Chinese character recognition in children. Because Chinese is a logographic language, visual skills are said to be crucial for learning to read in Chinese (Tzeng & Wang, 1983). Therefore, in our study aiming to investigate the relationships of phonological processing skills and reading ability, visual skills were controlled. The present study extended the work of McBride-Chang and Ho (2000a), because ours is a fairly large-scale longitudinal study including both phonological processing and visual skills as potential predictors of reading and it examined both Chinese and English reading.

Cross-Linguistic Transfer of Phonological Processing Skills

Apart from the importance of phonological processing skills in first-language reading, several research studies have showed associations between first-language phonological processing skills and second-language reading abilities. For example, Durgunoglu, Nagy, and Hancin-Bhatt (1993) found that phonological awareness in Spanish, the first language of the children tested, predicted how children learned to read new second-language English words. Also, Comeau, Cormier, Grandmaison, and Lacroix (1999) demonstrated that the relation of phonological awareness in English to word-reading ability in each of the languages, English and French, was equivalent to that in French among 122 English-speaking children in French immersion classes. However, few studies on the transfer of phonological processing skills from non-Indo-European languages to Indo-European languages, for example, from Chinese to English, have been conducted.

Some of the few researchers (Gottardo et al., 2001) who have conducted such a study investigated cross-language transfer of phonological processing among 65 Cantonese-speaking children who learned English as a second language. Relations among different phonological processing skills and reading tasks in Chinese and English were examined. Accounting for age and amount of education in the respective language, these researchers found that Chinese rhyme detection was predictive of English word reading. Although this was a comprehensive study investigating the cross-language transfer between Chinese and English, with individual phonological processing skills considered and important confounding variables controlled, their study involved participants with a broad age range (from first grade to eighth grade), and the data were analyzed with all participants involved. Thus, the study included both emerging and fluent readers. Because reading-related skills contribute to reading abilities differently across age (e.g., Wagner et al., 1997), the present study focused only on kindergarteners to examine the relations between phonological processing skills and reading abilities in beginning readers of Chinese and English.

Purposes of the Present Study

To summarize, the present study aimed to examine the associations of three phonological processing skills (phonological awareness, rapid automatized naming, and verbal short-term memory) to both Chinese and English word recognition. On the basis of previous research on phonological transfer (e.g., Comeau et al., 1999; Gottardo et al., 2001), it was predicted that these phonological processing skills would be moderately associated with reading abilities across orthographies. In addition, different contributions to concurrent and subsequent Chinese word recognition across the three phonological processing skills were expected. On the basis of previous findings (McBride-Chang & Ho, 2000a), both phonological awareness and speeded naming were expected to predict Chinese word recognition, but verbal memory was not. Different contributions of early Chinese word-reading abilities to subsequent phonological processing skills were also predicted. In particular, we anticipated that syllable awareness would be predicted by early Chinese word recognition because learning to read highlights important units of phonological awareness (e.g., Perfetti, Beck, Bell, & Hughes, 1987). However, the extent to which early reading would predict subsequent verbal memory and speeded naming was unclear. Finally, cross-linguistic transfer of these Chinese native phonological processing skills to English word reading was investigated. We expected that the three phonological processing skills in Chinese might predict concurrent and subsequent English word-reading abilities differently. On the basis of previous work on
English as a first language (e.g., Sunseth & Bowers, 2002; Wolf et al., 2002), phonological awareness and speeded naming were expected to predict unique variance in subsequent reading in a second language, though verbal memory was not (e.g., Wagner et al., 1997).

**Method**

**Participants**

Participants were 227 (114 boys, 113 girls) kindergarteners from six kindergartens in Hong Kong. At Time 1, the mean age of the participants was 4.88 years (range 3.80 to 6.20, SD = 0.56). Participants were tested again 9 months after initial testing. Owing to the dropouts at Time 2 testing, 203 participants were tested at Time 2. No significant differences were found on age and scores of Time 1 measures between participants included at Time 2 and dropouts at Time 2 (p > .05 for age and all Time 1 measures).

**Measures**

All tasks were administered in Cantonese, which was the first language of the participants.

### Chinese word reading

The Chinese Word Reading task (Ho & Bryant, 1997b) was administered at both Times 1 and 2. The task consisted of 27 single Chinese characters and 34 two-character words, increasing in difficulty level, and the children were required to read each character aloud. The children were given all items, and the maximum score of the task was 61.

