The development of phonological awareness: effects of spoken language experience and orthography

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Received 20 September 2000; received in revised form 3 February 2001; accepted 18 April 2001

Abstract

Phonological awareness, the ability to analyze spoken language into small sound units, has been shown to be affected by the individual’s early orthographic experience (alphabetic vs. non-alphabetic). Past studies, however, have not differentiated the effect of script alphabeticity from that of spoken language experience, which covaries strongly with the phonological properties of the language. The present study compares younger, pre-reading to older, literate children from different linguistic backgrounds on their phonological awareness. Hong Kong and Guangzhou subjects both spoke Cantonese. The latter subjects had early experience with Pinyin (alphabetic) in addition to their logographic Chinese reading; the former read only logographic Chinese. New Zealand subjects spoke English and read the Roman alphabet. Results showed that: (1) the Hong Kong and Guangzhou pre-readers performed very similarly at all levels of phonological awareness; (2) the New Zealand pre-readers outperformed their Hong Kong and Guangzhou counterparts on onset, rime, and coda analyses; (3) the Guangzhou reading children outperformed their Hong Kong counterparts on onset and coda analyses. Whereas finding (3) reflects an effect of alphabeticity in the first learned script, finding (2) in combination with finding (1) indicates an effect of early spoken language experience independent of orthography. The fact that orthographic and spoken language experience both impact on the development of phonological skills implies a mediating function of phonological awareness in integrating sound information derived from reading and perceiving speech.

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PII: S0010-0277(01)00136-6
1. Introduction

Phonological awareness is the ability to analyze spoken language into its component sounds and to manipulate these smaller units. We addressed the influence of early spoken language and reading experience on phonological awareness. The specific questions we asked are as follows. Do early experiences with both the phonology of the spoken language and the orthography of the written script contribute to phonological awareness development? Are the two factors differentially correlated with phonological awareness at different levels of linguistic analysis?

To answer these questions, we compared pre-reading and reading children from three distinct linguistic backgrounds on their phonological awareness performance in such a way that the effects of spoken language and reading experience could be separately assessed. The current research questions were motivated by three lines of previous studies.

The first line of research is represented by Rebecca Treiman and colleagues’ work on the linguistic status hypothesis (e.g. Bruck, Treiman, & Caravolas, 1995; Treiman, 1985, 1995; Treiman, Mullennix, Bijeljac-Babic, & Richmond-Welty, 1995). In this hypothesis, Treiman postulates that the component phonemes of a syllable are hierarchically structured. Between the syllable and the phonemes there exists an intermediate level of organization corresponding to the demi-syllables of onset and rime (Treiman, 1985, 1995; Treiman et al., 1995; Treiman & Zukowski, 1996). The onset includes all the pre-vocalic consonants, and the rime comprises the vocalic nucleus and the coda. Therefore, the syllable is on the top of the structure and is the most accessible unit, followed by the demi-syllabic units of onset and rime, and finally the individual phonemes. Treiman argues that the accessibility of a unit is determined by its position within the hierarchy, instead of its number of component phonemes.

There has been ample evidence for Treiman’s postulate. For instance, Bruck et al. (1995) administered a speeded non-word comparison task to English-speaking undergraduates, in which subjects decided quickly whether the two members of a non-word pair share the beginning, middle, or end sound. Results showed that responses were facilitated when the shared unit, which comprised a constant number of phonemes, was a complete syllable compared with when it was only part of a syllable. This finding demonstrates the special top-of-the-hierarchy status of the syllable in phonological processing.

The decomposition of the syllable into its onset and rime corresponds to the intermediate level of analysis in the accessibility hierarchy. Hence, Treiman (1985) showed that word games that required analyzing the syllable into onset and rime were especially easy for children to learn. Syllable-initial consonants
were more easily recognized when they were singletons (i.e. whole onsets) than when they were embedded in consonant clusters (i.e. part of onsets). Similarly, Treiman and Zukowski (1996) found that young children performed better on judging whether two items shared a beginning sound when the shared sound constituted a complete onset than when it was only part of an onset. Treiman et al. (1995) analyzed the sound–spelling relationships of some 1329 English words and reported that sound–spelling consistency was most likely to be found at the level of orthographic rimes (i.e. spelling units comprising a vowel grapheme followed by a consonant grapheme), compared to either individual vowels or consonant–vowel units. The predictive effect of the orthographic rime on word pronunciation errors and latencies was not explainable by that of its component graphemes. Furthermore, subjects were more likely to make pronunciation errors when the orthographic rimes were not consistently pronounced than when they were. The authors therefore concluded that the rime functions as a critical organizational unit in phonological processing.

