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English reading ability and phonological awareness of Chinese college students with early exposure to pinyin

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Abstract

This study investigated whether early exposure to pinyin alone is enough for superior performance on English phonological awareness tasks and reading aloud. This study replicated Holm and Dodd's study with two particular groups of Mandarin speakers. They were differentiated into pinyin and IPA-pinyin group with respect to their phonetic training. Thirty subjects with tertiary education participated in this study. Our results showed that the IPA-pinyin group performed significantly better than the pinyin group on all phonological awareness tasks and low frequency non-words reading and matching tasks. Findings from this study suggested that it is not pinyin knowledge in general which leads to superior performance on phonological awareness tasks, but possible phonetic training in English such as IPA that enhances awareness at the phonemic level. We recommended that the phonetic training for IPA should be introduced and completed at early age in order to achieve maximum benefit.

English reading ability and phonological awareness of Chinese college students with early exposure to pinyin

Phonological awareness (PA) is the ability to analyze spoken language into its component sounds and it has been shown to be affected by an individual's early exposure to an alphabetic system during first language (L1) acquisition (Holm & Dodd, 1996; Cheung, Chen, Lai, Wong, & Hills, 2001). There are three possible forms of phonological awareness, which can be in syllable, onset-rime or phonemic unit (Treiman & Zukowski, 1990). Tunmer and Rohl (1991) indicated that phonological awareness is an awareness of phonemes rather than other levels.

Different studies have investigated how different languages and their writing systems were related to phonological awareness (e.g. Bruck, Genesee, & Caravolas, 1997; Cossu, Shankweiler, Liberman, Katz, & Tola, 1988; Siok & Fletcher, 2001). Bruck et al. studied English- and French-speaking kindergarteners and first-grade children. The English-speaking children scored significantly higher on phoneme-level awareness whereas the French children scored higher on syllable-level awareness significantly. The result led the authors to conclude that English tends to be segmented at the phonemic level whereas French tends to be easier to segment at the syllabic level. In addition, Christensen (1997), as reported by McBride-Chang, Bialystok, Chong, and Li (2004), found that English readers with phonemic awareness read better than those with onset-rime awareness. Therefore, the characteristics of English writing system, which is segmented into phonemic level, facilitate the development of phonemic awareness for skilled reading.

There has been ample evidence that early exposure to alphabetic script does improve phonological awareness and thus reading ability (Cheung, 1999; Read, Zhang, Nie, & Ding, 1986; Cheung et al., 2001). Such a correlation is convincing for English since it is an alphabetic writing system. On the other hand, a question can be raised whether the learners of

English as a second language (ESL) can develop phonological awareness in the same way as the first language (L1) speakers of English.

Holm and Dodd (1996) compared the performance of students from the People's Republic of China, Hong Kong, Vietnam and Australia with a number of phonological awareness, reading and spelling tasks. Their results revealed that both Mainland Chinese and Australian students were significantly superior to the Hong Kong students in terms of phonological awareness tasks and reading ability for low frequency non-words (low frequency non-words are non-words with vowel-consonant (VC) units less frequent in real words). With respect to the Mainland Chinese and Hong Kong students, Holm and Dodd suggested that although both Hong Kong and Mainland Chinese students' first language was Chinese (non-alphabetic logographs), Mainland subjects had early experience with Pinyin (alphabetic) and applied it to reading, which helped to develop phonological awareness. Such skill was transferred to English reading and phonological awareness tasks resulting in the difference in performance.

Bialystok, Luk, and Kwan (2005) considered the extent of transfer from one language to another with respect to phonological awareness and reading literacy. Their results led them to conclude that the extent of transfer depended on the relation between the two writing systems in question; the extent would be greater for systems which were more similar. For instance, their Spanish-English bilinguals performed significantly better than their Chinese-English bilinguals on English reading and phonological awareness tasks. Another study which investigated the effects of language transfer also concluded that positive transfer of phonological awareness from L1 to second language (L2) would be easy if there were elements in common in both languages. However, it was very difficult for positive transfer to take place if those elements were specific to the L2 (Wade-Wooolley & Geva, 2000). To better understand the results in Holm and Dodd (1996), we compare the pinyin system and

English writing system in order to determine whether the better performance on phonological awareness tasks of students in Mainland China as comparable to Australia students was likely to be due to the similarity of their writing systems.

Indeed, the alphabetic learning experienced by English and Mandarin-speaking students is different to a certain extent. First, consonant clusters are not found in pinyin in either initial or final positions (Siok & Fletcher, 2001). Second, pinyin transcribes the sounds of its logographic characters in onset and rime units, rather than phonemes (Chen, Anderson, Li, Hao, Wu, & Shu , 2004; Siok & Fletcher, 2001). For instance, the character /班/ is pronounced by combining /b/ (onset) and /an/ (rime), with the first tone; the character /幫/ is pronounced by combing /b/ and /ang/, with the first tone. Students in Mainland China learn /an/ and /ang/ as rime units and are not told that these sounds can be further segmented into phonemic units (eg. /a/ and /n/; /a/ and /ng/). Children in Mainland China would then receive extensive training on putting together these onsets and rimes to form meaningful syllables (Siok & Fletcher). With such reading instructions, Chen et al. suggested that it would be difficult for Chinese students to develop phonemic awareness.

The findings in Siok and Fletcher (2001), which included 154 Mandarin-speaking children (from Grade 1 to 3 and Grade 5), support that claim. The study compared the performance of children's phonological awareness in an oddity test, tone awareness test, sound isolation test, sound blending test and pinyin knowledge. The oddity test measured onset-rime awareness, whereas sound isolation test measured phonemic awareness. Both Chinese and English items were included in the oddity test and sound isolation test. The results indicated that the main effect of language (Chinese vs. English) was not significant for the oddity test, but the performance on the sound isolation test on Chinese items was significantly better. However, those children only showed significant improvement in the sound isolation test from Grade 3 to Grade 5 as they learnt English in Grade 4. Such a result

led the authors to conclude that onset-rime awareness rather than phonemic awareness predicted Chinese reading, thus pinyin knowledge might help to enhance onset-rime but not phonemic awareness (Siok & Fletcher). Therefore, English-speaking students would possess phonemic awareness, while Mandarin-speaking students would only process the onset-rime level of awareness.

