[Published in *Clinical Linguistics and Phonetics*, *24 (4-5)*, 387-400]

Phonological awareness skills in the two languages of Mandarin-English bilingual children

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Abstract

A number of studies have shown that bilingual children have an advantage when performing on phonological awareness tasks, particularly in their stronger language. Little research has been done to date, examining the effects of bilingualism on both languages of bilingual children. In this study Mandarin-English bilingual children's performance on phonological awareness tests was compared with that of Mandarin monolingual children and English monolingual children. The Mandarin-English bilinguals performed better than English monolinguals on the Elision and Blending subtests of the Comprehensive Test of Phonological Processing (CTOPP: Wagner, Torgesen, and Rashotte, 1999). Similarly, Mandarin-English bilinguals also performed better than their Mandarin monolingual counterparts on most of the experimental Mandarin phonological awareness tasks. The results from the study are discussed in terms of the effects of bilingualism on phonological awareness in both languages of bilingual children. Further clinical and educational implications of these results are also discussed.

We are both honoured and saddened to be contributing this paper to an issue dedicated to the memory of Dr. Adele Miccio. Dr. Miccio was a highly respected colleague with keen insights and passion for speech- language pathology practice and research, and with a very friendly and engaging manner. The paper in this issue is on a topic familiar to readers of Dr. Miccio's work, which examined the relationships between early language and emerging literacy in young bilingual children from low-income families. Here we focus on a specific aspect of early language development, namely phonological awareness, by comparing the phonological awareness skills in the two languages of bilingual children, and at the end we link some of our findings to important implications for practice originally highlighted by Dr. Miccio and her collaborators.

Phonological awareness is a set of metalinguistic skills by which children become aware of and consciously manipulate the sound structure of a language (Gombert, 1992). It is important in predicting early reading development in alphabetic languages such as English (Adams, 1990; Goswami and Bryant, 1990) and non-alphabetic languages such as Chinese (Cheng, 1992; Anderson, Li, Ku, Shu, and Wu, 2003; Chow, McBride-Chang, and Burgess, 2005; He, Wang, and Anderson, 2005). In the last two decades, research has shown that bilingual children have more advanced metalinguistic awareness skills than monolingual children (Cummins, 1978; Bialystok, 1986; Yelland, Pollard, and Mercuri, 1993), and that these skills appear in both languages (Durgunoglu, Nagy, and Hancin-Bhatt, 1993; Comeau, Cormier, Grandmaison, and Lacroix, 1999; Gottardo, Siegel, Yan, and Wade-Woolley, 2001; Chow, *et al*., 2005). Moreover, bilingual children outperform monolingual children on some phonological awareness tasks

(Yelland, *et al*., 1993; Bruck and Genesee, 1995; Chen, Anderson, Li, Hao, Wu, and Shu, 2004). However, most studies have focused on examining the bilingual advantage in phonological awareness in only one of the two languages in bilingual children. The influence of bilingualism on phonological awareness in both languages has yet to be investigated more fully. Therefore, the main goal of the present study was to compare bilingual children with two groups of monolingual children who each speak one of the two languages. In the following section research on the phonological awareness skills of bilingual children will be reviewed with a focus on Chinese-English bilingual children's development of those skills in both languages.

Phonological awareness and bilingualism

Differences between their two languages presumably allow bilingual children to become more aware of language, i.e. to have more advanced skills in word and syntactic awareness (see Bialystok, 2001, for a review). A number of studies (Yelland, *et al*., 1993; Bruck and Genesee, 1995; Chen, *et al*., 2004) have shown that bilingual children who maintain their native language as they acquire an additional language have also initial advantages in phonological awareness when compared with monolingual children. We identified two studies, neither of which directly focused on comparing the phonological awareness skills of bilingual and monolingual children, but examined the phonological awareness skills in both languages of bilingual children. In an unpublished study by Miccio, Hammer, Davison, and Scarpino, 2006 (as reported in Hammer and Miccio, 2006) the authors examined phonological awareness skills in both languages of Spanish-English bilingual Head Start children and showed that the children who were raised bilingually from birth performed just as well as the children who had recent exposure to the second language, English. Although all children struggled with these tasks in pre-school, once explicit instruction in phonological awareness was introduced in kindergarten, the children’s phonological awareness skills in English were maintained well into first grade. The second study by Dickinson, McCabe, Clark-Chiarelli, and Wolf (2004) followed the development of phonological awareness skills of Spanish-English bilingual children who were in preschool (Head Start), and showed that phonological awareness skills in one language were the most important predictor of phonological awareness in the other language, and vice versa. While these studies highlight different aspects of the development of phonological awareness in bilingual children, the influence of bilingual exposure on phonological awareness in both languages has not yet been fully studied.