Treiman and colleagues have also obtained evidence for the linguistic status hypothesis from studies on short-term memory. For instance, examining the immediate recall of lists containing consonant–vowel–consonant items, Treiman and Danis (1988) and Treiman (1995) reported especially high proportions of a certain type of recombination errors in adult and child samples, respectively. An erroneous response in this situation involved recombining the onset of a target syllable with the rime of another target syllable. Hence, both adults and young children tend to encode syllables in terms of onsets and rimes for immediate recall.

The second line of research is represented by Paul Bertelson and colleagues’ work on the effect of orthographic experience on phonological awareness development (e.g. Bertelson, de Gelder, Tfouni, & Morais, 1989; Bertelson, de Gelder, & van Zon, 1997). Bertelson extended the linguistic status theory to the study of phonological awareness and hypothesized that: (1) phonological awareness is a multi-level ability; (2) the various levels correlate differentially with reading experience.

In an attempt to test the status of syllable onsets in explicit speech analysis, Bertelson, de Gelder, and van Zon (1997) had children perform a consonant deletion task in which the target consonant was either a complete onset on its own or only part of an onset. They found that deleting the whole onset was easier than deleting part of an onset, even though the target unit was always one phoneme in size. This finding was consistent with the hierarchical view of syllable structure.

If phonological awareness is a multi-level ability, how are the various levels related to reading? Developmental studies in the area have demonstrated a robust positive correlation between phonological awareness in general and early reading (e.g. Hatcher, Hulme, & Ellis, 1994; Leather & Henry, 1994; McDougall, Hulme, Ellis, & Monk, 1994). While admitting that this correlation is open to a range of interpretations, Bertelson and his colleagues focussed on how orthographic experience might shape the development of phonological awareness. Because the alphabetic writing system represents individual phonemes by letters, reading experience with the system should promote conscious phonological organization at the phonemic level. Such support is, however, unavailable in the non-alphabetic system in
which phoneme-sized units are not represented. From the model we can predict superior phonological awareness at the phonemic level, or simply phoneme awareness, in alphabetic readers, compared to non-alphabetic readers and illiterates. On the other hand, there is no reason to hypothesize any effects of orthographic experience on syllable, onset and rime awareness.

In line with this expectation, Morais, Bertelson, Cary, and Alegria (1986) observed that although reading experience in the form of alphabetic literacy strongly affected the development of phonemic analysis, it only weakly affected syllable and rime awareness. They concluded that only phoneme awareness requires training in an alphabetic orthography. Syllable, onset, and rime awareness should arise spontaneously with spoken language development and should not demand support from reading an alphabetic script. This position has received support from studies comparing alphabetically literate to illiterate subjects (e.g. Bertelson et al., 1989), alphabetic to non-alphabetic readers (e.g. de Gelder, Vroomen, & Bertelson, 1993; Read, Zhang, Nie, & Ding, 1986), and individuals trained on phonemic analysis to untrained controls (e.g. Cheung, 1999).

The third line of research comprises past studies on the possible effect of early spoken language experience on phonological awareness development (e.g. Caravolas & Bruck, 1993; Cossu, Shankweiler, Liberman, Katz, & Tola, 1988). Given that alphabetic reading modifies the representation subserving phonological awareness (phoneme awareness in particular), the next important issue is whether this level of phonological representation communicates with spoken language processing as well. This question bears significantly on how reading and spoken language processing are related. In more specific terms, the question pertains to investigating the role played by phonological awareness in speech communication. How are the two capacities related? Does the experience with spoken language modify the ability to analyze speech? If the level of representation supporting phonological awareness is modified by both reading and spoken language experience, then it essentially constitutes an informational space in which oral and written language could interface. Such interfacing gives rise to integration between reading and perceiving speech such that, for example, reading the letter string “m-a-k-e” would result in a phonological representation that is highly compatible with the representation derived from listening to the spoken word /meIk/.