Apart from the difference in orthography, Mandarin speakers are taught pinyin before they learn to read Chinese characters; it only serves as an auxiliary alphabet to help them learn the Chinese characters, usually appearing alongside the target characters. Pinyin would not be printed alongside the Chinese characters in textbooks from Grade 3 as the ultimate aim of pinyin was not to achieve pinyin literacy, but Chinese logography. In other words, the influence of the alphabetic script for Mandarin speakers is not comparable to English readers.

As for phonemic analysis ability, a number of studies across cultures have also demonstrated that the performance of Mandarin-speaking children was inferior to English-speaking children (Cheung et al., 2001; McBride-Chang et al., 2004). For example, Cheung et al. found that the 7-year-old children from New Zealand performed better than the 7-year-old Guangzhou subjects (who have been exposed to the pinyin system before Chinese characters were learnt) in terms of rime and coda matching (at phonemic level). Therefore, the pinyin system (which emphasizes onset-rime awareness) is believed to be unable to help a Chinese reader achieve phonemic level analysis as advanced as English speakers.

Based on the above reasons, whether the Mainland Chinese subjects in Holm and Dodd's (1996) study had received phonetic training such as International Phonetic Alphabet (IPA) became important as this might have contributed to their superior performance on the tasks reported in that study.

The present study investigated whether the early exposure to pinyin alone is enough for superior performance on English phonological awareness tasks and reading aloud. This study

replicated Holm and Dodd's study with two particular groups of Mandarin speakers. The first group of subjects had early exposure to pinyin system, but had not received IPA training [pinyin group]; the second group of subjects had received both pinyin and IPA training at young age [IPA-pinyin group]. The following predictions are made:

1. The pinyin group's performance on phonological awareness tasks would be inferior to the IPA-pinyin group.
2. The pinyin group's performance on reading aloud (especially for low frequency non-words) would be inferior to the IPA-pinyin group.

Method

Participants

Thirty subjects in Hong Kong with the same number of males and females participated in this study. The subjects formed two groups on the basis of the types of phonetic training they received in early age, which were confirmed through a screening test (production of pinyin and/or IPA symbols). They had to fulfill the following criteria:

(1) For the IPA-pinyin group, they received both IPA and pinyin training in young age. This was defined by the ability to pronounce 80% or above of both pinyin and IPA symbols. .

(2) For the pinyin group, they received pinyin training in young age. This was defined by the ability to pronounce 80% or above of pinyin symbols.

(3) They were either local undergraduates or graduates in the year 2004 and 2005.

(4) Students of English, Linguistics, English Education and Speech and Hearing Sciences were excluded in this study.

(5) All subjects had no previous spoken language or literacy difficulties in their first language

Each group comprised 15 participants (IPA-pinyin group: 7 females and 8 males; pinyin group: 8 females and 7 males). The time of the subject's first exposure to the phonetic training is shown in table 1. The subjects of the pinyin group had achieved a minimum of

grade E in Use of English in Hong Kong Advanced-Level Examination. Their average grade was D. The subjects of the IPA-pinyin group were exchange students to the University of Hong Kong from different provinces of Mainland China. They all have passed the admission requirement of the University of Hong Kong (which required them to score at least 60% in the admission test).

Table 1

Subject characteristics for each group

		IPA- Pinyin [a]	Pinyin
Age (year)	Mean (SD)	19.33 (0.72)	23.40 (1.06)
	Range	18-20	21-25
First exposure to	Mean (SD)	6.87 (0.35)	6.73 (0.46)
pinyin (age)	Range	6-7	6-7
First exposure to	Mean (SD)	11.60 (1.24)	---
IPA (age)	Range	9-13	
A-Level Use of English [b]	Mean (SD)	---	4.00 (0.76)
	Range		2-5

[a] The subjects in the IPA-pinyin group learned pinyin before IPA.

[b] Denotes Use of English grades in A-Level Examination: 1= A, 2 = B, 3 = C, 4 = D, 5 = E

Materials and Procedures

The subjects were tested individually in one 60-minute session. The test was administered in a quiet, comfortable room. Informed consents were obtained before testing began. The same tasks and the test materials in Holm and Dodd (1996) were used, with the exception of spelling of real word and non-words. Stimulus lists and detailed verbal instructions were provided in Appendix A. All subjects received the tasks in the same order

as in Holm and Dodd. Non-words were always given before real words to avoid visual priming from the real word.

All auditory stimuli were produced by a native speaker of English and recorded using a MZ-N10 net MD recorder to ensure consistent pronunciation. Stimuli were then digitized into a computer. PowerPoint files were constructed to play the stimuli through headphones to subjects.

Tasks

Phonological Processing Tasks

They included phoneme segmentation, spoonerism, verbal and visual rhyme judgment. The tasks targeted at phonemic segmentation, phoneme manipulation and onset-rime awareness, respectively.

The stimuli were controlled for the type of words. For example, in the phoneme segmentation tasks, the 24 stimuli were composed of three lists with eight words in each list: real words with one-to-one phoneme-to-grapheme correspondence (PGC) (e.g. on), one-to-many PGC (e.g. itch), and nonsense words with a one-to-one PGC (e.g. oskad). One practice item from each list was given and followed by accuracy feedback. The subjects had to identify the number of constituent phonemes. In the spoonerism task, a total of 10 real word pairs were made up of four types of stimuli: both words began with a single letter/ sound (e.g. poor, teddy); a digraph occurred in the first or second element of the spoonerism (e.g. soft, cheese); both initial elements contained digraphs (sharp, chain); and both words began with clusters (e.g. crowd, play). A total of four practice items from each type of stimuli were given and accuracy feedback was provided. Finally, there were 20 and 18 stimuli in verbal and visual rhyme judgement tasks, respectively; they were made up of four different types of word pairs: orthographically similar rhyming words (e.g. bush/push), orthographically dissimilar rhyming words (e.g. sheep/heap), orthographically similar non-rhyming words (e.g.

were/where), and orthographically dissimilar non-rhyming words (e.g. cart/kit). Four practice trials for each task were given followed by accuracy feedback. Two stimuli from the original visual rhyme judgement tasks (*core/raw; cow/row*) were excluded because two of the words (core, row) can have different pronunciations, making the scoring of response difficult.