### English word reading

The English Word Reading task was used at both Times 1 and 2. This task consisted of 30 English words and was successfully administered in previous research for both American and Hong Kong Chinese children (McBride-Chang & Kail, 2002). In this task, children were asked to read aloud each word. The children had to attempt all items, and the maximum score of the task was 30.

### Phonological processing tasks

Three tasks were used to test children’s phonological processing at both Times 1 and 2: Chinese Syllable Deletion (McBride-Chang & Ho, 2000a; McBride-Chang & Kail, 2002), Speeded Number Naming, and Verbal Memory.

The Chinese Syllable Deletion task (McBride-Chang & Ho, 2000a; McBride-Chang & Kail, 2002) consisted of 25 two- and three-syllable words that were orally presented by the experimenter. Children were asked to delete a single syllable from each word (e.g., in Cantonese, nìng4 mung1 cha4 without cha4 would be nìng4 mung1). We used the syllable deletion task as our only measure of phonological awareness because previous studies have shown that different levels of phonological awareness, including rhymes, syllables, and phonemes, represent the same underlying construct (e.g., Anthony et al., 2002).

The Speeded Number-Naming task was administered at both Times 1 and 2 to test children’s speed of number naming. The Speeded Number-Naming task consisted of five rows of five digits each. The five digits in each row were the same but were arranged in different orders for each row. Children were instructed to name all digits at the fastest speed possible. Two trials were completed, and the average was used for the analyses (e.g., Wagner et al., 1994). A lower score indicated a faster time.

The Verbal Memory task was used to measure children’s verbal memory ability at both Times 1 and 2. This task consisted of eight groups of number strings, with each group consisting of three items. The number strings started from a single number in the first group of items to eight numbers in the eighth group of items, with one additional number added to the number strings in a new group. Children were orally presented with each number string by the experimenter and asked to repeat the number string afterward. The test was terminated when the child incorrectly answered all three items in a group. The maximum score for this task was 24.

### Visual skills tasks

The Visual Closure, Visual Discrimination, and Visual Spatial Relationships subtests from Gardner’s (1996) Test of Visual-Perceptual Skills (Non-Motor)—Revised were administered to test children’s visual processing skills at Time 1 only. In these three tasks, children were presented a target item and then were required to choose the target from four or five choices. In the Visual Closure task, children were required to choose the item, from among four incomplete forms, that would be the same as the target completed form if the discrete lines were all connected. In the Visual Discrimination task, children were asked to select the choice that matched exact characteristics of the target among five choices. In the Visual Spatial Relationships task, children were required to indicate the figure that was oriented differently from the other four forms of identical configuration. All three tasks consisted of one practice item and 16 test items. The combined score of the three subtests was used in the present study, and the maximum combined visual skills score was 48.

### Vocabulary

The Vocabulary subtest from the Stanford-Binet Intelligence Scale (Thorndike, Hagen, & Sattler, 1986) was used to measure children’s vocabulary knowledge at Time 1 only. In this task, children were asked orally to explain concepts and objects ranked by increasing conceptual difficulty. This task was translated and adapted for Chinese children for the present study, and the maximum raw score possible was 20.

**Procedure**

Participants were initially tested in two 45-min sessions on tasks of Stanford Vocabulary, Chinese Word Reading, English Word Reading, Visual Skills, Chinese Syllable Deletion, Speeded Number Naming, and Verbal Memory individually by trained undergraduate psychology majors in a quiet room in the school during school hours. Nine months after the initial testing, they were tested again on Chinese Word Reading, English Word Reading, Chinese Syllable Deletion, Speeded Number Naming, and Verbal Memory tasks in two 45-min sessions at schools.

**Results**

Means and standard deviations of all variables included in the study at Times 1 and 2 are shown in Table 1. As indicated in Table 2, both Chinese Syllable Deletion and Speeded Number Naming tasks were moderately correlated with Chinese and English Word Reading across Times 1 and 2. The Verbal Memory tasks were also significantly correlated with Chinese and English Word Reading across Times 1 and 2, with the exception that Time 2 Verbal Memory was not significantly associated with Time 1 English Word Reading. Across the three phonological tasks, the Chinese Syllable Deletion and the Speeded Number Naming tasks showed relatively stronger associations with reading abilities than did the

