

Cross-Linguistic Transfer of Phonological Awareness in
Chinese Children Receiving English Instruction:
An Intervention Study



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A thesis submitted for the degree of

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Abstract

The aim of the research is to investigate whether children transfer phonological awareness between languages. There is theoretical and practical significance to study the transfer of phonological awareness across languages. We can gain a better insight into how bilingual children develop phonological awareness in both languages, and how children's phonological awareness support learning to read in different orthographies. In practice, the transfer enables bilingual children to develop phonological awareness in their first language and transfer to their second language. The learning of second language can be made easier by transferring the prior phonological knowledge across languages. In Study 1, phonological measures were developed to assess the phonological awareness of English and Cantonese in parallel. The measures were rhyme oddity, initial phoneme deletion, and final phoneme deletion. The measures were evaluated, and the results showed that the English version and the Cantonese version of each measure were comparable to each other. In Study 2, phonological awareness was hypothesized as a language-general ability across languages. It was predicted that training English phonological awareness could enhance Cantonese phonological awareness and vice versa. One hundred and sixty-two Hong Kong children at age five were randomly assigned to English phonological training, Cantonese phonological training, or an active control of print concepts. The children were tested on English and Cantonese phonological awareness before and after the training by the three phonological awareness measures developed in Study 1. Results revealed that the English training group significantly outperformed the print concepts control group in all the Cantonese measures, whereas the Cantonese training group significantly outperformed the control group in all the English measures. The results provided strong evidence that there was a bidirectional transfer of phonological awareness between English and Cantonese, suggesting that phonological awareness is a language-general ability that can transfer across languages. Practical and theoretical implications of the findings of both studies were discussed.

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Introduction

The aim of the research is to investigate if children can transfer their phonological awareness between languages. Phonological awareness is the awareness of the internal sound structure of words (Goswami & Bryant, 1990). It has been well established that phonological awareness plays a critical role in the process of learning to read in monolingual children (National Institute for Literacy, 2008). However, little is known about how bilingual children develop their phonological awareness of both languages. Do bilingual children develop the phonological awareness of both languages independently? Alternatively, do bilingual children develop the phonological awareness of one language and transfer the skill to another language? There is theoretical and practical significance for investigating whether phonological awareness can transfer across languages.

The theoretical significance is that the study of phonological awareness transfer helps us to understand how bilingual children develop the phonological awareness of both languages, and how phonological awareness supports the process of learning to read. If phonological awareness can transfer across languages, phonological awareness will be a language-general skill across languages. Thus, learning to read in different orthographies might be based on the same general phonological skills. If phonological awareness cannot transfer across languages, it will be a language-specific ability. Learning to read in each orthography might be based on unique phonological skills that developed specifically for that language. Either result can improve our understanding of the role of phonological awareness in the process of learning to read different orthographies.

The practical significance is that the transfer of phonological awareness allows bilingual children to develop their phonological awareness of one of the languages based on the prior knowledge of another language. In ordinary schools in China, Chinese children can develop phonological awareness in Mandarin (L1) from the Mandarin phonetic system

Pinyin, and then transfer the phonological skill to English (L2). Not only does the learning of Pinyin facilitate the development of their first language, but also suits the emotional needs that they are learning in their mother tongue. Alternatively, Chinese children can develop their phonological awareness in English (L2) first because English phonetic system is closely matched to the reading and spelling of English words whereas Pinyin does not directly contribute to the reading and writing of Chinese characters. Learning phonetic system in English can meaningfully help children to grasp the reading and spelling of English words. Regardless of which language educators choose to start phonological instruction, the transfer of phonological awareness allows educators to prepare programmes for bilingual children to start developing phonological awareness in either L1 or L2 and readily transfer the awareness to another language. The learning of phonological awareness in both languages can be made easier because of the cross-language facilitation. This transfer could potentially benefit billions of children who live with two languages or more (Grosjean, 2010).

The transfer of phonological awareness is based on the concept of transfer of learning (Judd, 1908; Royer, 1979). Transfer of learning is our use of past learning when learning something new (Haskell, 2001). It is different from typical learning in which new skills and knowledge are developed anew (Perkins & Salomon, 1992). A transfer occurs when a learner has abstracted the general principles from the previous context and applied the general principles in a novel context without re-learning (Judd, 1908). The abstraction of the general principles greatly reduces the demand for learning in a new context because learners can see the similarities and create categories for things they have encountered before (Haskell, 2001). Consequently, learners do not need to re-learn everything in each new context.

It is plausible that phonological awareness can transfer across languages based on two arguments. First, being taught to read involves breaking words up into their constituent sounds (Goswami, 2008). The principle of breaking words into sounds is universal in various

orthographies, even though the details vary across orthographies (Perfetti & Dunlap, 2008). In English, phonological awareness especially phoneme awareness is crucial to English word recognition. Each letter of the English alphabet can represent at least a single phoneme sound. Thus, the breaking and blending of sounds is an integral part of recognising English words. For example, the letters ‘c’, ‘a’, ‘t’ in *cat* /kæt/ represent the corresponding phonemes /k/, /æ/, /t/. Blending these sounds forms a syllable and blending these letters forms a word. The breaking and blending principles are also required in learning non-alphabetic orthographies. In Chinese, phonological awareness of larger linguistic units such as syllable awareness is a strong predictor of reading Chinese because most of the Chinese words comprise two or more syllables (Zhang et al., 2010). For example, the Chinese word 牛奶 (‘milk’) /ngau4 naai5/ is represented by the two syllables /ngau4/ and /naai5/. Breaking Chinese words into syllables helps to facilitate Chinese character recognition (McBride-Chang et al., 2008).

The second argument is that bilinguals show a greater readiness to transfer phonological awareness across languages. When bilingual children are exposed to two sets of sounds from two languages, they constantly need to pay attention to the internal sound structure of words in order to overcome the interlingual interference (Kuo & Anderson, 2010). The similarities and differences of the sound structures between the languages might become more salient for bilingual children to recognise (Kuo & Anderson, 2010, 2012). This advantage can help bilingual children abstract the general principles of how to perceive and manipulate the internal sound structure of words across languages (Kuo, Uchikoshi, Kim, & Yang, 2016).

The research strategy for investigating the transfer of phonological awareness consists of two studies. First, comparable measures across languages are developed. Two phonological measures are comparable when both of them have the same format and difficulty. Not only should both measures have the same task demand in which the same

cognitive operation and linguistic unit are used, the items across languages should also have the same phonological structure and lexical difficulty. The lack of comparable measures across languages might yield methodological implications. If the phonological awareness of L1 is assessed by a more difficult task or by manipulating sound units with more complex phonological structures than those of L2, the measurement of phonological awareness will be unfavourable for L1. In this case, it would be difficult to capture the transfer from L2 to L1. The transfer from L2 to L1 might have already occurred, but the phonological measure of L1 is too difficult for the child to demonstrate his/her transfer from L2 to L1. Second, phonological awareness of one language is taught and the improvement of phonological awareness of another language is assessed. In a transfer of phonological awareness, a learner abstracts the general principles of manipulating the sounds from one language and then transfers this general skill to another language. Thus, learning phonological awareness from L1 should help improve the phonological awareness of L2; Learning phonological awareness from L2 should also help improve the awareness of L1.

This introduction is concluded by the brief description of each chapter of the thesis as follows.