The subject's responses of the spoonerism were recorded by a MZ-N10 net MD recorder, and later transcribed by the researcher.

Reading Tasks

Auditory/ visual matching. The subjects were required to listen to an auditory stimulus and match it from an array of four printed stimuli. There were a total of 9 items in read word matching and ten items in non-word matching. The real-word matching task assessed the subjects' ability to match grapheme information with an auditorily presented stimulus that is within lexical knowledge (Holm & Dodd, 1996). Each set of words contained a target and three distractors (semantic distractor, items differ in the prevocalic or postvocalic unit). For example:

Auditory stimulus: toy (/tɔɪ/); Visual stimuli: game, boy, *toy*, tow

One item from the original real word matching (shall, smell, *shell*, stone) was excluded because one of the visual stimuli did not meet the criteria for distractors (shall: differ in terms of vowel from the target).

The non-word matching task assessed the subjects' silent phonological decoding by using simple phoneme-grapheme correspondence in a context of low semantic information. The distractors varied in terms of the postvocalic unit, the vowel or unrelated spelling. For example:

Auditory stimulus: stob (/stɒb/); Visual stimuli: stom, stib, blek, *stob*

Reading real words and non-words. The tasks were adopted by Holm and Dodd (1996) from Treiman, Goswami, and Bruck (1990). Non-word reading required the use of direct

grapheme-phoneme correspondence rules or rules that make analogies with familiar real words. This task was designed to evaluate the strategies readers used when confronted with non-words. The subjects read aloud two lists of consonant-vowel-consonant (CVC) non-words: one list of 23 high-frequency non-words with *VC* units more frequent in real words (e.g. *tain*) than the other list of 24 low-frequency non-words (e.g. *taich*). It is suggested that if direct GPC rules are used, the accuracy of reading the two lists should be similar since the non-words in both lists are regular and consistent. If analogies were use to read familiar real words like *main* and *rain*, the accuracy of reading the two lists would be different (Treiman et al.). One stimulus from the original high-frequency non-word list (*Goan*) was excluded because it was actually a low-frequency real word. Venezky's (1970) GPC rules and Treiman et al.'s standard were used to identify correct pronunciations of non-words.

The real word reading task from Treiman et al. (1990) was to determine whether the subjects knew the real words that could help them pronounce the non-words. The subjects were required to pronounce a list of 30 words that contained the same vowel-consonant units as the stimuli in the non-word reading tasks.

The subject's responses were recorded by a MZ-N10 net MD recorder, and later were transcribed by the researcher.

About 10% of all responses from the spoonerism and reading aloud tasks would be transcribed by another independent phonetically trained person in order to ensure inter-rater reliability.

Results

Phonological Awareness

One-way ANOVAs for independent samples were used to compare the two group's mean percentage of correct responses in each of the four phonological awareness tasks

(phoneme segmentation, spoonerisms, verbal and visual rhyme judgement). Table 2 indicates significant effects of groups on all four tasks.

Table 2

Total percentage correct of the two groups on phonological awareness tasks and results of one-way ANOVAs

				One-way ANOVAs	
	Mean	Range	SD [a]	*F* (df)	*p*
Phoneme segmentation		Total item=24		29.83(1, 28)	.000
IPA-pinyin	87.22%	18-23	6.77		
Pinyin	56.67%	2-21	21.72		
Spoonerism creation		Total item=10		25.99 (1, 28)	.000
IPA-pinyin	75.00%	5-9	14.57		
Pinyin	37.33%	1-9	24.92		
Verbal rhyme judgement		Total item=20		11.48 (1, 28)	.002
IPA-pinyin	88.00%	16-20	5.92		
Pinyin	75.67%	9-18	12.80		
Visual rhyme judgement		Total item=18		16.12 (1, 28)	.000
IPA-pinyin	89.26%	13-18	9.50		
Pinyin	71.85%	8-17	13.84		

[a] The SD of the pinyin group was greater than that of the IPA-pinyin group in all four tasks. We would look into such a difference in the Discussion.

Errors on the spoonerism task were analysed. The mean incorrect response for the task was 56.17% (among the errors, 64.89% on one word and 35.11% on both words). The errors made in the phoneme to be transposed were 28.25%. The errors made in rime were 67.80%

and 3.95% on both elements. Five types of errors emerged (the mean percentage of occurrence was shown in Table 3):

1. Rime errors in both words (REBW): the initial phonemes of the stimulus were transposed correctly but other letters phonemes (i.e. rime) in the stimulus were not retained correctly

(eg. Sharp chain→chop shim /tʃɒp ʃɪm/).

2. Rime errors in one word (REOW): The rime in one of the word of the stimulus was not retained correctly (eg. Dark ship→ shark dik /ʃa:k dɪk/).

3. Onset errors in one word (OEOW): the first phoneme of the first word was substituted by the first phoneme of the second word. The second word remained unchanged (eg. Chip shop→ ship shop / ʃɪp ʃɒp/).

4. Digraph sharing (DS): The digraph in one of the stimuli was transposed correctly, however the second letter of the digraph in that word was also preserved after transposition. (eg. Chilly seats→ shilly cheats /ʃɪlɪ tʃi:s/).

5. Onset errors in both words (OEBW): the initial phoneme of the response was changed incorrectly (eg. Short date→ tort sate /tɔ:t seɪt/).