To examine the modulating effect of spoken language experience on phonological awareness, we can compare the phonological skills of individuals speaking languages differing along certain phonological dimensions that should influence how speech sounds are explicitly organized. The approach is analogous to contrasting different orthographies to establish the effect of reading. Cossu et al. (1988) compared Italian- with English-speaking children on syllable and phoneme counting. The Italian subjects outperformed their English-speaking counterparts on both tasks. Although the effect was most pronounced with the reading children, it was also notable in the pre-readers. Whereas the effect of linguistic group in the reading children could be explained by the difference in orthographic depth between written Italian (relatively transparent) and English (relatively opaque), that in the pre-reading children could only be attributed to differences in syllable structure between the
two spoken languages. Therefore, the authors concluded that spoken language experience plays a role in phonological awareness development.

Caravolas and Bruck (1993) took a similar approach and compared Czech- with English-speaking children on certain phonological awareness tasks. They hypothesized that the relatively high prominence, variety, and complexity of consonant clusters in Czech syllables together with the orthographic transparency in written Czech should result in a high level of phoneme awareness in Czech learners compared to English-speaking/reading children. As expected, the Czech-speaking children performed better than the English-speaking children when asked to isolate and delete single consonants embedded in consonant clusters. Because the effect was of similar size in reading and pre-reading children, it tended to reflect primarily contributions from spoken language rather than orthographic experience.

Nevertheless, the studies by Cossu et al. (1988) and Caravolas and Bruck (1993) failed to produce any marked interaction between age and linguistic groups. If orthography had an effect, the between-group difference in phonological awareness should be more marked with increasing age as the children became more experienced in the respective orthographies. The lack of age by subject group interaction in these studies does not support any strong conclusion about an independent orthographic effect, thus contradicting what has typically been found (e.g. Bertelson et al., 1989; Read et al., 1986).

In the present study we compared the phonological awareness of both pre-reading and reading children recruited in Hong Kong (China), Guangzhou (China), and Dunedin (New Zealand). The Hong Kong and Guangzhou children spoke Cantonese-Chinese natively, whereas the New Zealand children spoke English as their mother tongue. Logographic Chinese was the first learned script of both the Hong Kong and the Guangzhou reading children; written English was the first learned script of the New Zealand reading children.

An important difference in orthographic experience between the Hong Kong and the Guangzhou readers had to do with how the logographs had been acquired. The former group had learned to read these logographs by rote: no alphabets were used in their learning. The Guangzhou reading children, on the other hand, had learned to read logographic Chinese with the aid of a set of specially designed alphabetic symbols called Pinyin. Children recruited in these three places therefore varied systematically in both spoken language and orthographic experience. The Hong Kong and Guangzhou children spoke the same language, which differed drastically from that spoken by the New Zealand children. The Hong Kong readers’ orthographic experience was primarily logographic, whereas their Guangzhou counterparts had learned alphabetic Pinyin to transcribe the sounds of logographic characters. The New Zealand reading children had full alphabetic experience with written English. All the pre-readers, on the other hand, were assumed to have extremely limited literacy skills. Comparing the phonological skills of these various groups might therefore reveal the relative contributions of spoken language and orthographic experience to the development of phonological awareness.

We assumed that the three groups of pre-reading children had equally minimal literacy skills. Formal reading instruction in the three places was to begin at school
around the age of 5. At the time of testing, the pre-reading groups had not been exposed to formal reading instruction whereas the readers had had about 2.5 years of such training. This is, however, not to say that the pre-readers were absolutely illiterate. Many parents in the three places encouraged their preschool children to start reading simple materials and play letter/word games. Parents also tended to participate actively in their children’s reading and play, taking the role of reading instructors. Educational television programs constituted yet another source from which the children might learn some reading. To ensure that the pre-reading children indeed had extremely limited and thus comparable literacy skills at the time of testing, an isolated character/word reading test was administered to each group. Results of the test are reported in Section 2.1.