Study 1

In this study, measures were developed to assess children's phonological awareness of English and Cantonese in parallel. These comparable measures were essential to the study of phonological awareness across languages. The English and Cantonese versions of the measures had the identical format, and the phoneme stimuli were matched to be equivalent across languages, enabling phonological awareness of both languages to be measured as analogous as possible. There were three phases in the development of the comparable measures. In Phase 1, the measures were drafted based on the review of the theories about phonological awareness and psychometrics. In Phase 2, the measures were subjected to pilot

test and were revised according to the results of the pilot. In Phase 3, the measures were evaluated in terms of the comparability between the English and Cantonese versions.

Study 2

This study was a training study to test whether training English phonological awareness would lead to better performance in Cantonese phonological awareness and vice versa. The study began with a review of the empirical findings of the transfer of phonological awareness using two approaches: correlation studies and training studies. In correlation studies, evidence suggested that phonological measures across languages were highly correlated, after controlling for general cognitive abilities such as intelligence and vocabulary. In training studies, there was emerging evidence that training phonological awareness in one language might lead to an improvement of phonological awareness in another language. The review contributed to the generation of the hypotheses that training phonological awareness in one language would improve phonological awareness of another language and vice versa.

After that, a randomised control trial was carried out to test whether training English phonological awareness would lead to higher performance in Cantonese phonological awareness, and whether training Cantonese phonological awareness would lead to better performance in English phonological awareness. The research design and the interventions were presented and justified. The effects of the phonological interventions were analysed with reference to hypotheses whether training phonological awareness in one language would improve the phonological awareness of another language and vice versa. The findings revealed that phonological training in English or Cantonese had improved the phonological awareness of another language.

General Discussions

The findings of the two studies were summarised. The findings suggested that phonological awareness was a common ability that could be transferred across languages. Suggestions for the improvement in future research were discussed, along with some practical and theoretical implications of the findings of this study.

Study 1:

Development of Comparable Phonological Measures across Languages

This study aims to present the phonological measures and to show that these measures can be considered comparable across English and Cantonese. A pair of measures can be considered comparable when both measures have the same format and difficulty. Both measures should use the same cognitive operation and manipulate the same kind of linguistic units (e.g. syllables). The items across languages should also be matched in phonological structure and lexical difficulty. Comparable measures across languages are the prerequisite for studying the transfer of phonological awareness. The transfer of phonological awareness occurs when the phonological awareness of one language improves the phonological awareness of another language. The transfer can be obscured when the measures used in each language are not parallel to each other. For example, when English phonological awareness is measured by a syllable matching task and Cantonese phonological awareness is assessed by a final phoneme deletion task, it becomes difficult to determine whether the transfer has occurred because the phonological awareness in each language is measured differently. These measures are based on different cognitive operations and different linguistic units. Thus, comparable phonological measures across languages form the foundation for the study of the transfer of phonological awareness. The comparable measures developed in this study were crucial to Study 2 which examines the transfer of phonological awareness between English and Cantonese.

There were four parts in the development of the comparable phonological measures. This study begins with a review of the theories that were essential to the development of the phonological measures. In the review, the psychometric framework for this study is presented and evaluated. Within the framework, the review focuses on how the measurement of phonological awareness can be affected by the cognitive operations and the linguistic units of

the tasks. After reviewing the psychometrics, the phonology of English and Cantonese is compared. The differences in phonology between both languages are highlighted. The review is concluded by discussing how the cognitive operations and linguistic units can interact with the phonological differences between English and Cantonese.

The second part of the study was to the draft of the measures with the justifications for the design. The design of the measures aimed to match the English version with the Cantonese version at macro and micro levels. The macro level concerns the broad issue of psychometrics such as deciding which cognitive operation and linguistic unit are used for the measures. The micro-level concerns the fine details about how individual items are matched across the two languages. There are explanations about how individual items are matched with the phonological structure of the syllables as well as the lexical difficulty of the words represented by these syllables.

The third part of the study was to pilot the first draft of the measures with a small group of children. The results of the pilot test were analysed to identify the issues of the measures and the items. The measures were further polished based on the results and analyses.

The final part of the study was to show that the phonological measures were comparable across English and Cantonese. The finalised measures were administered to a large group of children. The results were analysed by confirmatory factor analyses and other statistical techniques to show that the English version and the Cantonese version of each phonological measure are comparable.

Literature Review

This review aims to evaluate the theories necessary for the development of comparable phonological measures across English and Cantonese. This review covers two areas in the literature: the theories of psychometrics and the phonology of English and Cantonese. The review begins with evaluating Guilford's (1967) model of the Structure of Intellect as the psychometric framework for developing the phonological measures. This is followed by the illustrations of how Guilford's framework was applied to the measurement of phonological awareness. Within this adapted framework, the review further examines how the measurement of phonological awareness can be affected by cognitive operations of the tasks as well as the linguistic units manipulated in the tasks.

The second part of the literature review examines the differences in phonology between English and Cantonese. The phonology of both languages is compared with the aim of highlighting the similarities and differences that can be manipulated to develop comparable test items across languages.

Finally, the insights gained from the review of the psychometrics and phonology are examined together. These insights are the foundation for developing the comparable measures across English and Cantonese.

Guilford's (1967) Model of the Structure of Intellect

Guilford's (1967) Structure of Intellect model provides an adequate framework for the psychometric measurement of phonological awareness. The model is empirically based on the application of multivariate factor analysis to extensive psychometric tests (Guilford, 1967; Moseley, 2005). From the factor analyses, Guilford (1967) proposes that a psychometric test varies along three dimensions: operations, content, and products. The operations dimension represents the main intellectual demand of the test, which is the cognitive process in the ability to be measured by the test. Guilford (1967) suggests that there

are five categories of operations, namely cognition, memory, divergent production, convergent production, and evaluation. The cognition operation entails recognising, understanding, or comprehending the input information. The memory operation refers to the ability to store information. The divergent production operation is about generating a variety of alternative information whereas the convergent production is about generating information through analyses and reasoning. The evaluation operation compares the information generated with the established criteria (Moseley, 2005).

When Guilford's (1967) idea about operations dimension is applied to the measurement of phonological awareness, the operations dimension can be considered as the variety of the cognitive operations used in the phonological measures. The wide variety of cognitive operations in phonological measures has been categorised into three types: identity, synthesis, and analysis (Ehri et al., 2001; Lewkowicz, 1980; National Institute for Literacy, 2008). The identity operation involves recognising the target linguistic unit amongst other units. For example, matching tasks entail identifying whether an item contains the target linguistic unit (e.g. "Does fish start with /f/?"). Oddity tasks involve identifying the 'odd' item from the other two items sharing the same linguistic unit (e.g. "cat, hat, bet, which is the odd one out?"). The synthesis operation is about combining linguistic units to form a new unit. Typical examples include blending tasks where phonemes are combined to form a syllable (e.g. "What syllable is this—/f/, /l/, /j/?"), and substituting tasks where a part of the syllable is replaced to form a new syllable (e.g. "Say *meat*. Now say it with /f/ instead of /m/."). The analysis operation is about separating a linguistic unit from a larger unit. For example, deletion tasks involve omitting a designated linguistic unit from a larger unit ("Say *fish*. Now say it without the /f/."). Counting tasks require the child to count the number of the linguistic units (e.g. "How many sounds do you hear in the syllable *fish*?"). Examples of measures under these three categories are listed in Table 1.