Table 3

Distribution of the error types produced in spoonerism task

types	REBW	REOW	OEOW	DS	OEBW
Distribution %	44.12%	26.47%	19.41%	7.06%	2.94%
IPA-pinyin	34.88%	30.23%	27.91%	6.98%	0%
pinyin	47.24%	25.20%	16.54%	7.09%	3.94%

Reading

Auditory/ visual Matching

A two-way ANOVA with repeated measures was used to compare the two group's performance on real and non-words. Both the main effects of group (F (1, 28) = 9.83, p =.004) and word type (F (1, 28) = 47.43, p =.000) were significant. The interaction of group and word type was statistically significant (F (1, 28) = 10.28, p =.003). Fig. 1 showed that there were group differences in matching non-words. According to Scheffé comparisons, the non-word matching task found significant differences between the two groups.

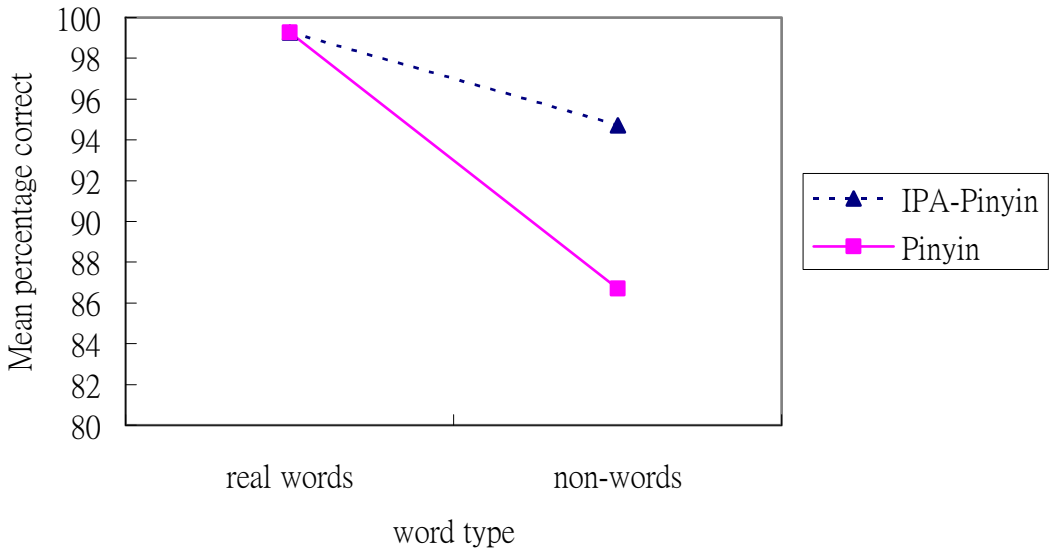

Figure 1. The group's performances on non-word and real words AV matching.

In the non-word auditory/ visual (AV) matching task, the errors made by both groups were to choose the distractors that differed in vowel from the target (e.g. chose *weg* for *wug*), while they never chose the distractors that differed in postvocalic unit or unrelated distractors. In matching real words, the errors they made were exclusively on distractors differing in postvocalic unit (e.g. chose *dram* for *draw*). They never chose the distractors differed in prevocalic unit or semantics.

Reading Real Words and Non-words

A two-way ANOVA with repeated measures was used to compare the groups' mean percentage of correctly read words in real words, high-frequency and low-frequency non-words. The results revealed a significant group effect (F (1, 28) = 19.19, p <.001). The main effect of word type was also significant (F (2, 56) = 63.53, p=.000). Post hoc analysis using Scheffé procedure confirmed that the differences among the three types of words were significant for both groups. Both groups performed better on reading real words, which was significantly better than both types of non-words. They read high-frequency better than low-frequency non-words.

The interaction of group and word type was statistically significant (F (2, 56) = 12.71, p =.000). Fig. 2 shows that the group differences in reading low-frequency non-words were larger than the group differences in reading the other two word types. It was confirmed statistically by Scheffé's procedure, which showed that the low-frequency non-word reading task revealed significant differences between the two groups, as shown in Table 4.

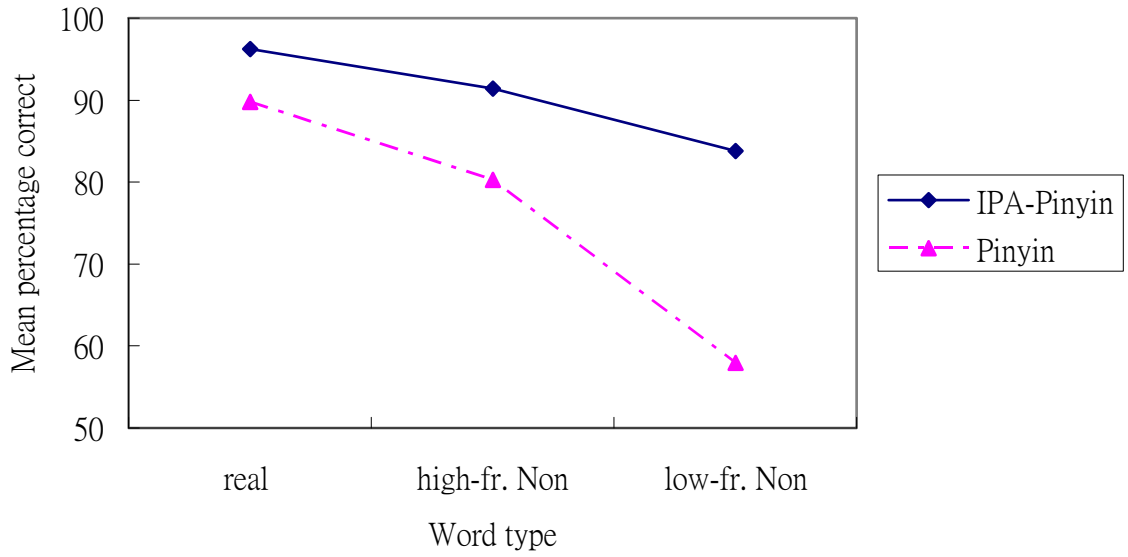

Figure 2. The group's performance on reading aloud real and non-words.