We assumed that the alphabetic experiences enjoyed by the New Zealand and the Guangzhou readers differed to some extent. Alphabetic experience is not an all-or-none concept; it can be evaluated along at least four independent dimensions. First, concerning the mere length of alphabetic learning, the two groups were comparable in that both had had formal contact with the respective alphabets for about 2.5 years at the time of testing. Second, Holm and Dodd (1996) have shown that the critical factor for developing phoneme awareness is whether the first learned orthography is alphabetic. The alphabeticity of later learned scripts does not appear to be a crucial determinant (see also Cheung, 1999). The New Zealand and Guangzhou reading groups in the present study were comparable along this dimension, in that written English and Pinyin, which is also based on the Roman alphabet, were the respective first learned orthographies. Third, regarding the teaching method, both places favor the phonic approach in which sound–spelling correspondence is emphasized. Finally, concerning the dominance of the alphabetic script, the two groups differed. The Guangzhou children were taught Pinyin only as an auxiliary alphabet assisting in their learning of characters. Target characters therefore always existed alongside Pinyin symbols, and the ultimate aim was to achieve logographic rather than Pinyin literacy. This was to be distinguished from the full alphabetic reading experienced by the New Zealand readers.

Nevertheless, the incomplete alphabetic literacy of the Guangzhou readers should not seriously affect their alphabet-reading status as far as phonemic analysis was concerned. It is because Read et al. (1986), Holm and Dodd (1996), and Bertelson, Chen, and de Gelder (1997) have all shown that learning Pinyin significantly improves phonemic analysis. Perhaps it is the awareness of the very function of Pinyin that brings about such effectiveness: if both the teacher and students are clear that the primary function of Pinyin symbols is to help them derive character pronunciations, it would not be surprising to see them capitalize on sound–spelling correspondence in Pinyin reading. Such an emphasis on the sound–spelling relationship might compensate for the fact that Pinyin is only used as an auxiliary script.

In Hong Kong, children typically start learning to read English as a second script around the age of 6 or 7. Therefore, a relevant issue is whether the Hong Kong reading children’s early exposure to written English would be the same as their New Zealand counterparts. We considered this possibility unlikely due to previous findings with Hong Kong subjects. For example, in the Holm and Dodd (1996) study,
phoneme awareness of the Hong Kong undergraduates was especially weak compared to that of the Australian, Vietnamese and mainland Chinese subjects. This happened even though the Hong Kong subjects had the longest history of English literacy. The authors thus concluded that it is the first learned script that is critical for the development of phonemic analysis. Bertelson, Chen, and de Gelder (1997) reported a similar finding. The phonemic analysis performance of the Hong Kong undergraduates in their study was inferior to that of the mainland Chinese subjects, who did not have extensive experience with written English but had learned Pinyin alongside logographic characters. Cheung (1999) also reported that the phoneme awareness of his Hong Kong adolescent subjects was very limited prior to focussed training on phonemic analysis, despite their long history of English literacy.

In the present study we contrasted English with Cantonese along the dimension of spoken language experience because the two languages differ significantly in syllable structure. Speakers of the two languages might thus organize phonological information quite differently due to their differential experiences with syllables. One notable fact about the Cantonese syllable is its total lack of consonant clusters. Caravolas and Bruck (1993) have shown that the frequency, variety, and complexity of within-syllable consonant clusters do have a positive effect on the speaker’s phonological skills. This effect is independent of orthographic experience. Whereas the syllable shape of the Czech language exemplifies a complex structure, Cantonese with its total lack of clusters is at the other extreme. Furthermore, the high proportion of consonant–vowel open syllables in Cantonese also contributes to its overall simple syllable structure relative to English.