Table 1 Examples of phonological measures involving the three categories of cognitive operations

Category	Operation	Example (Answer in parenthesis)
Identity	Recognition	Do these two things rhyme: <i>shell bell</i> ? (Yes)
	Oddity	Which word does not rhyme: <i>fish, dish, hook</i> ? (hook)
	Matching	Which word begins with the same sound as <i>bat</i> : <i>horn, bed</i> ? (bed)
	Identification	Which part of <i>compete</i> and <i>compare</i> sound the same? (/kəm/)
	Production	Tell me two words that rhyme with <i>bell</i> . (shell, spell)
Synthesis	Blending	What word do these sounds make: <i>c-at</i> ? (/kæt/)
	Substitution	Say <i>dash</i> . Now say it again with the /ɪ/ (/dɪʃ/).
	Spoonerisms	<i>felt made</i> becomes <i>melt fade</i> .
Analysis	Deletion	Say <i>coat</i> . Now say it again but don't say /k/. (oat /əʊt/)
	Isolation	Tell me the sound you hear at the beginning of the word <i>food</i> ? (/f/)
	Completion	Here is a picture of a watch. Complete the syllable for me: wɒ (tʃ).
	Segmentation	Tell me each sound you hear in the word <i>sheep</i> in the order that you hear it. (sh-ee-p /ʃ, i:, p/)
	Counting	How many sounds can you hear in the word <i>sit</i> ? (Three)

(Adapted from Gillon, 2004)

The content dimension refers to the kinds of information to which the test operations are applied (Guilford, 1967). The kinds of information in the content dimension include figural, symbolic, semantic, and behavioural. The figural information comprises concrete information perceived through sight (visual), hearing (auditory), and touch (kinaesthetic). The symbolic information is represented by symbols and signs that have no intrinsic value in themselves, such as letters and numbers. The semantic information is defined by meaning being conveyed through words such as verbal communication and writing. The behavioural information is the nonverbal information about people's actions, needs, or attitudes (Moseley, 2005).

Applying Guilford's (1967) idea of the content dimension to the measurement of phonological awareness, the information processed in phonological measures is always auditory. Thus, the content dimension in phonological measures is always uniform and does not vary for any phonological measures.

The products dimension is the result of applying particular operations to specific content. Guilford (1967) puts forward six products in his model: units, classes, relations, systems, transformations, and implications. The units concern the separated, individual items of information. The classes are the sets of items grouped by common characteristics. The relations are about the connections between items such as associations and sequences. The systems are the networks of inter-related parts of information. The transformations are the changes in the information or its function. The implications are the expected outcomes of the information.

Guilford's (1967) idea about the products dimension can be applied to assessing phonological awareness. The products of phonological tasks are the linguistic units that are being manipulated in the tasks. There are various sizes for linguistic units. The largest linguistic unit is syllables. Syllables are a unit of spoken language that consists of a vowel sound (Abercrombie, 1967). For example, the word *bicycle* /baɪsɪkl/ can be divided into three syllables /baɪ/, /sɪ/, and /kl/. The next smaller linguistic units are onsets and rimes. An onset is the sounds before the vowel of a syllable, whereas a rime is the vowel and any remaining sounds (Abercrombie, 1967). For example, the monosyllabic word *bread* /bred/ can be divided into an onset /br/ and a rime /ed/. The smallest linguistic unit is phonemes. Phonemes are the smallest units of speech that are perceived to be a single distinctive sound (Abercrombie, 1967). For example, the syllable *bread* /bred/ is comprised of four phonemes: /b/, /r/, /e/, and /d/.

The result of applying Guilford's (1967) model to the measurement of phonological awareness is a three-dimensional cuboid shown in Figure 1. According to this adapted model, each phonological measure varies in three dimensions: the operations (identity, synthesis, analysis), the content (auditory), and the products (syllables, subsyllables, phonemes). When the categories in each dimension are considered, there will be 3 (identity, synthesis, analysis) \times 1 (auditory) \times 3 (syllables, subsyllables, phonemes) = 9 possible phonological measures. Because the content dimension is always uniform in any phonological measure, the operations and products dimensions become the key to deciding how phonological awareness is measured. These two dimensions are further examined in the following.

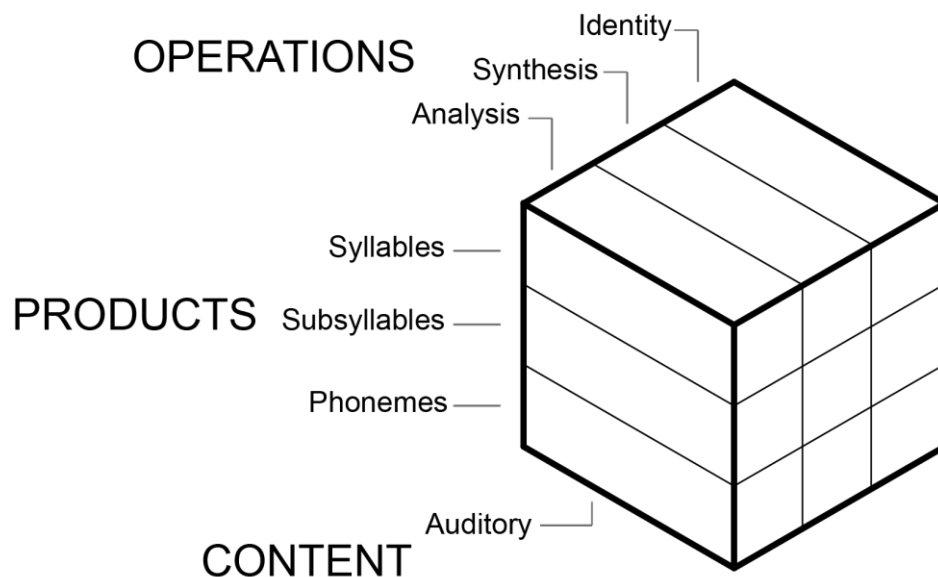


Figure 1 Three dimensions of a phonological awareness measure, model adapted from Guilford (1967)

Operations Dimension (Cognitive Operations)

The operations dimension concerns how phonological awareness is measured by different cognitive operations. Three categories of operations are commonly used in phonological measures, namely identity, syntheses, and analysis. Research has examined how the choices of cognitive operations can affect the measurement of phonological awareness (Anthony, Lonigan, Kimberly, Phillips, & Burgess, 2003; Perfetti, Beck, Bell, & Hughes, 1987; Wagner, Torgesen, & Rashotte, 1994).

Yopp (1988) administered 10 phonological measures to 96 five-year-old kindergarteners in California. These 10 measures included identity tasks (e.g. recognition), synthesis tasks (e.g. blending), and analysis tasks (e.g. counting, segmentation, deletion). The results showed that children performed best in the identity tasks (67.1% correct), followed by the synthesis tasks (64.9% correct) and analysis tasks (49.1% correct). A major problem in this study was that the dimension of linguistic units was not properly controlled. For example, Yopp (1988) reported that the rhyme recognition task (identity task) had the highest mean score, whereas two phoneme deletion tasks (analysis tasks) had the lowest mean scores. Yopp's conclusion that the identity tasks were easier than analysis tasks is problematic. The rhyme recognition task differed from the phoneme deletion tasks not only because different operations were used, but also because different linguistic units were being manipulated. Children might have performed better in the rhyme recognition task because the concept of rhyme is easier to grasp than that of phonemes, not because the recognition operation is easier than the deletion operation.