Table 4

The groups' performances on the reading aloud tasks

	Mean	SD	Pinyin
Reading tasks: real words			
Pinyin-IPA	96.22%	4.52	
Pinyin	89.78%	8.50	
Reading tasks: high-frequency nonwords			
Pinyin-IPA	91.39%	8.10	
Pinyin	80.28%	13.13	
Reading tasks: low-frequency nonwords			
Pinyin-IPA	83.77%	12.13	*
Pinyin	57.97%	15.90	

*$p < .007$.

The mean percentage of errors for both real and non-words in all word positions and error types were calculated and the result was in Table 5.

Table 5

Percentage of errors in different word position and the distribution of the error types

	IPA-pinyin			Pinyin		
	onset	nucleus	coda	onset	nucleus	coda
% of correct	98.87%	92.29%	99.22%	97.58%	81.30%	95.76%
% of errors	1.13%	7.71%	0.78%	2.42%	18.70%	4.24%
Error type						
Substitution	100%	100%	22.22%	100%	100%	46.94%
Omission	0%	0%	77.78%	0%	0%	53.06%

Analysis of the two groups' error patterns revealed that all errors were substitution that occurred on the onsets and nucleus. The errors on coda were mostly omission (56.90%); followed by substitution (43.10%). The analysis of onsets and codas on whether the erroneous sound could retain the place and manner feature of the original target phoneme was carried out and it was shown in table 6 and table 7 respectively.

Table 6

Percentage of the features that could be retained in the erroneous phoneme in the onsets of reading aloud tasks

Onsets	Examples	percentage of occurrence
-place, -manner	/dʒ-/→[j-]	61.54%
+manner, -place	/s-/→[ʃ-]	35.90%
+place, -manner	/f-/→[v-]	2.56%

Table 7

Percentage of the features that could be retained in the erroneous phoneme in the codas of reading aloud tasks

Codas	Examples	percentage of occurrence
+manner, -place	/-s/→[-ʃ]	45.45%
+place, -manner	/-d/→[-n]	36.36%
-place, -manner	/-p/→[-f]	18.18%

For onsets, the subjects showed the greatest difficulty in retaining both place and manner of articulation (eg. josh /d̲ʒʊʃ/→[j̲ʊʃ], the post-alveolar affricate was substituted by the palatal approximant).. For codas, deletion was the most common type of error (eg. veed /vi:d̲ / →

[vi:]), followed by substitution. The subjects showed the greatest difficulty in retaining the place of articulation (eg. fiss /fɪs/→[fɪʃ], the alveolar fricative was substituted by the post-alveolar fricative). There were also comparable (although lower) proportions of errors with place retained but manner changed.

For errors on nucleus, analysis on whether the erroneous sound could retain the features (ie. roundness of lip (R), front-back (FB) and high-low (HL)) of the original target phoneme was also carried out and the result was in table 8.

Table 8

Percentage of the features that could be retained in the erroneous phoneme in the nucleus of reading aloud tasks

Features that were (not) retained	Examples	Percentage of occurrence
+FB, +R, -HL	/u:/→ [ɒ]	58.46%
+FB, -R, -HL	/ʌ/→ [ʊ]	20.09%
-FB, -R, +HL	/ʌ/→ [ɒ]	10.50%
-FB, +R, -HL	/æ/→ [ə]	10.05%
-FB, -R, -HL	/ ɒ/→ [ə]	0.91%
+FB, -R, +HL	---	0.00%
-FB, +R, +HL	---	0.00%

For nucleus, the subjects showed the greatest difficulty in differentiating between nucleus that had different high-low feature. However, they made vowel errors without bias in terms of high-low feature. High vowels was sometimes substituted by low vowels (eg. foon /fu:n/→[fɒn]) and vice versa (eg. vud /vʌd/→[vud]).

The inter-rater reliability of phonetic transcriptions between the researcher and the independent phonetically trained person was 98%.

In summary, our results showed that the IPA-pinyin group performed significantly better than the pinyin group in all four phonological awareness tasks. The IPA-pinyin group also performed significantly better than the pinyin group in reading low frequency non-words and matching non-words. In terms of distribution of error types in different segments of reading aloud tasks, no difference was found in the onset and nucleus segements (i.e. all errors were substitution). However, the IPA-pinyin group made more omission errors than substitution errors in the coda position. The pinyin group made comparable errors in both types.

Discussion

Thirty Hong Kong college students with early exposure to pinyin system were divided into two groups according to the types of phonetic training they received. The IPA-pinyin group received both pinyin and IPA training at young age. The pinyin group had early exposure to pinyin system, but had not received IPA training. The IPA-pinyin group was superior to the pinyin group in all four phonological awareness tasks. They were also superior in reading low frequency non-words and matching non-words. The results of the phonological awareness tasks and reading aloud tasks in the present study supported the two predictions. The following reasons might contribute to the two groups' difference in performance.

First, the emphasis on onset-rime awareness in pinyin makes the concept of individual phonemes implicit. It is unable to help a Chinese reader achieve phonemic level analysis required for English phonological tasks and reading aloud tasks. It evidently requires explicit instruction. Second, there are only two final consonants /n/ and /ng/ in pinyin system, which are few compared with English (Huang & Hanley, 1995). Thus pinyin training might not be

able to raise the pinyin group's awareness to the final consonants; and this may account for the poorer performance on phoneme segmentation and reading aloud tasks. Third, consonant clusters are not found in pinyin in either initial or final positions. Thus pinyin training could not enhance the awareness of the clusters in English words. Fourth, many pinyin alphabetic units such as /ia/ and /ang/ are treated as a single unit (i.e. single phoneme) in pinyin. However, they correspond to multi-phonemes in English IPA (eg. /ia/ in pinyin corresponds to /j + a:/ and /ang/ in pinyin corresponds to /a: + ŋ/ in IPA). Hence it is possible that students in the pinyin group treated some multi-phonemes in English as single phoneme due to the effect of pinyin system, resulting in poorer performance on the phoneme segmentation task.