We used a sound-matching task to measure phonological awareness at the various linguistic levels. The task was an auditory version of the character comparison procedure used by Bertelson, Chen, and de Gelder (1997). On each trial, the child was to decide which one of two probe syllables sounded more similar to a target syllable. There were four types of trials, varying in the level of phonological analysis required for matching. In the whole syllable condition, the target and the correct probe were identical, differing from the incorrect probe only in the coda phoneme (e.g. target = correct probe = “vogue”; incorrect probe = “vote”). A correct response required matching the target to the correct probe as an unanalyzed syllable. In the onset condition, the target (e.g. “day”) shared its consonantal onset only with the correct probe (e.g. “dark”), not the incorrect probe (e.g. “park”). Matching required isolating the consonantal onset, which was the largest phonological constituent common to the target and the correct probe. In the rime condition, the target (e.g. “®sh”) shared its rime only with the correct probe (e.g. target = “fish”; correct probe = “dish”; incorrect probe = “dig”). The basis of matching was the syllabic rime. The coda trials worked similarly, with the target sharing the same coda only with the correct probe (e.g. target = “lute”; correct probe = “wait”; incorrect probe = “waive”). Children’s phonological awareness at the various linguistic levels could thus be assessed by examining their matching performance on these different trial types.

The design of the present study enables us to formulate the following predictions.
First, the Hong Kong and the Guangzhou pre-readers would perform very similarly on sound matching at all levels, because the two groups spoke the same language and had not yet been heavily influenced by the activity of reading.

Second, assuming that English has a more complex syllable structure than Cantonese, the New Zealand pre-readers would outperform their Hong Kong and Guangzhou counterparts on sound matching due to the contrast in spoken language experience. English syllables are assumed to be more complex than Cantonese syllables because the latter do not contain consonant clusters. This hypothesis is consistent with the observation by Caravolas and Bruck (1993) that the complex syllable structure of Czech, due to its high frequency and complexity of consonant clusters, enhances the phonological skills of its young speakers, compared to the simpler phonological input received by English-speaking children. Furthermore, according to Liberman, Shankweiler, Fischer, and Carter (1974), Bertelson et al. (1989), and Lukatela, Carello, Shankweiler, and Liberman (1995), awareness of syllables, onsets and rimes develops prior to reading instruction and may thus be attributed to early spoken language experience. We therefore expected that the effect of spoken language experience on phonological skill development would not be restricted to the phonemic level.

Third, the Guangzhou readers would outperform the Hong Kong readers on phonemic analysis, due to the former group’s early experience with alphabetic Pinyin. This hypothesis rests on the previous findings that alphabetic reading promotes phoneme awareness (e.g. Bertelson et al., 1989; Read et al., 1986), and that advanced phoneme awareness arises only from either an alphabetic first learned script (Holm & Dodd, 1996) or focussed training on phonemic analysis (Cheung, 1999). The hypothesized effect of alphabetic reading was not expected to occur in rime matching because rime awareness has been shown to be a natural consequence of spoken language development that is unaffected by reading experience (e.g. Bertelson et al., 1989).

2. Method

2.1. Subjects

Three groups of children were contrasted in the present study. Group 1 comprised 60 Cantonese-speaking children recruited in Hong Kong, China. The group was further divided into a pre-reading (HK-P) and a reading sub-group (HK-R). HK-P had 30 children with a mean age of 48.8 months (SD 2.0); HK-R had 30 children with a mean age of 89.8 months (SD 3.4).

Group 2 comprised 60 Cantonese-speaking children recruited in Guangzhou, China. Mean ages of the pre-reading (GZ-P; n = 30) and the reading sub-group (GZ-R; n = 30) were 50.8 months (SD 6.1) and 87.1 months (SD 4.3), respectively.

Group 3 consisted of 49 English-speaking children recruited in Dunedin, New Zealand. Mean ages of the pre-reading (NZ-P; n = 24) and the reading sub-group (NZ-R; n = 25) were 50.0 months (SD 6.0) and 89.0 months (SD 4.5), respectively.
An isolated character/word reading test was administered to measure the children’s literacy achievement and, more importantly, the extent to which this ability varied among the pre-reading and reading sub-groups. The Chinese character-reading test for the Hong Kong and Guangzhou children consisted of 30 isolated characters selected from a wide range of primary 1 to primary 5 (i.e. grade 1 to grade 5) textbooks. The selected characters were graded and arranged in terms of difficulty, based on their occurrence frequencies in the corpus. The first 30 (easiest) words in the word reading sub-test of the Wide Range Achievement Test (WRAT; Jastak and Wilkinson, 1994) were used as test words in the English word reading test administered to the New Zealand children.