<table>
<thead>
<tr>
<th>Measure</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>4.89</td>
<td>0.56</td>
</tr>
<tr>
<td>Stanford Vocabulary (Time 1)</td>
<td>11.20</td>
<td>4.38</td>
</tr>
<tr>
<td>Visual Skills (Time 1)</td>
<td>18.62</td>
<td>9.11</td>
</tr>
<tr>
<td>Chinese Word Reading (Time 1)</td>
<td>36.91</td>
<td>13.56</td>
</tr>
<tr>
<td>Chinese Word Reading (Time 2)</td>
<td>47.37</td>
<td>12.05</td>
</tr>
<tr>
<td>English Word Reading (Time 1)</td>
<td>7.34</td>
<td>7.63</td>
</tr>
<tr>
<td>English Word Reading (Time 2)</td>
<td>12.93</td>
<td>8.19</td>
</tr>
<tr>
<td>Chinese Syllable Deletion (Time 1)</td>
<td>15.75</td>
<td>7.19</td>
</tr>
<tr>
<td>Chinese Syllable Deletion (Time 2)</td>
<td>20.84</td>
<td>4.66</td>
</tr>
<tr>
<td>Speeded Number Naming (Time 1)</td>
<td>23.09</td>
<td>8.30</td>
</tr>
<tr>
<td>Speeded Number Naming (Time 2)</td>
<td>17.70</td>
<td>5.03</td>
</tr>
<tr>
<td>Verbal Memory (Time 1)</td>
<td>18.62</td>
<td>3.31</td>
</tr>
<tr>
<td>Verbal Memory (Time 2)</td>
<td>20.48</td>
<td>3.22</td>
</tr>
</tbody>
</table>

*Note. N = 227 for Time 1 measures; N = 203 for Time 2 measures. Maximum scores are in parentheses. Stanford = Stanford-Binet Intelligence Scale.*
Table 2
Correlations Controlling for Age Between Different Phonological Processing Tasks and Word Reading Tasks at Both Times 1 and 2

<table>
<thead>
<tr>
<th></th>
<th>Chinese Word Reading</th>
<th>English Word Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>Time 2</td>
</tr>
<tr>
<td>Chinese Syllable Deletion (Time 1)</td>
<td>.42**</td>
<td>.44**</td>
</tr>
<tr>
<td>Chinese Syllable Deletion (Time 2)</td>
<td>.39**</td>
<td>.41**</td>
</tr>
<tr>
<td>Speeded Number Naming (Time 1)</td>
<td>−.37**</td>
<td>−.38**</td>
</tr>
<tr>
<td>Speeded Number Naming (Time 2)</td>
<td>−.32**</td>
<td>−.39**</td>
</tr>
<tr>
<td>Verbal Memory (Time 1)</td>
<td>.23**</td>
<td>.16*</td>
</tr>
<tr>
<td>Verbal Memory (Time 2)</td>
<td>.19**</td>
<td>.27**</td>
</tr>
</tbody>
</table>

Note. * N = 227 for Time 1 measures; N = 203 for Time 2 measures.
** p < .01.

Verbal Memory test. In addition, the associations of each phonological processing task at Time 1 and Chinese and English reading performance across Time 1 and Time 2 were quite stable. For instance, the correlation of Time 1 Chinese Syllable Deletion with Time 1 Chinese Word Reading was the strongest (r = .42), and this strong correlation was also shown between it and Time 2 Chinese Syllable Deletion (r = .44), whereas the correlation of Time 1 Verbal Memory to Time 1 Chinese Word Reading was relatively low (r = .23) and even lower with Time 2 Chinese Word Reading (r = .16).

Predicting Concurrent and Subsequent Word-Reading Abilities

To investigate the unique contribution of each phonological processing skill to Chinese and English Word reading, we included all phonological tasks in separate linear regression equations predicting concurrent and subsequent Chinese Word Reading as well as English Word Reading. Age, vocabulary, and visual skills, which have been shown to be important for reading abilities, were also entered into the equations to control for the variance in predicting word reading accounted for by these factors. For the equations predicting subsequent Chinese and English Word Reading, Time 1 word reading of the corresponding language was also included as an autoregressor. As shown in Table 3, Chinese Syllable Deletion and Speeded Number Naming significantly predicted concurrent Chinese and English Word Reading. However, only Chinese Syllable Deletion uniquely contributed to subsequent Chinese and English Word Reading among three phonological processing tasks. Across all regression equations, neither the Visual Skills nor the Verbal Memory measures predicted any reading measure.