The results are consistent with those of Bialystok et al.(2005) and Wade-Wooolley and Geva(2000) with respect to the extent of transfer for phonological awareness and reading literacy from one language to another. In other words, it is difficult for positive transfer to take place since the pinyin system and the English writing system are different.

Since Holm and Dodd (1996) have not mentioned about the background of the mainland Chinese subjects, would it be possible that their background of phonetic training was mixed? First, assuming that Holm and Dodd's Chinese Subjects had mixed background (i.e. some of them have received IPA training and some of them have not), we averaged the IPA-pinyin group and pinyin group's result in the present study and compared with Holm and Dodd's result for the Mainland Chinese Subjects. For phonological awareness tasks, the mean percentage of accuracy of the present study was lower than that of Holm and Dodd in all four tasks. Is the result indicating that their subjects have received IPA training? The second step of comparing Holm and Dodd's results with the present study's pinyin and IPA-pinyin groups are also carried out. The results are shown in Table 9.

Clearly, our IPA-pinyin group performed more like Holm and Dodd's (1996) Mainland Chinese subjects than the pinyin group with respect to phonological awareness tasks.

Whether the Mainland Chinese subjects in Holm and Dodd's study had received phonetic training (such as IPA) other than pinyin was in question.

Table 9

Mean percentage correct (SD) on phonological awareness tasks and reading aloud tasks

	The present study		Holm and Dodd (1996)
	Pinyin group	IPA-pinyin group	Mainland Chinese
Phoneme segmentation	56.67% (21.72)	87.22% (6.77)	89.90% (4.58)
Spoonerism creation	37.33% (24.92)	75.00% (14.57)	97.50% (5.40)
Verbal rhyme judgement	75.67% (12.80)	88.00% (5.92)	86.00% (3.94)
Visual rhyme judgement	71.85% (13.84)	89.26% (9.50)	83.50% (3.37)
Reading real words	89.78% (8.50)	96.22% (4.52)	83.70% (2.20)
Reading HF non-words	80.28% (13.13)	91.39% (8.10)	71.70% (2.50)
Reading LF non-words	57.97% (15.90)	83.77% (12.13)	65.40% (3.50)

However, not all performance of the IPA–pinyin group was similar to the results of Holm and Dodd (1996). First, the performance of the present subjects on spoonerism creation was much inferior to all four groups in Holm and Dodd's (1996) study. All the subjects in the present study commented that spoonerism was the most difficult task among the phonological awareness and reading aloud tasks. Since in the present study, they were not allowed to write down the stimuli that were auditorily presented. When they were doing the transposition of the initial phoneme, they might have already forgotten the whole word. The big discrepancy might be due to the difference in the format of presentation (eg. the subjects in Holm and Dodd's study might be allowed to write down the stimuli that were auditorily presented to them. Hence it resulted in superior performance on spoonerism).

Second, there was also a discrepancy between the performances of reading aloud tasks. The ability to read real words is clearly affected by English word knowledge. English knowledge can also help to read high frequency non-words since they shared the same VC units which were more frequent in real words. According to Holm and Dodd's study, those Mainland Chinese subjects had their first exposure to English literacy at the age of 21 in general, while the present study's subjects started learning English at a much earlier age (age range: 9 to 13). It could result in the difference of English word knowledge. The fact that the subjects in the present study performed better in reading real words also support that they had better English knowledge. In addition, the lower performance of the pinyin group in the present study on reading LF non-words than Holm and Dodd's study further supported that they might have received phonetic training other than pinyin.

The present study's result was also compared with another study (Choy, 2003), which replicated Holm and Dodd's (1996) tasks using subjects of Hong Kong college students with similar background as the present study in terms of phonetic training (i.e. both studies used subjects that received pinyin training only [pinyin group] and IPA training in addition to pinyin [IPA-pinyin group]). The differences between the two studies' subjects were the age of receiving phonetic training and the present study's IPA-pinyin group subjects were Mainland Chinese. The present study was compared with Choy's study since difference in performance on some tasks were identified. The results are shown in Table 10.

Choy's (2003) results corresponded with those of the present study for both groups of subjects in most of the tasks. However, differences in performance on spoonerism and phoneme segmentation tasks were identified. The big discrepancy for spoonerism task might be due to difference in presentation of the task. Choy's IPA-pinyin group performed significantly poorer on phoneme segmentation than our IPA-pinyin group. The age difference in receiving phonetic training (their main difference in background) might be a contributing

factor for the difference in performance. Choy's IPA-pinyin group learnt pinyin and IPA at the age of 14.9 and 15.6 in general, respectively, while our subjects learnt pinyin and IPA at the age of 6.8 and 11.6 in general, respectively. Hence, our subjects might be more experienced in segmenting phonemes and sensitized to symbol-sound correspondence. This might explain why our IPA-pinyin group performed better on phoneme segmentation task than the IPA-pinyin group of Choy's study.

Table 10

Mean percentage correct on phonological awareness tasks and reading aloud tasks

	Choy (2003) Mean (SD)	Present study Mean (SD)
Phoneme segmentation		
IPA-pinyin	64.40% (16.86)	87.22% (6.77)
Pinyin	48.50% (13.25)	56.27% (21.72)
Spoonerism creation		
IPA-pinyin	95.30% (7.72)	75.00% (14.57)
Pinyin	91.90% (10.78)	37.33% (24.92)
Verbal rhyme judgement		
IPA-pinyin	84.70% (10.86)	88.00% (5.92)
Pinyin	76.00% (12.91)	75.67% (12.80)
Visual rhyme judgement		
IPA-pinyin	80.80% (13.87)	89.26% (9.50)
Pinyin	69.00% (10.32)	71.85% (13.84)
Reading tasks: real words		
IPA-pinyin	97.50% (3.32)	96.22% (4.52)
Pinyin	91.90% (7.52)	89.78% (8.50)
Reading tasks: high-frequency nonwords		
IPA-pinyin	85.30% (8.58)	91.39% (8.10)
Pinyin	76.60% (13.87)	80.28% (13.13)
Reading tasks: low-frequency nonwords		
IPA-pinyin	79.70% (12.50)	83.77% (12.13)
Pinyin	68.10% (13.30)	57.97% (15.90)