There is a debate over whether the bilingual advantages observed in previous studies are due simply to children’s bilingual experiences or rather to the phonological structures of the two languages. For example, Chen *et al*. (2004) attributed the bilingual advantage found in their study of Cantonese-Mandarin bilinguals to children’s bilingual experience; Cantonese and Mandarin share a similar phonological structure and the two groups of children received similar instruction at school. However, Bialystok, Majumder, and Martin (2003) argued that some of the bilingual advantages observed in previous studies might be due to the specific languages learned rather than bilingualism. Bialystok *et al*. (2003) conducted a cross-sectional study with school-aged English monolingual children and two groups of bilingual children: Spanish-English bilinguals and Chinese-English bilinguals (consisting of both Cantonese and Mandarin speakers). The Chinese-English bilinguals had lower scores than English monolinguals on a phoneme segmentation task, but Spanish-English bilinguals had higher scores. Thus, Bialystok *et al*. (2003) suggested that bilingualism itself may not be an advantage for the development of phonological awareness; however, the knowledge of another alphabetic language with transparent letter-sound correspondence (e.g. Spanish) may have facilitated the acquisition of phonological awareness in English. It is important to understand the phonological awareness abilities in both languages of young bilingual children because these skills relate to early reading abilities in both languages, one of which is the language of instruction at schools. It is now established that children's performance on phonological awareness tasks, especially at the phonemic level, is strongly associated with their reading acquisition in alphabetic languages (Adams, 1990; Brady and Shankweiler, 1991; Gough, Ehri, and Treiman, 1992, Blachman, 1997). In contrast to English, Chinese has a morphographic writing system and the basic symbols of written Chinese are characters. Each character represents both a syllable and a morpheme. Therefore, some researchers have argued that Chinese orthography is a meaning-based script, and so morphological awareness rather than phonological awareness uniquely predicts early Chinese character recognition (McBride-Chang, Wat, Shu, Zhou, and Wagner, 2003; Shu, Wu, McBride-Chang, and Liu, 2006). However, Cheng (1992) suggested that phonological awareness also plays an important role in Chinese character identification since Chinese orthography is indeed a speech-based script. More than 80% of Chinese characters are semantic-phonetic compounds, which have a semantic radical to indicate the word meaning and a phonetic radical to provide clues to the pronunciation of the character, ranging from exact homophones to analogy cues at the level of syllable or rime[1] (Leong, 1986). Anderson, *et al*. (2003) and He, *et* *al*. (2005) found that Chinese children are able to use information about the pronunciation derived from the phonetic radicals to decode unfamiliar compound characters, and this analytic ability was associated with children’s performance on rhyme and tone awareness tasks. Therefore, even though learning to read Chinese does not involve the phoneme-grapheme mapping process, it still requires the reader to understand the nature of the correspondence between the written script and the spoken language. Therefore, the research to date (Adams, 1990; Brady and Shankweiler, 1991; Gough, *et al*., 1992; Blachman, 1997; Anderson, *et al*., 2003; He, *et al*., 2005) suggests that the role of phonological awareness in learning to read may be universal across languages.

A cross-linguistic transfer effect, in which phonological awareness skills in one language predict reading skills in another, was first observed between alphabetic languages such as English and Spanish (Durgunoglu, *et al*., 1993), and English and French (Comeau, *et al*., 1999). However, few studies have investigated whether such relationships exist between alphabetic and non-alphabetic languages such as English and Chinese. One study with Cantonese-English bilingual children revealed that Chinese rhyme detection skills were significantly correlated with English rhyme detection and phoneme deletion skills, and were a good predictor of the children’s English word reading skills (Gottardo, *et al*., 2001). Similarly, the Chinese syllable deletion skills of Cantonese-English bilingual kindergarteners significantly predicted their Chinese and English word reading in a study by Chow, *et al*. (2005). Therefore, cross-linguistic transfer effects of phonological awareness appear not to be restricted to alphabetic languages.

The main goal of the present study was to examine the effects of bilingual exposure on the development of phonological awareness both in Mandarin and in English for Mandarin-English bilingual children. Two possible alternatives were considered:

1) If the bilingual advantage in phonological awareness is due to the properties of the two languages rather than bilingualism itself, it was expected that Mandarin-English bilingual children would not outperform Mandarin monolinguals on the Chinese-specific phonological awareness tasks, such as syllable deletion and tone discrimination. Furthermore, the Mandarin-English bilingual children would not be expected to outperform English monolinguals on English phonemic awareness tests because acquisition of written Chinese does not rely on phonemic awareness (Cheung, Chen, Lai, Wong, and Hills, 2001; McBride-Chang, Bialystok, Chong, and Li, 2004).
2) If bilingualism plays a facilitative role in the development of phonological awareness, it was expected that Mandarin-English bilingual children would outperform their Mandarin monolingual counterparts on Chinese-specific phonological awareness tasks, and would also demonstrate advantages on English phonemic awareness tests when compared with English monolinguals.