To control properly for the linguistic units, Wagner et al. (1994) compared tasks using identity, synthesis, and analysis operations all at the phoneme level. The researchers administered an identity task (odddity), a synthesis task (blending), and an analysis task (segmentation) to 244 children from kindergarten through second grade in Florida. They

reported that children's performance in the oddity (identity) task was the best, scoring 41.3% correct. The performance in the blending (synthesis) task was 18.7% correct. The performance in the segmentation (analysis) task was the poorest at 6.7% correct. The results provide reliable evidence that the kind of operation can affect children's performance in phonological awareness. The identity operation could be the easiest, followed by synthesis operation, and analysis operation could be the most difficult.

Similar results were found in Anthony et al. (2003) in which blending and deleting tasks were administered to 947 children aged between two and six. The study aimed to test the model that children were more likely to master one of the operations before they mastered the other operation. Using hierarchical loglinear analyses, the linguistic units in the phonological measures were statistically controlled. The results found that children learned to blend syllables, onsets, and rimes before they learned to delete the same linguistic units. The finding provided strong developmental evidence that children can complete synthesis tasks (e.g. blending) before analysis tasks (e.g. deleting).

To summarise the studies reviewed, cognitive operations can influence the measurement of phonological awareness. There is evidence that children generally perform better in identity tasks which involve perceiving similar sounds. Children perform less well in synthesis tasks which involve explicit blending of sounds. Children perform the worst in analysis tasks which involve explicit manipulation of sounds. The effect of cognitive operations on the measurement of phonological awareness should be taken into account when designing phonological measures.

Products Dimension (Linguistic units)

The products dimension concerns how phonological awareness is measured in different linguistic units, ranging from syllables to subsyllables (onsets and rimes) to phonemes. Before deciding which linguistic unit is used in measuring phonological awareness, one should examine the relations among the linguistic units, as well as the effect of linguistic units on children's performance in phonological awareness.

It is essential to understand how awareness of various linguistic units is manifested in the developmental sequence. This understanding can help design developmentally appropriate measures for children. Four decades of research has identified a general developmental sequence of phonological awareness for monolingual children (Anthony & Francis, 2005; Goswami, 2008; Goswami & Bryant, 1990). Goswami and Bryant (1990) propose that children develop their phonological awareness through three levels of linguistic units: from awareness of syllables to awareness of subsyllables (onsets and rimes) and eventually to phonemic awareness. They argue that children develop an awareness of syllables and subsyllables before they are taught to read. An awareness of phonemes emerges after learning to read. Such developmental sequence has been identified among monolingual children speaking English (Anthony et al., 2002; Anthony et al., 2003), Spanish (Cisero & Royer, 1995), Italian (Cossu, Shankweiler, Liberman, Katz, & Tola, 1988), French (Demont & Gombert, 1996), Turkish (Durgunoğlu & Öney, 1999), and Cantonese (Cheung, Chen, Lai, Wong, & Hills, 2001).

For example, Anthony et al. (2002; 2003) assessed the phonological awareness of more than 1,000 American pre-schoolers aged between two and six. The researchers aimed to investigate the developmental order of awareness of syllables, onsets, rimes, and phonemes while holding the cognitive operations constant. They used blending and deletion tasks to assess children's awareness of various linguistic units. Thus, the cognitive operations were

controlled across the different linguistic units being assessed. Using hierarchical loglinear analyses and a factorial design, the results showed that children generally develop their phonological awareness from large linguistic units to small linguistic units. They can manipulate syllables before they can manipulate onsets and rimes. They can work with onsets and rimes before they can work with phonemes.

For Cantonese, Cheung et al. (2001) used matching tasks to measure Cantonese-speaking children's phonological awareness of syllables, onsets, rimes, and final phonemes. Because the same matching operation was used to assess awareness of various linguistic units, the cognition operations of the tasks were well controlled. The tasks were administered to 60 Cantonese-speaking children aged seven from China. The results showed that the children scored almost perfectly in the syllable task at 95.0% correct. The performance in the onset and rime was comparable at 75.0% and 71.7% correct respectively. The performance in the final phoneme task was 66.7% correct. The discrepancy between the performance in various linguistic units suggested that children's phonological awareness in Cantonese also develops from large units (e.g. syllables) and progresses to small units (e.g. phonemes).

From monolingual children learning an alphabetic orthography, available evidence demonstrates that there is a universal developmental sequence of phonological awareness across languages (Anthony et al., 2003; Carroll, Snowling, Stevenson, & Hulme, 2003). Children first gain awareness of syllables. Then their awareness of onsets and rimes emerges. Finally, they become aware of phonemes. Phoneme awareness emerges at different ages in different languages depending on the time of instruction of the alphabetic orthography.

The development of phonological awareness among bilingual children could be more complicated than among monolingual children. The interactions between the languages might change the course of development. The developmental sequence of phonological awareness of bilingual children is not widely studied, particularly those speaking English and

Cantonese. There is emerging evidence suggesting that Cantonese-English kindergarteners also develop their phonological awareness in the same sequence as their monolingual peers. Four recent studies have examined the phonological awareness of Cantonese-English bilingual children (Bialystok, McBride-Chang, & Luk, 2005; Luk & Bialystok, 2008; McBride-Chang, Bialystok, Chong, & Li, 2004; McBride-Chang, Cheung, Chow, Chow, & Choi, 2006). The phonological awareness of both languages was assessed in these studies and is represented in percentage correct in Table 2.

Table 2 Percentage Correct in Syllable and Phoneme Deletion Tasks for Cantonese-English Kindergarteners

Study	Age (months)	Percentage Correct			
		English		Cantonese	
		Syllable	Initial phoneme	Syllable	Initial phoneme
McBride-Chang et al. (2004)	70.6	63.2%	2.10%	66.3%	5.30%
McBride-Chang et al. (2006)	63.4	59.9%	9.19%	58.8%	14.7%
Bialystok, McBride-Chang, et al. (2005)	70.3	63.2%	1.82%	70.0%	10.0%
Luk and Bialystok (2008)	76.3	68.7%	74.2%	80.0%	71.8%

For both English and Cantonese phonological awareness, these bilingual children performed better in the syllable deletion tasks than the initial phoneme deletion task. Generally, children were better at deleting syllables than deleting initial phonemes in English and Cantonese. There was one exception in Luk and Bialystok (2008) that children performed much better in the English initial phoneme deletion tasks than in the English syllable tasks. The unusual result can be explained by the stimuli used in the English syllable tasks in that there was something peculiar about them because it was only the performance in the English syllable task that was out of sequence. However, the author did not present the stimuli used in the English syllable task and therefore there is no way to examine the task carefully. Based on the available evidence, bilingual children speaking Cantonese and English appear to follow a similar developmental sequence as that of monolingual children.

To summarise, there is a universal developmental sequence of phonological awareness across languages. Children develop their phonological awareness from large to small linguistic units. An awareness of syllables emerges first, followed by awareness of subsyllabic onsets and rimes. Finally, an awareness of phonemes emerges after reading instruction. This universal sequence has been widely found among monolingual children. There is emerging evidence suggesting that bilingual children follow the same universal developmental sequence as their monolingual peers.

The phonology of English and Cantonese

The comparability of the measures must take into account the similarities and differences between the phonology of English and Cantonese. Thus, the phonology of these two languages will be examined. The common consonant phonemes between English and Cantonese will be introduced first, followed by the syllable structures and the rules regulating the position of phonemes of both languages. Finally, two differences in phonology between English and Cantonese will be highlighted, namely the onset and initial phoneme ambiguity as well as the effect of the position of the phonemes.