Children were asked to read aloud the items, being arranged in rows in increasing difficulty, from left to right at a self-determined pace. Testing ceased when five consecutive errors (including “don’t know” responses) were made; the number of correctly read items was recorded.

Mean reading scores were 2.1 (SD 2.2), 1.4 (SD 2.9) and 3.2 (SD 4.1) for the HK-P, GZ-P and NZ-P groups, respectively. No differences among the groups were revealed by t-tests (all $P > 0.05$). Mean reading scores for the HK-R, GZ-R and NZ-R groups were 26.8 (SD 1.7), 20.0 (SD 5.1) and 16.7 (SD 6.2), respectively. The differences between HK-R and GZ-R ($t(58) = 6.8$, $P < 0.001$), GZ-R and NZ-R ($t(53) = 2.2$, $P = 0.03$), and NZ-R and HK-R ($t(53) = 8.4$, $P < 0.001$) were all significant. Hence, the pre-reading and reading sub-groups did contrast in literacy skill. While some discrepancies in reading ability might be noticeable among the reading sub-groups, the pre-reading children appeared to have very limited and comparable literacy skill.

2.2. Materials and tasks

2.2.1. Non-verbal intelligence

Sets A and Ab of the Coloured Progressive Matrices (Raven, Raven, & Court, 1998) were used to measure non-verbal intelligence. This test involves the child selecting a piece out of a possible six to complete a series of four simple geometric patterns (three actually present; the child was ask to find the fourth).

2.2.2. Digit span

The Cantonese and English digits from 1 to 9, except the two-syllable English digit 7, were used in the digit span task for constructing digit lists of different lengths in the two languages.

2.2.3. Phonological awareness

A sound-matching task was adopted to measure phonological awareness. On each trial the child was to decide which one of two probe syllables sounded more similar to a target syllable. These syllables were all meaningful lexical items corresponding to the units of character (Cantonese-Chinese) and word (English). Occurrence frequencies of these items were matched across languages and trial types (Francis & Kucera, 1982; Hong Kong Department of Education, 1986).
2.3. Procedure

Measures of non-verbal intelligence and digit span were taken to ensure that group differences in sound-matching performance were not due to these factors. The child was first asked to complete either set A or set Ab of the Coloured Progressive Matrices. In the digit span task, the child was instructed to repeat aloud in order a sequence of digits orally presented by the interviewer. Sequence length increased over trials and testing proceeded until errors were made on two or all three trials at a certain sequence length.

In the phonological awareness task of sound matching, trials were blocked by types (i.e. whole syllable, onset, rime, coda); there were six trials in each trial type. All subjects encountered all four trial types. The Cantonese-speaking children listened and responded to Cantonese syllables whereas the English-speaking children listened and responded to English syllables. Block presentation was counterbalanced across subjects. Within each block, trials were randomly presented. Three practice trials preceded each block.

The three syllables on each trial were presented as the names of three stuffed toy bears. Children were told that on each trial the three toy bears took on different names, and the game was to tell which one of two bears (probes) had a name sounding similar to the name of the designated third (target). The three bears were of the same appearance but in different colors. The syllables were orally produced by the interviewer. The target was always the last to be presented, while the correct probe appeared randomly as the first or second probe. In the rime and coda conditions, the child was asked to listen very carefully to the ends of the names; in the onset condition, the child was to listen to the beginnings of the names when making judgements. In the whole syllable condition, no specific parts of the names were specified. The interviewer kept track of the errors made. It was also stressed that decisions were to be made strictly on the basis of sound similarity; meanings of the names should be ignored. The child was asked to make a guess if unsure about the answer.

3. Results

Mean phonological awareness scores are shown in Table 1. Non-verbal intelligence and digit span scores were highly similar across the linguistic groups and did not discriminate between them. Cross-group differences in sound-matching performance were thus evaluated with simple $t$-tests.