Secondary goals were to examine the oral proficiency of the bilingual group when compared with their monolingual counterparts in each language, and any possible relationships in phonological awareness between the two languages of the bilingual children.

Method

Participants

The study included three groups of children. The first group consisted of 61 Mandarin-speaking monolingual children between the ages of five (n = 31, mean age = 5;4) and six (n = 30, mean age = 6;5) (33 boys and 28 girls). They were randomly selected from two mid-ranking kindergartens (according to the monthly fee that parents pay) in Shanghai, China. Children in Shanghai begin kindergarten at the age of four years, but formal reading instruction typically begins around the age 6 with the introduction of Pinyin. Pinyin is a writing system of Mandarin Chinese, which uses roman letters to represent sounds in Mandarin. It is currently used in Mainland China to teach children how to pronounce Chinese characters in Mandarin Chinese. Only Mandarin was used in the kindergartens, and more than 90% of the children also communicated with their parents in Mandarin (the rest also communicated at home in the local dialect, Shanghainese). Children in these two kindergartens were minimally exposed to English; they were only taught single words and had no functional skills or literacy experience in English. According to the teachers' reports, all the participants had normal or corrected-to-normal vision, normal hearing and no history of any physical, emotional, or cognitive difficulties.

The second group, the English monolinguals, consisted of 21 5-to-6-year-old children (9 males and 12 females) who were recruited from kindergartens in Metro Vancouver, Canada. These children had no exposure to languages other than English according to parental questionnaire responses[2]. They had normal or corrected-to-normal vision, normal hearing and no history of any physical, emotional, or cognitive difficulties.

The third group consisted of 62 five (n = 36, mean age = 5;6) and six-year-old (n = 26, mean age = 6;6) Mandarin-English bilingual children who were recruited from the Chinese community in Metro Vancouver, Canada. The bilingual children and the English monolingual children lived in the same districts and all came from middle-class families according to the background information provided by the parents. All the bilingual children had normal or corrected-to-normal vision, normal hearing and no history of any physical, emotional, or cognitive difficulties. Information was gathered about the literacy activities and language exposure in the homes of the bilingual children with a background questionnaire filled out by their primary caregivers. For all the bilingual children, Mandarin was used in the home between parents and the child, whereas English was the language of school.

The bilingual children had a mean length of residence in Canada of almost 3.5 years (mean = 3.41, SD = 2.07), with the majority of the children having been born in Canada or exposed to English before the age 2. All had a range of experience in terms of Chinese literacy. According to the background questionnaire, one third of the bilingual children received literacy instruction in Chinese by attending Chinese schools or study groups or being taught by personal tutors. The aspects of Chinese instruction included speaking, reading, and writing, but focused mainly on reading. Parents reported that 28 out of 62 bilingual children had some knowledge of Pinyin.

Procedures and Tasks

The bilingual children were assessed both in Mandarin and English. They completed testing in two sessions, once in each language. The order of the languages was counterbalanced. Within each language session, all tasks were presented in a fixed order. A native speaker of Mandarin administered the Chinese tasks, and two English native speakers administered the

English tests.

Mandarin testing

Mandarin vocabulary comprehension of the Mandarin monolinguals and the Mandarin-English bilinguals was tested with the Chinese version of the Peabody Picture Vocabulary Test - Revised (PPVT-R) (Lu and Liu, 1998). The child was asked to point to one of four pictures that corresponded to an aurally presented word. The mean standard score for this test is 100 (SD of 15).

Five phonological awareness tasks in Mandarin were developed for the present study. The Syllable Deletion, Onset-rime Combination, and Initial Sound Identification tasks were developed to match the three subtests of the Comprehensive Test of Phonological Processing (CTOPP) (Wagner, Torgesen, and Rashotte, 1999), namely Elision, Blending, and Sound Matching. The Rhyme Detection and Tone Discrimination tasks were adapted from So and Siegel (1997).

Tone Discrimination

This task consisted of 12 experimental trials including all the possible contrasts among the four tones in Mandarin. The number of characters was decreased from four (as in So and Siegel, 1997) to three in each trial in order to avoid memory overload, because the present study focused on preschoolers while So and Siegel (1997) tested school-aged children. For this task, all the words in each trial shared the same syllable[3]. Two of the words had the same tone while one word had a different tone. For this tone discrimination task, in each trial, children heard three words and were asked to pick out the word which had a different tone, e.g. '/kun4/, /kun1/ and

/kun1/', which word sounds different, the first, the second or the third?'. In order to avoid any possibility that errors were related to tone production rather than tone perception, a numerical response was requested rather than producing the word. The score was the total number correct out of 12 items.

Syllable Deletion

This task consisted of 15 compound words. Children were asked to reproduce the word without one of the syllables. In each trial, the examiner first asked the child to repeat the stimulus and then requested the child to delete a specific syllable from the word (e.g. 'Say /dian4//hua4/ without /dian4/'). The resulting words were real words in Mandarin. The score was the total number correct out of 15 items.