Common consonants phonemes. There are 24 consonants and 20 vowels in received pronunciation English (Crystal, 1995), whereas there are 19 consonants and 18 vowels in Cantonese (Bauer & Benedict, 1997). Among these phonemes, 15 consonants are shared by both languages, including six plosives /p, b, t, d, k, g/, three fricatives /f, s, h/, three nasals /m, n, ŋ/, one lateral /l/, and two approximants /j, w/. Other than these common consonants, both languages have their own unique inventory of vowels and consonants.

Syllable structures. An English syllable can be constituted by up to three initial consonants and four final consonants between the vowel (Abercrombie, 1967). An English vowel can stand alone as a syllable. The syllable structure in English is denoted as (C)0-

${}^3V(C)_{0-4}$, where C is the consonant and V is the vowel. In terms of the syllable structure complexity, around 47.5% of English monosyllables have simple CV or CVC structures (De Cara & Goswami, 2002). The rest of the monosyllables have complex structures such as CVCC (21%), CCVC (15%), or more complex structures (De Cara & Goswami, 2002). The complex syllable structure of English is also characterised by the prevalence of consonant clusters. According to De Cara and Goswami (2002), around half of English monosyllables (49.8%) contain consonant clusters including those with initial clusters (25.7%), with final clusters (17.5%), and with both initial and final clusters (6.6%). Another half of English syllables (50.2%) contain no consonant clusters (De Cara & Goswami, 2002).

A Cantonese syllable can accommodate at most one initial consonant and one final consonant between a vowel. A Cantonese vowel can stand alone as a syllable (Bauer & Benedict, 1997). The syllable structure in Cantonese is denoted as $(C)_{0-1}V(C)_{0-1}$. Syllables of simple CV and CVC structures constitute 98% of all Cantonese syllables (Wong, 1984), the ratio of CV to CVC Cantonese syllables is 9:10 (Leung, Law, & Fung, 2004). Particularly, there are no consonant clusters in any Cantonese syllables.

In summary, English has a more complex syllable structure than Cantonese. Regarding the syllable structure, the similarity between the two languages is that syllables with simple CV or CVC structures are common in both languages. Around half of English syllables (47.5%) have CV or CVC structures (De Cara & Goswami, 2002), whereas almost all the Cantonese syllables (98%) have CV or CVC structures (Wong, 1984). A major structural difference between English and Cantonese syllables is that consonant clusters exist in English syllables but not in any Cantonese syllables.

Position of phonemes. For initial phonemes, there are no strict rules regulating English and Cantonese consonants as the initial phoneme of a syllable. All 24 English consonants and all 19 Cantonese consonants can be the initial consonants of an English or

Cantonese syllable, except /ŋ/ in *siŋg* for English. Thus, among the 15 common consonants shared by both languages, 14 of them (/p, b, t, d, k, g, f, s, h, m, n, l, j, w/) can be the initial phonemes of an English or Cantonese syllable.

Vowels can be the initial phoneme, but syllables beginning with a vowel are rare in both English and Cantonese. Around 3.9% of English syllables start with a vowel, including those with V, VC, VCC, or VCCC structures (De Cara & Goswami, 2002). Fewer than 2% of Cantonese syllables begin with a vowel (Wong, 1984). Thus, the frequency of these syllables starting with a vowel is negligible in both languages.

The final phonemes are regulated differently in English and Cantonese. For English, 21 out of 24 consonants are allowed at the final position of an English syllable. Only the /h, j, w/ are not allowed as the final phonemes. In contrast, for Cantonese, only six out of 19 consonants are allowed as the final phonemes. The six consonants are plosives /p, t, k/ and nasals /m, n, ŋ/. These six consonants happen to be the common consonants shared by both languages. Thus, only six out of 14 common consonants can be the final phonemes of an English or Cantonese syllable (/p, t, k, m, n, ŋ/). Interestingly, when the Cantonese plosives /p, t, k/ act as the final consonants, they become unreleased consonants that have no audible indication of the end of their occlusion (Bauer & Benedict, 1997, p. 22). This unreleased articulation is similar to the unreleased first plosive of a plosive cluster such as the /k/ in *doctor* /'dɒktə(r)/.

Vowels as the final phoneme are rare in English but are common in Cantonese. Syllables ending with a vowel account for 7.3% of English syllables (De Cara & Goswami, 2002), but 46.5% of Cantonese syllables end with a vowel (Leung et al., 2004). Table 3 summarises the eligible initial consonants and final consonants of English and Cantonese syllables.

Table 3 Possible Consonants at the initial and final position of an English or Cantonese Syllable

	Initial consonants	Final consonants
English	23 consonants (excluding nasal /ŋ/ e.g. <i>si<u>ng</u></i>)	21 consonants (excluding /h, j, w/ e.g. <i>hi</i> , <i>y<u>e</u>s</i> , <i>w<u>a</u>r</i>)
Cantonese	All 19 consonants	Plosives: /p, t, k/ (unreleased) Nasals: /m, n, ŋ/

In summary, English and Cantonese have their own rules regulating the position of consonants. Regarding the position of phonemes, there are two similarities between English and Cantonese. First, 14 of the common consonants (/p, b, t, d, k, g, f, s, h, m, n, l, j, w/) can be the initial phonemes of an English or Cantonese syllable. Second, only six consonants (/p, t, k, m, n, ŋ/) can be the final phonemes of an English or Cantonese syllable. A major difference is that syllables ending with a vowel are common in Cantonese (46.5%) but not in English (7.3%).

Onset and initial phoneme ambiguity

A major difference between the phonology of English and Cantonese is the ambiguous boundary differentiating the onset from the initial phoneme in a syllable. An onset is the part of a syllable that precedes the vowel, which is also the initial consonant or consonant cluster of a syllable. When a syllable begins with a consonant cluster (e.g. *glue* /glu:/), the onset is the consonant cluster of the syllable (/gl/). However, the boundary becomes blurred when a syllable begins with a single consonant (e.g. *get* /get/). In this case, the onset is also the initial phoneme of the syllable. It is unclear whether awareness of these single consonant onsets should be treated as awareness of subsyllables or awareness of phonemes. Often the boundary is not clearly drawn between subsyllables and phonemes in the literature. For example, Cisero and Royer (1995) considered awareness of single consonant onsets as awareness of subsyllables, whereas Hulme et al. (2002) treated awareness of single consonant onsets as the awareness of phonemes.

The ambiguous role of onsets must be addressed because it will perplex our understanding of the transfer of phonological awareness. When the boundary between onsets and initial phoneme is unclear, it is difficult to capture the transfer of phonological awareness at subsyllable and phoneme levels. This problem is particularly worse for languages with no consonant clusters such as Cantonese. In Cantonese, there is no consonant cluster in any syllable (Bauer & Benedict, 1997). Thus, the onset of a Cantonese syllable is always the initial phoneme of the syllable. According to Treiman's (1985) linguistic status hypothesis, the components of a syllable are hierarchically structured. Between the syllable and its constituent phonemes, there is an intermediate level of grouping representing the subsyllables (i.e. onset and rime). Based on Treiman's idea, awareness of subsyllables is supposed to represent awareness of linguistic units with the size between syllables and phonemes. Thus, awareness of onsets with a single consonant does not represent awareness of subsyllables. Instead, awareness of single consonant onsets is a part of phonemic awareness. To illustrate this argument, how children complete an onset deletion task and an initial phoneme deletion task is contrasted. When a child is asked to delete the onset of the Cantonese syllable /maa1/ ('mother'), the child needs to isolate the initial phoneme /m/ from the rest of the syllable. The phonological awareness involved is indeed at phoneme level, even though the resulting product is a subsyllabic rime /aa1/. This onset deletion task is identical to an initial phoneme deletion task where the same initial phoneme /m/ is deleted from the syllable /maa1/. Children require awareness of phonemes to complete both the onset task and the initial phoneme task. Thus, the phonological awareness being measured in both onset and initial deletion tasks is awareness of phonemes.