For the present study, with respect to all phonological awareness tasks, the variation among the pinyin group's subjects was much greater than that of the IPA-pinyin group (refer to their SDs and ranges). Apart from the effect of individual differences, different degree of transfer of their pinyin knowledge to English tasks may be another contributing factor. In other words, some subjects may be able to transfer their pinyin knowledge to English tasks better while some subjects may encounter more difficulty in doing so. Such phenomenon is possible as pinyin training cannot enhance awareness at the phonemic level. Furthermore, some of the subjects in the pinyin group reported that they only guessed the number of phonemes in the segmentation task since they did not have such knowledge. However, the IPA-pinyin group uses their IPA knowledge to segment the word into phonemes so they could tell the number of phonemes for a word. This suggests that learning pinyin alone is not enough for consistent and superior performance on English phonological awareness tasks.

Both groups' major error type in reading aloud was mispronouncing the vowels. The error pattern in auditory/ visual matching of non-words was also choosing distractors differing in vowel from the target. It was consistent with Treiman et al's (1990) finding. This may be due to the fact that consonants are more consistent in pronunciation. However, vowel graphemes often have more than one pronunciation which result in particular difficulty in pronouncing vowels. For onsets, substitution was the most common error type which suggested that the subjects were aware of the presence of the initial consonants. They showed the greatest difficulty in retaining both place and manner features which /dʒ-/ (eg. jub) and /v-/ (eg. vag) contributed to such high percentage of error rate (91.67% for this type of error rate). This might be due to the fact that they were not familiar with the pronunciations of these two onsets and therefore replaced them with another pronunciations which are presented in both English and pinyin (/dʒ-/→[j], /v/→[w]). For codas, deletion was the most common type of errors, followed by substitution. The dominance of deletion in codas further

supported the fact that pinyin training might not be able to raise the subject's awareness of the final consonants since there are only two codas (/n/ and /ng/) in pinyin system.

One of the limitations of the present study was the demonstration of the comparability between the two groups' English ability. No information about their English ability was able to show that. One solution to this would be to carry out an English test for all subjects (eg. TOEFL (Test of English as a Foreign Language). However, since there were no significant differences between the two groups for real words and HF non-words reading aloud tasks. Therefore, it is likely their English abilities were comparable.

Conclusion

To conclude, the IPA-pinyin group performed significantly better than the pinyin group on all phonological awareness tasks, matching non-words and reading LF non-words. This indicated the effect of phonetic training on phonological awareness and reading LF non-words. The results of present study demonstrate that: First, exposure to IPA instruction might result in superior performance on phonological awareness tasks as such instruction enhances symbol-sound awareness. Subjects who received IPA instruction use their IPA knowledge to segment words (i.e. stimuli) which are presented auditorily or visually into phonemes (i.e. IPA). Such phonemic awareness is required in the phonological awareness tasks. Second, the most apparent effect of IPA training on reading aloud tasks is to read LF non-words. Third, it is not pinyin knowledge in general which leads to superior performance on phonological awareness tasks, but possible phonetic training in English that enhances awareness at the phonemic level. It suggested that Holm and Dodd's (1996) conclusion on the transfer of L1 skills with pinyin training to ESL learning were not well justified.

Implications

The results of this study have two implications for ESL learners who learn non-alphabetic L1 orthography (such as Hong Kong students). First, learning pinyin alone is not

enough to enhance phonemic awareness, it is recommended to learn IPA as well. Second, the whole set of the phonetic training for IPA should be introduced and completed at early age such as in elementary school curriculum in order to achieve maximum benefit. Hence IPA knowledge becomes consolidated and through practice of symbol-sound corresponding, they can segment spoken syllables into phonemic units skillfully and generalize to new words.

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Appendix A. Test Stimuli

A.1. Phonological awareness

A.1.1. Phoneme segmentation

Instruction:

“等陣你會聽到啲英文字 / 假字, 你要話俾我知每一個字有幾多個音素.”

(In the following task, you will hear some English words/ non-words. You have to decide the number of phonemes in each word.)

1:1 GPC	Many:1 GPC	Nonwords
It	Out	Og
On	Itch	Ap
Pet	White	Zeg
Big	Cake	Lek
Swim	Ocean	Klon
Frog	Plate	Vist
Stamp	Friend	Stelp
Robin	Whistle	Oskad

A.1.2. Spoonerism creation

Instruction:

“等陣你會聽到一對一對嘅英文字, 你要將每一對字既第一個音倒轉.”

(You will hear pairs of English words; you have to transpose the first sound of each word pair)

Big	Dog
Poor	Teddy
Dark	Ship
Soft	Cheese
Chilly	Seats
Short	Date
Chip	Shop
Sharp	Chain
Crowd	Play
Clown	Prince

A.1.3. Rhyme judgement

Instructions:

“等陣你會睇 / 聽到一對一對英文字, 你要判斷佢地係唔係押韻.”

(You will see / hear pairs of English words, you have to decide whether they rhyme or not.)

A.1.3.1. Verbal stimuli

OSR	ODR	OSNR	ODNR
Rang / sang	Laugh / staff	Beast / breast	Wait / wet
Bush / push	Fern / yearn	Said / paid	Cart / kit
Jar / tar	Sheep / heap	Bear / rear	Beg / bag
Fate / mate	Fought / port	Were / where	Shop / ship
Fine / mine	Through / new	Wreath / death	Fit / fat

A.1.3.2. Visual stimuli

Sing / ring	Maid / grade	Post / lost	Rot / rat
Rain / pain	Mist / missed	Worm / form	Bed / bad
Wife / life	Tight / bite	Steak / peak	Ball / bill
Beat / heat	Core / raw*	Dew / sew	Lace / lice
Song / wrong	Fair / care	Cow / row*	Sin / sun

Note. * Item was excluded from the stimulus list because two of the words (core, row) can have different pronunciations, making the scoring of response difficult.