Onset-rime Combination

The purpose of this task was to determine children's ability to combine onsets and rimes into words. Learning to read Chinese does not require children to combine sounds into words because Chinese characters map onto the speech at the level of syllables (Tzeng, 2002). However, children in Mainland China may develop this ability as a result of Pinyin instruction. In this task, children heard two or three parts of a syllable and were asked to say the complete word (e.g. 'Put these sounds together: b-ei. What word do they make?'). The component sounds were audio-recorded by a native Mandarin speaker. The score was the total number correct out of 12 items.

Initial Sound Identification

The Initial Sound Identification task in this study consisted of 10 experimental items. We only tested children's initial sound identification skill since there are no final consonants in most Chinese syllables and the only acceptable syllable-final consonants are alveolar and velar nasals (i.e. /n/ and /ŋ/) (Zhu, 2002). Children were shown pictures and asked which of three words starts with the same sound as the target words, e.g. 'Which word starts with the same sound as '/fei1/'? /feng1/, /san1/ or /bei1/?'. The score was the total number correct out of 10 items.

Rhyme Detection

This task consisted of 15 experimental trials. Again, the number of characters was decreased to three in each trial to avoid memory overload for preschoolers. All the stimuli were real words in Mandarin and were audio-recorded by a native Mandarin speaker. In each trial, all three words had a different onset. Therefore, children were not able to contrast them based on the phonological characteristics of the onsets. For this task, children listened to three words in each trial and were asked to identify which word did not rhyme, e.g. '/shi4/, /xi4/ and /guo4/'. All the words were real words in Mandarin. The score was the total number correct out of 15 items.

English testing

The Peabody Picture Vocabulary Test-Ш (PPVT- Ш: Dunn and Dunn, 1997) is a standardized test of single-word comprehension in English. It was used in the present study as a measure of the children's English vocabulary comprehension. The mean standard score for this test is 100 (SD of 15).

The following three subtests of the CTOPP (Wagner *et al*., 1999), specifically designed to test for phonological awareness skills, were administered to the English monolingual and Chinese-English bilingual children: (1) Elision, or deleting speech segments from words; (2)

Blending, or combining speech segments into words; and (3) Sound Matching, or identifying word-initial and word-final phonemes. The CTOPP was chosen for this study, because of its comprehensive nature, high degree of reliability and validity, and its appropriateness for the age groups under investigation. The mean standard score for each of the subtests is 10 (SD of 3).

Results

The main goal of the present study was to examine the effects of bilingual exposure on the development of phonological awareness in both languages of Mandarin-English bilingual children. The effect of bilingualism on English phonological awareness was examined by comparing the performance of the Mandarin-English bilingual children with that of the English monolingual children on the three subtests of the CTOPP (standard scores were used in the analyses). A three-way ANOVA on age (2), group (2), and phonological awareness test (3) revealed no significant main effects and only one significant interaction, i.e., between the phonological awareness test and group (F (2, 78) = 5.37, p= 0.0065). Across both age groups, the bilingual children had higher scores than the monolingual English-speaking children on the Elision (F (1, 82) = 6.15, p = 0.02) and Blending (F (1, 82) = 4.37, p = 0.04) subtests of the CTOPP, although there was no significant difference between the two groups on the Sound Matching subtest (F (1, 82) = 0, p = 0.98). Results are displayed in figure 1.

Insert figure 1 about here

To examine the effect of bilingualism on phonological awareness of Mandarin, the bilingual children's performance on the Mandarin phonological awareness tests was compared with that of the Mandarin monolingual children. The raw scores of the Chinese phonological awareness tasks were converted into proportion correct scores, which were used in the analysis. A three-way ANOVA on age (2), group (2) and phonological awareness task (4) revealed statistically significant main effects for phonological awareness task (F (4,116) =77.74, $p<$ 0.0001), age (F (1, 116) =25.66, $p<0.0001$) and language group (F (1, 119) = 55.01, $p<0.0001$), and a significant interaction among the three factors (F (4, 116) = 2.82, p = 0.03). Among the 5-year olds, the bilingual group performed significantly better than the Mandarin monolingual group on the Onset-rime Combination task (F (1, 66) = 47.81, p < 0.0001), the Initial Sound Identification task (F (1, 66) = 26, p < 0.0001), and the Rhyme Detection task (F (1, 66) = 8.5, p = 0.005), and there were no significant differences between the two groups on the Syllable Deletion (F (1, 66) = 1.96, p = 0.17) and Tone Discrimination tasks (F (1,66) = .05, p = 0.83). Among the 6-year-olds, the bilingual group performed significantly better than the Mandarin monolingual group on the Onset-rime Combination task (F (1, 55) = 15.19, p = 0.0003), the Initial Sound Identification task (F (1, 55) = 42.83, p < 0.0001), the Rhyme Detection task (F (1, 55) = 18.05, p < 0.0001), and the Tone Discrimination tasks (F (1,55) = .12.60, p = 0.0008), although there were no significant differences between the two groups on Syllable Deletion (F (1, 55) = 0, p = 0.96). Results are displayed in figure 2.