To sum up, there is a debate about the ambiguous boundary between the onset and initial phoneme in a syllable, particularly for syllables with a single consonant onset.

According to the literature, awareness of single consonant onsets should be considered as awareness of phonemes, rather than awareness of subsyllables.

Effect of the position of phonemes

One more concern is about the position of phonemes in a syllable. The target phoneme can be placed at the initial, medial, and final position of a syllable. Much research has found that the position of the target phoneme has an effect on children's performance in phonological awareness (Castles, Holmes, Neath, & Kinoshita, 2003; Durgunoğlu & Öney, 1999; Hulme et al., 2002; Koda, 1998; McBride-Chang, 1995; Newman, Tardif, Huang, & Shu, 2011; Stage & Wagner, 1992).

For example, Newman et al. (2011) assessed the phonological awareness of 71 monolingual Mandarin-speaking children aged six using Mandarin phoneme deletion tasks. The results of repeated measures analysis of variance (ANOVA) revealed a significant effect of phoneme position. Children's performance in deleting medial phonemes was significantly worse than their performance in deleting initial and final phonemes, while children's performance in deleting initial and final phonemes was comparable. The medial phonemes are widely known to be the most difficult phonemes to be manipulated, as this pattern has been found by various studies (Castles et al., 2003; Dixon, Stuart, & Masterson, 2002; Durgunoğlu & Öney, 1999; Hulme et al., 2002; Koda, 1998; McBride-Chang, 1995; Newman et al., 2011; Puolakanaho, Poikkeus, Ahonen, Tolvanen, & Lyytinen, 2003; Treiman, 1991).

It is unclear whether initial phonemes are easier to be manipulated than final phonemes or vice versa. The findings are mixed in the literature. There is evidence suggesting that children perform comparably in manipulating initial and final phonemes (Durgunoğlu & Öney, 1999; Newman et al., 2011). Other studies suggested that initial phonemes are easier to manipulate than final phonemes (Castles et al., 2003; Puolakanaho et al., 2003; Smith, 1995; Treiman, 1991; Vandervelden & Siegel, 1995). There is one exception

showing that initial phonemes are more difficult to manipulate than final phonemes.

Durgunoğlu and Öney (1999) administered phoneme deletion tasks to 138 Turkish-speaking and English-speaking children aged five and six. The results showed that the Turkish children performed significantly worse in deleting initial phonemes than deleting final phonemes, whereas the English-speaking children performed comparably in deleting initial and final phonemes. The researchers explained that the unusual performance of Turkish children could be attributed to the characteristics of Turkish. When inflections are added to the end of a Turkish word, the final phoneme of the original syllable representing the word must be manipulated to create the new syllable. Turkish children have gained experience in manipulating the final phoneme in everyday conversations and thus performed better in deleting the final phonemes than initial phonemes.

In summary, there is strong evidence that the position of the phoneme has an effect on children's performance in phonological awareness. Children found medial phonemes more difficult to manipulate than initial and final phonemes. Some studies found that initial phonemes might be easier than final phonemes to be manipulated, but the evidence is weak.

In summary, the position of the target phoneme in a syllable can have an effect on children's performance in phonological awareness. There is strong evidence demonstrating that children perform worst in manipulating medial phonemes than initial and final phonemes. It remains unclear whether children perform better in manipulating initial phonemes than final phonemes or vice versa.

Interactions between operations and products dimensions

From the studies reviewed, there is a wealth of research showing that children's performance in phonological awareness depends on the operations dimension (cognitive operations) and products dimension (linguistic units) of the phonological measures. The

interaction between cognitive operations and linguistic units can form phonological measures across a spectrum of difficulty.

To study the interaction effect between cognitive operations and linguistic units, Stahl and Murray (1994) used four operations (isolating, blending, deletion, segmentation) to measure awareness of subsyllables (onsets and rimes) and phonemes of 113 English-speaking kindergartners and first graders. The results showed that children’s performance varied considerably due to the interaction between operations and linguistic units. Children’s performance in various tasks is listed in Table 4.

Table 4 Percentage correct for the phonological awareness measures in Stahl and Murray (1994)

		Cognitive Operations			
		Isolating	Blending	Deletion	Segmentation
Linguistic Units	Onset and rime	94.0%	68.2%	64.0%	71.4%
	Final Phoneme	77.7%	48.8%	53.0%	36.4%

The percentage correct of the onset-rime tasks using different operations ranged from 64.0% to 94.0%, whereas the percentage correct of the final phoneme tasks using various operations ranged from 36.4% to 77.7%. Among these results, there was a ceiling effect in the onset-rime isolating task where the children scored 94.0% correct. There might also be a floor effect for the phoneme segmentation task where the children scored 36.4% correct.

These results provide valuable insights for researchers to make informed choices about the phonological measures. In order to assess the phonological awareness of children aged between five and six, researchers prefer measures that are developmentally appropriate for the participants. Measures that are too easy or too difficult are avoided because a ceiling effect or a floor effect are observed. Based on the findings of Stahl and Murray (1994), using more difficult operations such as blending and deletion to assess awareness of subsyllables can avoid a potential ceiling effect because many children have already mastered awareness of subsyllables at age five. For the phonemic awareness that many children have not yet

mastered at that age, using easier operations such as isolating can avoid a potential floor effect.

To summarise, the interactions between the operations (cognitive operations) and products (linguistic units) dimensions can affect the measurement of phonological awareness. To capitalise on such interactions, researchers can switch from using different operations to assess phonological awareness in different linguistic units so that these measures are developmentally appropriate for the participants.

The First Draft of Measures

The phonological measures aimed to be comparable between the English version and the Cantonese version. The two language versions were designed to match at the macro- and micro-level. The macro level concerns the English and Cantonese versions of each task being parallel in terms of cognitive operations and linguistic units. The micro level concerns how the test items of each task were constructed to be comparable in the English and Cantonese versions.

Design at the macro level

According to the model adapted from Guilford's (1967) theory, there would be $3 \times 3 \times 1 = 9$ possible phonological measures. These nine measures assess children's phonological awareness in different linguistic units using different cognitive operations. Not all measures are developmentally appropriate for kindergarteners. Thus, the following sections will explain which cognitive operations and linguistic units were chosen for this new set of phonological measures.

The first decision was about what operations were to be used in the phonological measures. Children's phonological awareness can be measured by multiple operations at the same time. However, it is argued that phonological awareness measured by a single operation should be sufficient in this study for two reasons. The first reason was that using a single operation for the assessment means more operations would be available for phonological training in Study 2. The operations used in the assessment and training should not be overlapped because children might do better in the assessment simply because they have worked with the same operations used in training, but not because they have received teaching in phonological awareness. The second reason was that children's phonological awareness measured by one operation is sufficient for the purpose of studying the transfer of phonological awareness. Using multiple operations will only place an unwanted burden on

the children and researcher. Thus, a single operation was used to measure children's phonological awareness.