Predicting Subsequent Phonological Processing Skills

To examine the bidirectional relationships between phonological processing skills and reading abilities, we performed a linear regression predicting subsequent phonological processing from age, vocabulary, visual skills, an autoregressor of the respective phonological processing skill, and Time 1 Chinese Word Reading for the three phonological processing tasks. The final beta weights of regression equations for Chinese Syllable Deletion, Verbal Memory, and Speeded Number Naming are shown in Table 4. From these regression equations, only Time 2 Chinese Syllable Deletion was significantly predicted by Time 1 Chinese Word Reading. It is interesting to note that the Time 1 Visual Skills measure uniquely predicted Time 2 Verbal Memory, perhaps because the visual skills tapped required good memory for visual stimuli.

Table 3
Standardized Betas for Regression Equations Predicting Reading Abilities From Time 1 Predictor Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chinese Word Reading</th>
<th>English Word Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Concurrent</td>
<td>Subsequent</td>
</tr>
<tr>
<td></td>
<td>β r(6, 221)</td>
<td>β r(7, 196)</td>
</tr>
<tr>
<td>Age</td>
<td>.09 1.22</td>
<td>−.01 −.024</td>
</tr>
<tr>
<td>Stanford Vocabulary</td>
<td>.10 1.58</td>
<td>.01 .18</td>
</tr>
<tr>
<td>Visual Skills</td>
<td>.14 1.95</td>
<td>−.03 −.51</td>
</tr>
<tr>
<td>Autoregressor</td>
<td>.80 17.17**</td>
<td>.12 2.25*</td>
</tr>
<tr>
<td>Chinese Syllable Deletion</td>
<td>.25 3.40**</td>
<td>.12 2.25*</td>
</tr>
<tr>
<td>Speeded Number Naming</td>
<td>−.25 −3.97**</td>
<td>−.06 −1.25</td>
</tr>
<tr>
<td>Verbal Memory</td>
<td>.04 0.68</td>
<td>−.05 1.32</td>
</tr>
</tbody>
</table>

Note. * N = 227 and R² = .46 for equations predicting concurrent Chinese Word Reading and English Word Reading; N = 203 and R² = .77 and .73 for equations predicting subsequent Chinese Word Reading and English Word Reading, respectively. Stanford = Stanford-Binet Intelligence Scale.
* p < .05. ** p < .01.
**Discussion**

In the present study, the three facets of phonological processing skills, phonological awareness, rapid automatized naming, and short-term verbal memory, were shown to be moderately associated with reading abilities and relatively stable over time. As hypothesized, the relations with Time 1 and Time 2 reading varied by type of phonological processing. Similar patterns of contributions of phonological processing skills to reading abilities across Chinese and English were found. Of the three facets of phonological processing skills measured, syllable deletion was a relatively strong predictor of Chinese and English reading abilities, both concurrently and longitudinally. Rapid automatized naming also contributed to both concurrently measured Chinese and English word reading. However, rapid automatized naming did not predict subsequent word-reading abilities. Unique associations of either short-term verbal memory or visual skills to word reading were not demonstrated in our study.

In contrast to Huang and Hanley’s (1994) findings, our results showed that phonological awareness still explained significant variance in Chinese word reading even when visual skills were controlled. Thus, phonological awareness is not only important for learning alphabetical languages but also for Chinese reading acquisition (Ho & Bryant, 1997b; Hu & Catts, 1998). Phonological awareness, representing the ability to manipulate sound units and mapping sound units to written symbols, seems to be an essential element in reading across orthographies. Using phonological elements to process written languages may be a universal process of reading development no matter how limited the presentation of phonological cues are in written form (Hu & Catts, 1998).

In addition, the bidirectional relationship between phonological awareness and Chinese reading was found indicated that the development of phonological awareness and Chinese reading abilities proceeds hand in hand. Thus, phonological awareness skills aid in reading acquisition in Chinese and they are also the by-products of learning to read at the same time. It is interesting to note that the bidirectional relationship was demonstrated in phonological awareness only. This bidirectional association is similar to that noted by Perfetti and colleagues (1987). In Chinese, the basic phonological unit is the syllable. Every character represents a single syllable. Thus, for beginning readers, experience with print may sensitise children to syllable-level units, just as learning to read English sensitizes children to phoneme-level units.

Rapid automatized naming was demonstrated to be important to concurrent Chinese reading abilities only. Previous studies demonstrated the importance of rapid automatized naming in Chinese reading acquisition (e.g., Ho & Lai, 1999; McBride-Chang & Ho, 2000b). Rapid automatized naming is considered to be especially important for Chinese reading acquisition for at least two reasons. First, Chinese is a logographic language, making visual skills particularly important for learning it. As the tasks of rapid automatized naming involved a visual element, regarded as semantic information by Hu and Catts (1998), rapid automatized naming may contribute to Chinese reading development. Second, Chinese has a less regular grapheme–phonological relationship, so Chinese characters are generally taught by rote instruction. Thus, children are required to become facile at making relatively arbitrary associations between language and print. This arbitrariness factor is a central element in speeded naming tasks as well (Manis et al., 1999).