Insert figure 2 about here

The scores on the Mandarin phonological awareness tasks were also analyzed in terms of the probability that children were performing above chance. The Chinese phonological awareness tasks consisted of a set number of trials (between 10 and 15) and a closed response set of three. Binomial probability at the 0.02-level requires at least 7 correct responses out of 10 (or

70% correct), or at least 9 correct responses out of 15 (or 60% correct). As shown in figure 2, by the age of 6, the bilingual children performed above chance on all the Chinese phonological awareness tasks, whereas the Mandarin monolingual children achieved this level of accuracy only on the Syllable Deletion and Tone Discrimination tasks.

One of our secondary goals was to examine the oral proficiency of the bilingual group when compared with their monolingual counterparts in each language. Results are displayed in figure 3. All participants performed within age limits on both tests. Independent-sample t-tests were used to compare the bilingual children's performance in each language. The scores of the 5-year-old bilingual children for Mandarin were higher than their English scores (t (70) = 5.16, p<0.001), suggesting that Mandarin was their stronger language in terms of vocabulary comprehension. The difference between mean scores by language in the 6-year-old group was not significant (t (50) = 1.75, p > 0.05).

Insert figure 3 about here

Next, in each language the bilingual children's performance on the PPVT was compared with that of the monolingual counterparts. In Mandarin, the scores of the 5-year-olds were not significantly different (t (65) =1.32, p > 0.05), but in the 6-year-old group, the scores of the Mandarin monolinguals were higher than the scores of the bilinguals (t (54) = 2.39, p< 0.05). Both age groups of the English monolingual children had higher scores than the bilingual children (t (49) =5.47, p< 0.001 for the 5-year-olds; t (30) = 2.58, p< 0.05 for the 6-year-olds). Taken together, the results from the language tests revealed that the bilingual children, especially the younger ones, had stronger language skills in Mandarin although there was a tendency toward an increase of their English vocabulary comprehension with age.

In order to determine whether phonological awareness skills are related between languages that are structurally and etymologically different, partial correlations were computed for the phonological awareness skills in each language, controlling for vocabulary comprehension scores in English and Mandarin. (See table 1.)

Insert table 1 about here

Overall, the magnitude of the correlation coefficients between the English and Chinese phonological awareness tasks was moderate to weak. Tone awareness, as a Chinese-specific phonological awareness skill, was not correlated with any of the English tasks. The Mandarin Onset-rime Combination task was correlated with the Elision and Blending subtests of the CTOPP, and the Mandarin Initial Sound Identification task was correlated with the Blending and Sound Matching subtests of the CTOPP. The Mandarin Syllable Deletion task tests syllable awareness whereas the Elision task in English mainly examines phonemic awareness, with a small number of the test items targeting syllable awareness, and the Sound identification tasks targeting only phonemic awareness. Despite these differences, the Mandarin Syllable Deletion task was correlated with the two English tasks. The Mandarin Rhyme Detection task tests children's segmentation skills. There was a significant correlation between this task and the English tests, which examine segmentation skills such as Elision and Sound Matching. When examining the within-language correlations, the magnitude of the correlation coefficients did not increase dramatically. While the inter-task correlation coefficients for the English phonological awareness tasks were slightly higher than the between-language correlations, the correlations among the Mandarin phonological awareness tasks remained moderate to weak.

Discussion

Effects of bilingualism on phonological awareness

In this study an advantage in phonological awareness skill for Mandarin-English bilingual children was observed not only in their stronger language (i.e. Mandarin) but also in their weaker language (i.e. English). Both the 5- and 6-year-old bilingual children outperformed their English monolingual counterparts on two of the standardized English phonological awareness tests (i.e. the Elision and Blending subtests of the CTOPP). This finding indicates that exposure to another language, even one as different from English as Chinese, may enhance children's awareness of phonological structures in English. Similarly, Mandarin-English bilingual children performed better than their Mandarin monolingual counterparts on the three Chinese phonological awareness tasks that test the awareness of onsets and rimes (i.e. Onset-rime Combination, Initial Sound Identification, and Rhyme Detection). This suggests that English exposure may have facilitated the bilingual children's onset-rime awareness in Chinese. Finally, it must be noted that the scores on the Onset-rime combination task were particularly low for the 5-year-old monolingual Mandarin children. Adams (1990) pointed out that the conscious knowledge of phonemes does not develop spontaneously in English-speaking children, and further reading instruction facilitates children's acquisition of phonemic awareness in English. Similarly, speaking Chinese is not sufficient for children to develop an awareness of onsets and rimes and it is possible that with the introduction of Chinese reading instruction (particularly Pinyin) this skill quickly develops as becomes obvious from the scores of the 6-

year-old Mandarin-speaking monolingual children.