Among the three types of operations (identity, synthesis, analysis), analysis operation is considered the most difficult (National Institute for Literacy, 2008). If the transfer of phonological awareness is demonstrated in tasks involving more difficult operations, evidence for the transfer will become more convincing. Several tasks are under the category of analysis operation, including deletion, isolation, completion segmentation and counting. In this study, deletion was chosen among the analysis tasks because it is not possible to guess the answers in a deletion task.

The second decision was what linguistic units to use to measure phonological awareness. Phonological awareness can be measured using a single linguistic unit or a variety of linguistic units. The merit of assessing awareness of one linguistic unit is that it can save considerable time and effort. The advantage of assessing awareness of a spectrum of linguistic units is that it can reflect the fact that different linguistic units have different relative importance in English and Cantonese (McBride-Chang et al., 2008). For example, awareness of phonemes is more important for English than for Cantonese because English is represented by an alphabetic orthography whereas Cantonese is represented by a non-alphabetic orthography. In English, letters represent phonemes, and consequently become an external representation of phonemes for children to manipulate. This alphabetic principle dictates that phonemes are important for reading English (Adams, 1990). In Cantonese, characters represent syllables. Phonemes are not directly involved in the reading of Chinese characters (Ho & Bryant, 1997a). Thus, phonemes are more important and easier to learn in English than in Cantonese. Because the relative importance of linguistic units varies for English and Cantonese, phonological awareness is better measured using a variety of linguistic units. In this study, phonological awareness was measured across a spectrum of

linguistic units of various sizes, from syllables to subsyllables (onsets and rimes), to phonemes (initial and final).

There is a spectrum of linguistic units that can be used to measure phonological awareness. Awareness of subsyllables can be further divided into awareness of onsets and awareness of rimes. Awareness of phonemes can also be divided into awareness of initial phonemes, medial phonemes, and final phonemes. As learned from the literature review, children generally develop their phonological awareness from large linguistic units to small linguistic units (Anthony & Francis, 2005; Goswami, 2008). An awareness of syllables emerges, followed by awareness of subsyllables (onsets and rimes) and eventually awareness of phonemes. Within the phoneme-level awareness, an awareness of initial phonemes and final phonemes emerges before awareness of medial phonemes (Castles et al., 2003; Dixon et al., 2002; Durgunoğlu & Öney, 1999; Hulme et al., 2002; Koda, 1998; McBride-Chang, 1995; Newman et al., 2011; Puolakanaaho et al., 2003; Treiman, 1991). For kindergarteners, awareness of some small linguistic units such as medial phonemes could be too challenging for them. In fact, Cantonese-English kindergarteners performed poorly in the phoneme-level tasks as reviewed in Table 2 (p.25). The children scored 1.82% to 14.7% correct in manipulating initial phonemes. Given that manipulating medial phonemes is more challenging than manipulating initial or final phonemes (e.g. Castles et al., 2003), it is very likely that there would be a floor effect for tasks manipulating medial phonemes. Thus, awareness of medial phonemes was not included in this set of phonological measures.

Awareness of phonemes could be indicated by awareness of both initial phonemes and final phonemes, or by awareness of either unit. It was argued that awareness of initial phonemes and final phonemes should be measured separately. The reason is that there is mixed evidence about whether initial phonemes are easier to be manipulated than final phonemes or not (Castles et al., 2003; Durgunoğlu & Öney, 1999; Smith, 1995; Treiman,

1991). The proper approach to these mixed results is to measure awareness of both initial phonemes and final phonemes if children perform differently in manipulating initial phonemes and final phonemes.

The ambiguity between onsets and initial phonemes should also be addressed. As discussed previously (p.29), the boundary between the onset and the initial phoneme of a syllable is ambiguous if the syllable begins with a single consonant. This issue particularly affects the design of the phonological measures because a Cantonese syllable can only accommodate one single consonant before the vowel. In this case, the onset of a Cantonese syllable is always the initial phoneme of the syllable. It was argued that manipulating the onsets of such syllables requires awareness of initial phonemes but not awareness of subsyllables. It would be redundant to measure the same awareness twice when both awareness of onsets and awareness of initial phonemes are measured. Hence, awareness of onsets was not included in this set of phonological measures.

How awareness of rimes should be measured has also been affected by the ambiguity between onsets and initial phonemes. A new issue arose in that the operation of deleting rimes is practically the same as deleting initial phonemes from syllables beginning with a single consonant. For example, when the rime /æt/ is deleted from the syllable *cat* /kæt/, the remaining phoneme /k/ is also the initial phoneme. Awareness of initial phonemes is also required to delete the rime from a syllable beginning with a single consonant. Thus, rime deletion is practically identical to initial phoneme deletion in this case. Two options are available to resolve this issue. The first is to use another operation other than deletion to measure awareness of rimes. The second is to forgo measuring awareness of rimes. The former option was preferred because an assessment of awareness of subsyllables would remain, given that awareness of onsets has been excluded from this set of phonological measures.

The next decision was to select an alternative operation for measuring awareness of rimes. The replacement operation should only involve awareness of subsyllables but not awareness of phonemes. Among other operations, oddity operation is an adequate replacement for deletion operation because the former can assess rime awareness without manipulating the initial phonemes. In a rhyme oddity task, there is a trio of pictures representing three monosyllables (e.g. ‘cat, ‘hat, ‘bell’) in which two of the syllables rhyme. A child is asked to identify the non-rhyming ‘odd’ syllable in the trio by pointing to the respective picture. To complete the oddity task, the child has to pay attention to the ending part of the syllables. In this process, only awareness of subsyllables is required instead of awareness of initial phonemes. Thus, rhyme oddity was selected to replace the rime deletion task for the phonological measures.

To conclude, four phonological tasks were chosen to measure phonological awareness of English and Cantonese in parallel, namely syllable deletion, rhyme oddity, initial phoneme deletion, and final phoneme deletion. The cognitive operations and linguistic units between the English and Cantonese versions of each phonological task are comparable. English and Cantonese rime awareness was assessed by a rhyme oddity task, whereas awareness of syllables, initial phonemes, and final phonemes in English and Cantonese was assessed by deletion tasks.

Design at the micro level

The micro level concerns the fine details about what test items to include for the English and Cantonese versions of each measure. The test items across the languages were matched in terms of the phonological structure and lexical difficulty.

Phonological structure. The phonological structure of the syllables used in the measures should be selected cautiously because children are asked to manipulate the sound structures of these syllables in the measures. Test items with different syllable structure across

the English and Cantonese versions can lead to inconclusive findings of the transfer of phonological awareness. The phonological structure of the test items was matched between the English and Cantonese versions by two means. First, all the syllables used in the English and Cantonese versions have either consonant-vowel (CV) or consonant-vowel-consonant (CVC) structures. The reason was that 98% of Cantonese syllables have simple CV or CVC structures (Wong, 1984). To match with their Cantonese counterparts, the English syllables used in the English measures should also have CV or CVC structures which constitute 47.5% of English monosyllables (De Cara & Goswami, 2002). Second, the syllable structure across the English and Cantonese versions is identical. When a syllable in the English version has a CV structure (e.g. *man* /mæn/), its counterpart in the Cantonese version has the identical CV structure (e.g. /maat3/ ‘wipe’) to match with the English syllable. These two means ensure that the test items across the languages have comparable syllable structures.