3.1. Pre-reading children

Consistent with the first prediction, no differences at any level of phonological analysis were detected comparing HK-P against GZ-P (whole syllable: $t(58) = 1.6$, $P = 0.13$; onset: $t(58) = 0.8$, $P = 0.45$; rime: $t(58) = 1.6$, $P = 0.11$; coda: $t(58) = 1.7$, $P = 0.10$). The data from HK-P and GZ-P were then pooled and contrasted with those from NZ-P to test the second prediction. The NZ-P children
outperformed the HK-P/GZ-P children on onset ($t(82) = 3.7, P < 0.001$), rime ($t(82) = 3.4, P = 0.001$) and coda matching ($t(82) = 3.3, P = 0.002$), but not on whole syllable matching ($t(82) = 1.2, P = 0.22$).

3.2. Reading children

The third prediction contrasted HK-R with GZ-R. Results indicated that the latter group performed significantly better than the former on onset ($t(58) = 2.4, P = 0.02$) and coda matching ($t(58) = 2.5, P = 0.02$). The two groups performed at the same level on whole syllable matching ($t(58) = 0.0, P = 1.00$), and very similarly on rime matching ($t(58) = 0.2, P = 0.83$). Another analysis that might be of some interest compared the performance of the NZ-R children to that of the GZ-R children. The NZ-R children were found to outperform the GZ-R children in both rime ($t(53) = 2.7, P = 0.01$) and coda matching ($t(53) = 2.1, P = 0.05$). However, the two groups attained similar levels of performance on whole syllable ($t(53) = 1.2, P = 0.25$) and onset matching ($t(53) = 1.3, P = 0.20$).

4. Discussion

We investigated how orthographic and spoken language experience influence the ability to analyze speech explicitly. There were three major results. First, the Hong Kong and Guangzhou pre-readers attained very similar levels of phonological awareness performance on whole syllable, onset, rime, and coda matching. Because the two groups of children spoke the same language and were equally illiterate in any written scripts, similar phonological awareness performance was expected.

Second, when these two groups of pre-reading Cantonese speakers were combined and compared to the New Zealand pre-readers, the New Zealand pre-
readers were found to be much more advanced in onset, rime, and coda awareness. We attribute this result to variations in early spoken language experience. The effect appears to be more general than the influence of orthography in that it extends beyond the phonemic level to onset and rime analysis. This is consistent with the notion that onset and rime awareness develop spontaneously with speech prior to reading instruction (Bertelson & de Gelder, 1991, 1994; Bertelson et al., 1989; Liberman et al., 1974; Lukatela et al., 1995). The lack of any group influence on whole syllable matching was probably due to a ceiling effect. Mean scores in this condition were high and comparable among the groups. Because the target and the correct probe were identical in the whole syllable condition, the child did not need to decompose the stimulus items for matching. This task contrasts with the sound comparison task adopted by Bruck et al. (1995) in which multi-syllabic items were used, so that whole syllable matching would demand sound decomposition and extraction. In the present study, the lack of a sound extraction requirement in the whole syllable condition might have given rise to near-ceiling performance. Third, the Guangzhou readers outperformed their Hong Kong counterparts on onset and coda matching. We attribute this result to variations in orthographic experience, because the Guangzhou readers had learned alphabetic Pinyin symbols to transcribe the sounds of characters, whereas the Hong Kong readers read logographic characters as their only primary script. This finding is in line with the previous characterization of the effect of alphabetic reading, that it only affects phonological awareness at the phonemic level (Bertelson & de Gelder, 1991, 1994). The lack of a group difference in the rime condition was expected because rime awareness has been shown to be independent of literacy development (Bertelson et al., 1989). We also observed that the New Zealand reading group performed better than the Guangzhou reading group on rime and coda matching. Very tentatively, one could consider the possibility that differences in spoken language experience between these two groups might have contributed to part of the performance difference. Nevertheless, no strong statements that such a performance difference reflects a “pure” effect of spoken language experience should be made, because the Guangzhou and the New Zealand readers were not fully comparable in terms of the quality of alphabetic exposure, as already discussed. The current results are in line with the finding of Caravolas and Bruck (1993), that an experience with complex syllables promotes phonological skills. However, this conclusion contradicts the report by Cossu et al. (1988) that Italian-speaking children were more advanced in syllable and phoneme counting than English-speaking children both before and after formal reading instruction began. The superior performance of the Italian group was attributed to the children’s experience with the relatively simple Italian syllables. Caravolas and Bruck (1993) pointed out some methodological shortcomings of the Cossu et al. (1988) study which might have undermined the validity of its conclusion and thus contributed to the discrepancy. First, the English data were adopted from an earlier study (Liberman et al., 1974) and no statistical tests were conducted to evaluate the differences in phonological skills between the two subject groups.
Second, the items used with the Italian children were consistently longer than the English items, due to Italian having a very small number of monosyllabic words. Therefore, findings based on two-, three- and four-unit Italian test items were compared to findings based on one-, two- and three-unit English items. Results were likely to be systematically distorted.