Two factors may account for these apparent bilingual advantages. On one hand, bilingual children acquire simultaneously different phonological awareness skills when learning two languages (see Goswami, 1999, for a review). Cheung *et al*. (2001) found that English-speaking children have better onset-rime awareness than Chinese-speaking children do. Therefore, the bilingual advantage in Chinese onset-rime awareness tasks in the current study may be due to the children's experience of learning English rather than bilingualism itself. On the other hand, the fact that the 6-year-old bilingual children performed significantly better than the Mandarin monolingual children on the Mandarin Tone Discrimination task cannot be explained by the linguistic properties of English since English is not a tonal language. Moreover, the bilingual children's better performance on the English phonemic awareness tests cannot be attributed to learning Chinese because, as was revealed by the extremely low performance of the 5-year old Mandarin monolinguals on the Mandarin Onset-rhyme combination task, speaking Mandarin alone is not sufficient for children to develop awareness of sub-syllabic structures. Therefore, it is likely that bilingual exposure, per se, facilitated the development of Mandarin tone awareness and English phonemic awareness.

Regardless of which of the two explanation one finds more convincing, the results from this study clearly show that bilingualism plays a facilitating role in the development of phonological awareness skills in two languages that are unrelated in terms of phonology and orthography, such as English and Chinese. Phonological awareness has been established as a main factor in the process of learning to read Chinese and English (Adams, 1990; Ho and Bryant, 1997), thus, Chinese-English bilingual children are likely to be better prepared for literacy acquisition in both languages when compared to their monolingual peers.

Associations between phonological awareness skills in one language and those in another language have been observed (Durgunoglu, *et al*., 1993; Gottardo, *et al*., 2001). We also found associations between the Chinese phonological awareness tasks and the English phonological awareness measures, especially between the tasks that examine similar phonological processing skills such as the Chinese Onset-rime Combination and the English Blending measure. Moreover, the observed similarity of the magnitude of the associations between phonological awareness measures within a language, and those between the two languages suggested that performance on these measures depends on the individual's general cognitive abilities, rather than on the language of assessment. This observation further supports the notion that bilingualism per se, rather than the specific languages involved, contributes to stronger phonological awareness skills, since the bilingual children tended to perform better on most measures of phonological awareness in both languages. Therefore, this study provides further evidence showing that the benefits of bilingualism are not restricted to alphabetic languages alone. It must be noted here, that at the age of 6 all of the Mandarin monolingual children, and almost half of the bilingual children were exposed to an alphabetic writing system, Pinyin. Therefore, it is possible that some of the observed relationships between the two languages, especially in the 6-year old groups, are a result of literacy instruction in an alphabetic writing system. In order to further confirm the effects of bilingualism on phonological awareness in purely non-alphabetic languages, future studies with Chinese languages other than Mandarin, e.g., Cantonese, would provide for better comparisons with English.

A secondary goal of the study was to evaluate language proficiency in bilingual children. It has been reported that bilingual children generally perform more poorly than monolinguals on monolingual vocabulary size measures because their vocabulary is divided between two language systems (Umbel, Pearson, Fernandez, and Oller, 1992; Merriman and Kutlesic, 1993). Consistent with previous research (see Oller and Eilers, 2002, for a review), the bilingual children in our study had lower vocabulary scores in English than the English monolingual children, even though they had been living in Canada for more than three years. Similarly, the older bilingual children also had lower vocabulary scores in Chinese. On the other hand, the younger bilingual children had vocabulary scores equivalent to those of the Chinese monolinguals, and they were balanced in terms of their vocabulary scores between the two languages, while the older bilingual children had higher vocabulary scores in English than in Chinese (reflecting English school instruction). All of these taken together indicated an improvement in English skills, and the potential for loss of the home language in bilingual children who are living and are being educated in English-speaking environment.

Implications and Relationship to the Work of Adele Miccio

The current study is one of few to systematically investigate the development of phonological awareness in both languages of Mandarin-English bilingual children. The findings of the relative skill level in each phonological awareness domain of English and Chinese could provide clinicians and educators in English-speaking countries, as well as in China, with important information about children’s development of phonological awareness in English and

Mandarin. As our study showed, children who have been exposed to two languages are likely to have different abilities in each language, as well as different abilities from monolingual speakers of each language. Therefore, as also suggested by Hammer and Miccio (2006), the performance of bilingual children needs to be considered independently and not in comparison with that of monolinguals, because the bilingual children's performance on diagnostic measures would differ depending on the amount of exposure to each language. Moreover, speech-language pathologists and educators need to gather detailed background information on the children's exposure to the two languages, which can be considered as part of their diagnostic decisions (Miccio, Hammer, and Toribio, 2002). Finally, in clinical practice and future research involving groups of children from different countries and cultural backgrounds, we recommend that a non-linguistic test (e.g., a test evaluating nonverbal skills) also be used in order to ascertain levels of cognitive functioning among the groups.