A.2. Reading

A.2.1. Auditory/ visual matching.

The target words are underlined.

A.2.1.1. Real words

Instruction:

“等陣你會睇到 4 個英文字同聽到 1 個字, 你要選出聽到□個個字.”

(You will see four English words and hear one word; you have to choose of an array of four written words to match to the word you hear.)

1	Car	Jar	Bus	Can
2	Wallet	Purge	Nurse	Purse
3	Game	Boy	Toy	Tow
4	Boot	Cook	Book	Story
5	Cable	Tale	Chair	Table
6	Store	Shop	Stop	Ship
7	Knee	Flower	True	Tree
8	Draw	Dram	Gnaw	Paint
9*	Shall	Smell	Shell	Stone
10	Pie	Café	Cake	fake

Note. * Item was excluded from the stimulus list because one of the visual stimuli did not meet the criteria for distractors (shall: differ in terms of vowel from the target)..

A.2.1.2. Nonwords

Instruction:

“等陣你會睇到 4 個假字同聽到 1 個假字, 你要選出聽到□個個字.”

(You will see four nonwords and hear one nonword, you have to choose from an array of four written nonwords to match to the nonword you hear.)

1	Orp	Lun	lon	Lup
2	Brev	Brep	Lang	Brap
3	Stom	Blek	Stib	Stob
4	Losk	Lasp	Foad	Lask
5	Soav	Kerth	Suv	Soag
6	Kom	Kesh	Kosh	Selp
7	Dit	Fres	Frel	Fral
8	Wug	Weg	Wup	Klat
9	Ket	Koot	Kej	Layf
10	Slorn	Slern	Croil	slerf

A.2.2. Reading aloud.

A.2.2.1. Real words

Instruction:

“等陣你會睇到□的英文字, 你要盡量讀出佢地既讀音.”

(You will see some English words; you have to try your best to read them aloud)

Main, coach, coal, dug, less, ship, tail, dog, truck, clef, loud, job, bag, beef, loop, club, need, drum, deep, fresh, josh, loan, miss, step, Sol, check, God, soon, mud, seem

A.2.2.2. Nonwords

Instruction:

“等陣你會睇到口的假字, 你要盡量讀出佢地既讀音.”

(You will see some nonwords, you have to try your best to read them aloud.)

High-frequency nonwords:

Tain, goach, joal, sug, vess, fip, chail, pog, juck, lef, foud, chob, vag, peef, foop, hain, jub, veed, cheed, lum, meep, fesh, losh, yoal.

Low-frequency nonwords:

Goan*, taich, soag, jul, fiss, vep, paig, chol, leck, juf, choub, fod, paf, veeg, haip, foon, vud, jeeb, leem, chud, fep, meesh, yol, loash.

Note. * Item was excluded from the stimulus list because it is a real word.

Appendix B. Consent form

香港大學言語及科學系

Division of Speech and Hearing Sciences

Consent Form 同意書

I consent to participate in a study of phonological awareness in local college students. I understand that all information revealed during the study, including the identity of the participants, will be kept confidential.

本人同意參與一項有關大學生語音覺識的研究, 亦明白過程中所有資料 (包括被測試者的姓名) 將會絕對保密。

I give consent that audio recordings of my speech will be made for use in research. It is understood that the tapes will not be identified by name.

本人同意測試過程被錄音, 以作研究之用, 而此記錄將不會記名。

I understand that I have the right to quit this study at any time and ask any questions during this study.

本人明白在測試過程中, 有權隨時退出研究或詢問任何問題。

This form has been fully explained to me and I certify that its consents are understood.

以上所有內容, 研究員已向本人詳細解釋, 並完全明白以上一切有關事項.

_____	_____	_____
Name 本人姓名	Signature 本人簽署	Date 日期
_____	_____	_____
Researcher's name 研究員 陳冬冬	Researcher's signature 研究員簽署	Date 日期

Appendix C. Background Information Form

Background Information

Name _____ Sex/ Age _____

University ☐HKU ☐CU ☐BU ☐PolyU ☐CityU ☐UST ☐ Shue Yan ☐Others ___

Curriculum _____

Year of study _____/ Year of graduation_____

Previous knowledge of: A.☐ English Phonetics B.☐ Mandarin *pinyin*
C.☐ None of them D.☐ others _____

When did you learn the above phonetics? A. _____
B. _____

A-Level Use of English Result ☐A ☐B ☐C ☐D ☐E

The English Admission Test Result (港大英語考試) _____

Screening Results: 1) English phonetics _____ % (/ 43) ☐ > 80% ☐ <80%
2) Mandarin *pinyin* _____ % (/ 39) ◯ > 80% ◯ <80%

Appendix D. Screening Items

I. International Phonetic Alphabet (IPA) for English

1	p	25	iː
2	b	26	ɪ
3	t	27	e
4	d	28	œ
5	k	29	aː
6	g	30	ɒ
7	tʃ	31	ɔː
8	dʒ	32	ʊ
9	f	33	uː
10	v	34	ʌ
11	θ	35	ɜː
12	ð	36	ə
13	s	37	eɪ
14	z	38	au
15	ʃ	39	aɪ
16	ʒ	40	əu
17	h	41	ɔɪ
18	m	42	ɪə
19	n	43	eə
20	ŋ		
21	l		
22	r		
23	j		
24	w		

II. Mandarin *pinyin*

1	b	22	a
2	p	23	o
3	m	24	e
4	f	25	i
5	d	26	u
6	t	27	ü
7	n	28	ai
8	l	29	ei
9	g	30	ao
10	k	31	ou
11	h	32	an
12	z	33	en
13	c	34	in
14	s	35	ang
15	r	36	eng
16	zh	37	ing
17	ch	38	ong
18	sh	39	er
19	j		
20	q		
21	x		