Third, occurrence frequencies were not equated across the English and Italian items. Considering these problems, Caravolas and Bruck (1993) employed highly comparable Czech and English items and formulated their main hypothesis that appeared to contradict the findings of Cossu et al. (1988). The Czech-speaking children’s experience with complex consonant clusters was expected to contribute positively to their phonological skills in comparison with the English-speaking children.

Furthermore, the fact that different phonological tasks were used in the three studies might explain why seemingly contradictory results were documented. According to Yopp (1988), phoneme counting (Cossu et al., 1988), phoneme deletion/isolation (Caravolas & Bruck, 1993) and word matching (the present study) entail different sets of underlying processes. Most notably, the abilities to locate a given position, to identify a sound in a given position, and to isolate a sound in a given position are all required in phoneme deletion/isolation and word matching, but not in phoneme counting. Position-independent counting, on the other hand, is required only in the phoneme counting task. It is well known that in the world’s languages, the occurrence of consonants is differentially restrictive at the syllable-initial vs. the syllable-final position, in that the initial position allows a greater variety of consonants and clusters than the final position (Carstairs-McCarthy, 1999; Clements & Keyser, 1983; Laver, 1994). Hence, speaking a language with a variety of clusters should promote one’s sensitivity to sound positioning, because the syllable-internal distribution of consonants and clusters is position-dependent. This might explain why superior performance was shown in speakers of languages having complex clusters especially with tasks calling for sound position analyses on top of phonemic analysis.

Together with the study by Caravolas and Bruck (1993), the present research establishes that syllable structure constitutes a critical dimension in early spoken language that impacts on the development of phonological awareness. The complexity of consonant clusters and prominence of open syllables appear to be two highly relevant parameters. The complex clusters in Czech syllables relative to English syllables were associated with the superior phonological skills of Czech-speaking children (Caravolas & Bruck, 1993). The presence of consonant clusters in English syllables contrasted with a total lack of them in Cantonese syllables; English-speaking children therefore outperformed Cantonese-speaking children on phonological tasks. In addition, the high proportion of open syllables in Cantonese also contributes to a simple phonological structure and thus further discourages sub-syllabic analyses.

Given that both orthographic and spoken language experience modify phonological awareness, we can consider the following possibility: phonological awareness provides an informational space in which phonological data derived from speech
and written symbols could integrate. According to this view, the representation underlying phonological awareness is shaped by both spoken language and orthographic experience. Through such modification, the coding format of this conscious level of phonological representation approaches maximal compatibility with the phonological and orthographic peculiarities associated with the oral and written language input, respectively. Such compatibility facilitates communication between the activities of listening and reading. Communication is achieved when information coming from the two sources integrates at the level of phonological awareness. In this scenario, phonological awareness takes on a mediating/binding function. It exemplifies one major role of awareness or consciousness in general, that it binds perceptual data coming through the various senses and thus produces the organized perception of consistent objects and events that constitutes our phenomenological world (Baddeley, 1997, p. 331).

To conclude, the current findings support the hypothesis that both orthographic and spoken language experience affect phonological awareness development. Unlike the effect of orthography which is restricted to the phonemic level, the impact of early spoken language extends to onset and rime awareness. Spoken language input shapes onset, rime, and phoneme awareness. A complex syllable structure featuring a variety of consonant clusters promotes general phonological skills.

Acknowledgements

This research was supported by Earmarked Grants from the Research Grants Council of Hong Kong to Hsuan-Chih Chen. We are grateful to the Director, Lei Mo, of the Center for Applied Research in Psychology at the South China Normal University and Hua Song for their kind support and assistance in collecting the data in Guangzhou. We also thank three anonymous reviewers for useful comments.

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