On a practical level, the phonological awareness measures developed for this study may prove to be a useful tool for the growing number of Chinese-speaking speech-language therapists and educators working with Chinese-speaking children in English-dominant countries. Increasingly, clinicians encounter situations in which they need to make judgments about whether a bilingual child's difficulties in English are due to language difference or a true language disorder (Genesee, Paradis, and Crago, 2004). Many bilingual children cannot be assessed in English due to their limited English proficiency. Therefore, assessing bilingual children's phonological awareness in their native language can, and must be, a solution for this clinical issue (Hammer and Miccio, 2006). Moreover, due to the cross-language transfer of phonological awareness skills, the information gathered about bilingual children's phonological awareness abilities in their native language will help clinicians and educators predict these children's literacy acquisition in both languages and guide them when planning intervention and instructional approaches.

Acknowledgements

The research reported here was supported in part by a UBC Hampton Fund research grant to the first author, and a BC Michael Smith Foundation Summer Research Scholarship and a Postgraduate Scholarship from the Natural Sciences and Engineering Research Council (NSERC) of Canada to the second author. We are extremely grateful to all the children and their families who participated in this study, both in Canada and in China. We would like to acknowledge Lee Yao, Lu Hong, Ying Chen, Xinchen Wang, Jack He, and the second author's previous colleagues in the department of Child Behavior and Development of Shanghai Children's Medical Centre, especially Prof. Xingming Jin, for assisting us with participant recruitment in China. Our thanks also go to Kristina Campbell, Sarah Wright and Jill Petersen for helping with the data collection in Canada. Finally, we are grateful to an anonymous reviewer, and to Dr. Linda Siegel and Erin Hall who commented on earlier versions of this paper.

Notes

[1] 'Rime' is also spelled 'rhyme' (Gussenhoven and Jacobs, 1998). The term 'rime' is frequently used by linguists when contrasting to 'onset'; however, 'rhyme' is often used in specific tasks since it is a familiar term to educators and the public.

[2] The smaller number of monolingual children reflects the demographic distribution of students in public schools in the Metro Vancouver area. In order to control for socio-economic status in our sample, we aimed to recruit monolingual children from the same neighbourhoods as the Mandarin-English bilinguals. However, in the neighbourhoods where the more recent immigrant children live, the proportion of purely monolingual children is very small and, thus, subject recruitment was difficult. Results need to be interpreted more cautiously therefore concerning comparisons with the English monolinguals.

[3] Based on a pilot study it was found that it was difficult for a preschooler to make judgment of oddity along one dimension when another dimension was also being manipulated; therefore, for the three stimuli, the same syllable was used.

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Table 1 Partial correlations between phonological awareness measures in both English and Chinese for the bilingual group only. In the within-language correlations, the vocabulary scores in the relevant language are partialed out. In the between-language correlations, both the English and Chinese vocabulary scores are partialed out.

	1	2	3	4	5	6	7	8
English								
1. Elision	-							
2. Blending	0.61***	-						
3. Sound Matching	0.63***	0.49**	-					
Chinese								
4. Syllable Deletion	0.42**	0.31	0.34*	-				
5. Onset-rime Combination	0.47**	0.51**	0.23	0.31*	-			
6. Initial Sound Identification	0.28	0.32*	0.42**	0.14	0.56**	-		
7. Rhyme Detection	0.44**	0.19	0.46**	0.32*	0.42**	0.52**	-	
8. Tone Discrimination	0.17	0.30	0.08	0.23	0.35*	0.28	0.49**	-

*p < 0.05, **p < 0.01, ***p < 0.0001

List of Figures

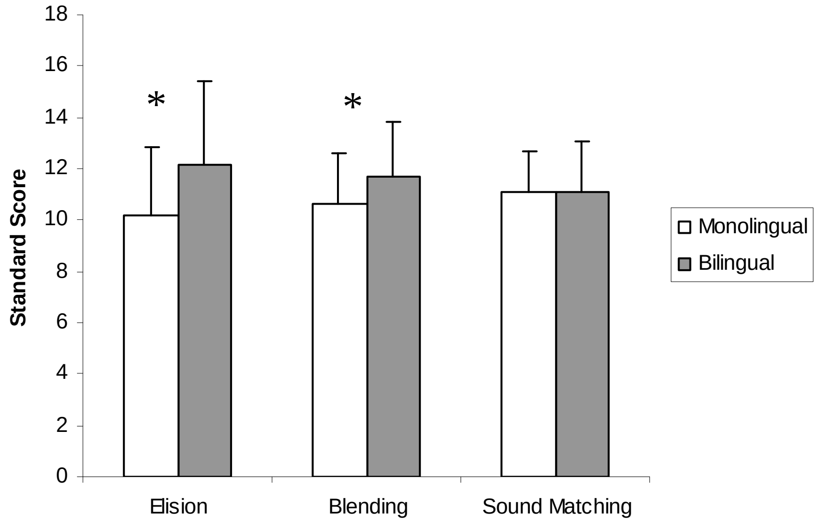
18
16
14
12
10
8
6
4
2
0
Standard Score
*
*
Elision
Blending
Sound Matching
Monolingual
Bilingual