In contrast to the results for phonological awareness, the importance of rapid automatized naming to Chinese word reading faded with development as more of the variance of subsequent Chinese word reading was explained by previous Chinese word reading. This is in line with Wagner and colleagues’ (1997) findings that (a) there was an autoregressive effect and (b) the contribution of phonological processing abilities on subsequent reading skills was developmentally limited for rapid automatized naming. During the early stages of reading acquisition, rapid automatized naming tends to be important to word-level reading. However, when children encounter more complicated words, sentences, and other aspects in print, this automatization may be more important to other advanced levels of reading and less important in predicting word-level reading. When only the word-level reading was considered, as was the case in our study, rapid automatized naming skills may not predict word-reading abilities longitudinally.

The phonological transfer demonstrated in the present study showed that phonological awareness in Chinese can aid concurrent and subsequent English language acquisition, whereas rapid automatized naming in Chinese is more important in concurrent than later English learning. The patterns of contributions of individual phonological processing skills to English reading were similar to those to Chinese reading. This finding highlights the importance of certain phonological processing skills in Chinese for learning to decode English. Phonological transfer is not restricted to languages.

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**Table 4**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chinese syllable deletion</th>
<th>Verbal memory</th>
<th>Speeded number naming</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \beta )</td>
<td>( t(5, 198) )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>Age</td>
<td>.04</td>
<td>0.51</td>
<td>−.15</td>
</tr>
<tr>
<td>Stanford Vocabulary</td>
<td>−.01</td>
<td>−0.21</td>
<td>.08</td>
</tr>
<tr>
<td>Visual Skills</td>
<td>.03</td>
<td>0.48</td>
<td>.16</td>
</tr>
<tr>
<td>Autoregressor</td>
<td>.53</td>
<td>7.48**</td>
<td>.56</td>
</tr>
<tr>
<td>Chinese Word Reading</td>
<td>.21</td>
<td>3.15**</td>
<td>.03</td>
</tr>
</tbody>
</table>

*Note. N = 203. \( R^2 = .51 \) for equation predicting subsequent Chinese syllable deletion, \( R^2 = .39 \) for equation predicting subsequent verbal memory, \( R^2 = .51 \) for equation predicting subsequent speeded number naming. Stanford = Stanford-Binet Intelligence Scale.

* \( p < .05 \). ** \( p < .01 \).
with similar structures. Phonological processing skills in a nonalphabetic language can aid in the acquisition of an alphabetic language, and it appears that some phonological processing skills are intrinsic to children’s language acquisition across orthographies. This supports the possibility, proposed by Gottardo et al. (2001), of early screening children who are at risk for later reading impairment in the first and second language using early testing of phonological processing skills in the first language.

Limitations and Conclusions

There were some limitations of the present study. First, because it was an exploratory study of different phonological processing skills, we included only a single task of each phonological processing skill. For example, we used the syllable deletion task as our only measure of phonological awareness. There was no evidence the tasks were too easy, as young children did not get ceiling effects on the tasks and it was significantly associated with reading. Although there is good reason to focus on the syllable as an important level of phonological awareness for Chinese (e.g., Leong, 1997), different levels of phonological awareness should be included in future studies.

In addition, we focused on reading at the word level only in the present study. The associations of phonological processing skills to other reading abilities, such as reading comprehension at the sentence or even story level, should be pursued in future research.

To conclude, the present study highlighted the different relations of three facets of phonological processing skills, phonological awareness, rapid automatized naming, and short-term verbal memory, with Chinese and English reading abilities in Chinese children learning English as a second language. This study has demonstrated three aspects of early reading. First, the importance of phonological awareness to very early reading is not specific to alphabetic languages but also applies to Chinese. Phonological awareness is uniquely and bidirectionally related to concurrent and subsequent reading abilities in Chinese even when visual skills are accounted for, and this strong relationship is in line with those found in alphabetic orthographies. Second, even controlling for visual skills, rapid automatized naming skill appears to be particularly useful for early word acquisition. Third, we demonstrated phonological transfer of certain phonological processing skills from Chinese to English in very young readers.

References


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