Figure 1

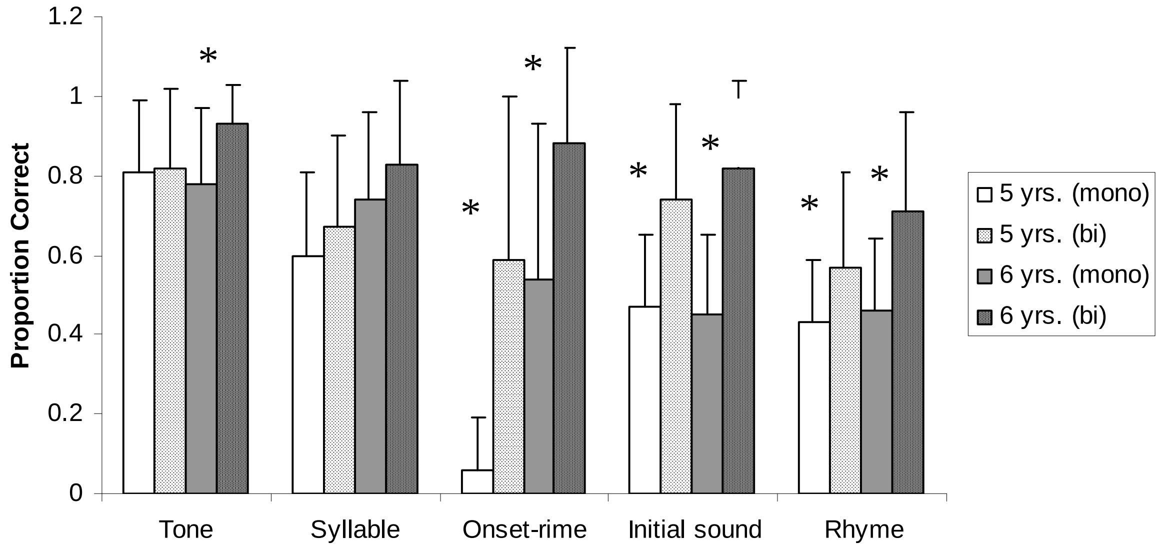
1.2
1
0.8
0.6
0.4
0.2
0
Proportion Correct
Tone
Syllable
Onset-rime
Initial sound
Rhyme
5 yrs. (mono)
5 yrs. (bi)
6 yrs. (mono)
6 yrs. (bi)

Figure 2

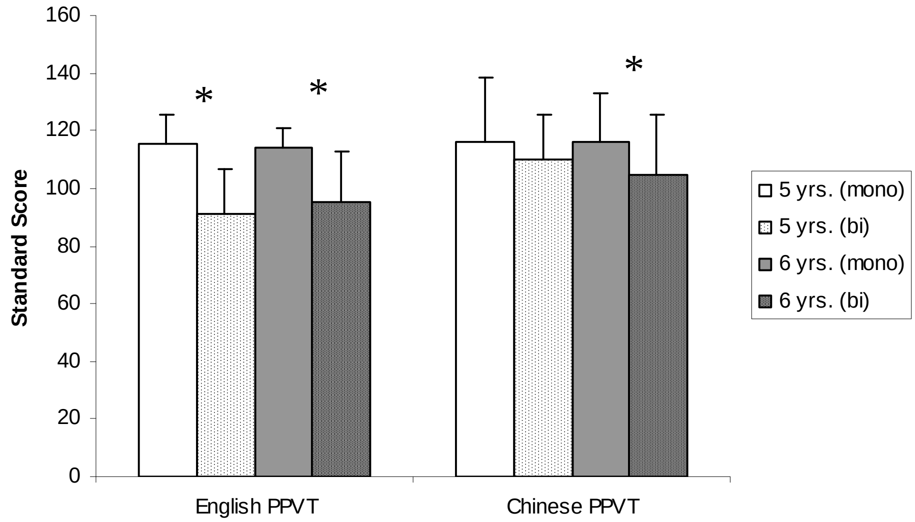
160
140
120
100
80
60
40
20
0
Standard Score
*
*
*
English PPVT
Chinese PPVT
5 yrs. (mono)
5 yrs. (bi)
6 yrs. (mono)
6 yrs. (bi)

Figure 3