Lexical difficulty. The syllables used in the measures represent real English words or Chinese characters. The lexical difficulty of the words or characters represented by these syllables should be simple because young children will take these tests. Some phonetically simple syllables can be difficult for young children because these syllables represent words with complex lexical meaning. For example, *cog* (/kɒg/) is phonetically simple but its meaning of a gear tooth is too difficult for children. The lexical difficulty varies in regard to two factors, the lexical meaning and the part of speech.

Cantonese syllables were selected from *Hong Kong Chinese Lexical Lists for Primary Learning* (HKSAR Education Bureau, 2007) so that the Cantonese syllables used have the appropriate lexical difficulty for young children. This list is the only lexical list recognised by the Hong Kong Government. The compilation of the list considered Hong Kong’s convergence of Chinese and Western culture and thus is suitable for participants in Hong Kong (HKSAR Education Bureau, 2007). Among the collection of 9,706 Chinese words,

4,914 words were intended for children in Primary 1 to 3 (HKSAR Education Bureau, 2007). These 4,914 words had the appropriate lexical difficulty for the participants in this study because these children would study Primary 1 in the coming year. The syllables in the Cantonese measures were selected from the Chinese characters forming these 4,914 Chinese words. The syllables in the English measures were selected from the English translation version of the same list (HKSAR Education Bureau, 2009). The English list is not intended to provide a lexical list of English words, but is useful to judge whether an English word has the appropriate lexical difficulty for kindergarteners.

The part of speech determines the ease of expressing the syllable in pictures, which is particularly relevant to the assessment of young children. Pictures are preferred over words to represent syllables because using pictures can lower the cognitive demand required for young children to recognise syllables. Thus children can pay more attention to the internal sound structure of the syllables in the phonological measures (Carney & Levin, 2002). Some parts of speech such as nouns and verbs are easier to be expressed by pictures. Thus, nouns and verbs were selected from *Hong Kong Chinese Lexical Lists for Primary Learning* (HKSAR Education Bureau, 2007) for the Cantonese items, and from the English translated list (HKSAR Education Bureau, 2009) for the English items.

The first draft of the measures

Four phonological measures were constructed in English and Cantonese in the first draft, namely syllable deletion, rhyme oddity, initial phoneme deletion, and final phoneme deletion. These four phonological measures were constructed to be comparable at the macro- and micro- levels. Not only was each measure based on the same cognitive operations and linguistic units in the English and Cantonese versions, but their items were also matched with syllable structure and lexical difficulty across the two languages. The procedures and items of syllable deletion, rhyme oddity, initial phoneme deletion, and final phoneme deletion measures are described as follows.

Syllable deletion. Two practice items and eight testing items were in the English and Cantonese versions respectively. The first half of the testing items were disyllabic nonwords (e.g. *manda*) whereas the other half were trisyllabic nonwords (e.g. *samily*). In each item, a picture of a cartoon monster was presented to a child. The experimenter said the nonword (e.g. *manda*) to the child and claimed that the nonword was the name of that cartoon monster. The child was then asked to make fun of a monster's name by dropping the first syllable of the multi-syllable. One mark was awarded for each correct response. The maximum score was eight for each language version. In total, five disyllabic nonwords and five trisyllabic nonwords were required to construct the English version. In the Cantonese version, the construction of the nonword items was more complicated due to the phonology of Cantonese. As Cantonese syllables are all monosyllabic, a multisyllabic Cantonese nonword was constructed by combining two or three nonsense syllables. The nonsense syllables were syllables not corresponding to any syllables representing real Chinese characters. By combining these nonsense syllables, a disyllabic or trisyllabic Cantonese nonword was created. In total, five disyllabic Cantonese nonwords and five trisyllabic nonwords were

required to construct the Cantonese version. In Table 5, the items of the English and Cantonese versions of the syllable deletion tasks are listed.

The syllables across languages were matched in regard to syllable structure and lexical difficulty. The syllable structure was perfectly matched for each syllable across the two languages. For example in Item 2, the English disyllable *dofa* /'dɒʊfə/ and its Cantonese counterpart /zo1 faa2/ have the same CVCV structures. The nonwords in all the items were created by modifying the common real words from the Hong Kong Lexical List (HKSAR Education Bureau, 2007, 2009). Thus, the lexical difficulty of the syllables was also matched across the two languages, even though they were all nonwords.

Table 5 Items of the Syllable Deletion Task in English and Cantonese (First Draft)

	English (real word)	Syllable structure	Cantonese (real characters) [meaning]	Syllable structure
Practice	tappy /'tæpi/ (happy)	CVCV	ko2 daa3 (可怕) [scary]	CV CV
	falala /fə'li:lə/ (banana)	CVCVCV	taai6 kai1 jaa1 (大西瓜) [watermelon]	CV CV CV
1.	higer /'hɑrgə(r)/ (tiger)	CVCV	hou5 lu2 (老虎) [tiger]	CV CV
2.	dofa /'dɒʊfə/ (sofa)	CVCV	zo1 faa2 梳化 [sofa]	CV CV
3.	falad /'fæləd/ (salad)	CVCVC	jaa1 feot6 沙律 [salad]	CV CVC
4.	lotel /lɒʊ'tel/ (hotel)	CVCVC	lau2 tim3 酒店 [hotel]	CV CVC
5.	samily /'sæməli/ (family)	CVCVCV	su3 mi6 lyu1 (故事書) [storybook]	CV CV CV
6.	jotato /jə'tetəʊ/ (potato)	CVCVCV	dyu5 bou4 bau4 (羽毛球) [badminton]	CV CV CV
7.	mokonut /'mɒkənʌt/ (coconut)	CVCVCVC	mai2 kau2 naan1 (洗手間) (toilet)	CV CV CVC
8.	beledon /'belɪdɒn/ (telephone)	CVCVCVC	bai5 laai3 pat6 (禮拜日) [Sunday]	CV CV CVC

Note: The real words/characters are in parenthesis; C=consonant, V= vowels.

Rhyme oddity. Two practice items and eight testing items were used in each language version. In each item, three monosyllabic syllables (e.g. 'cat', 'hat', 'bell') were presented as pictures. The child was asked to point to the 'odd' syllable that did not rhyme with the other two rhyming syllables. One mark was awarded for each correct response. The maximum score was eight for each language set. In total, 30 English monosyllables were required to construct the English version, whereas 30 Cantonese syllables were needed to construct the

Cantonese version. The items of the English and Cantonese versions of the rhyme oddity measure are listed in Table 6.

The items in the English and Cantonese versions were matched in regard to syllable structure and lexical difficulty as best as possible. All the syllables in the English version had a CVC structure whereas the syllables in the Cantonese version had CV or CVC structures. Five out of the eight testing items were perfectly matched in regard to the syllable structure across the two languages, whereas the remaining three items were not perfectly matched. For example, in Item 2, the English syllables *peg*, *cot*, *leg* have a CVC structure whereas the Cantonese counterparts *hau2*, *teoi2*, *sau2* have a CV structure. The reason for the partial matching of syllable structure was that there are insufficient English syllables with CV structure. Only 4.5% of English syllables have a CV structure (De Cara & Goswami, 2002) whereas 46.4% of Cantonese syllables have a CV structure (Leung et al., 2004). It was challenging to find two rhyming English syllables with a CV structure. In such case, pairing rhyming English syllables took priority over matching the syllable structure with the Cantonese counterparts because pairing rhyming syllables is the only condition that should not be compromised in a rhyme oddity task. A special feature in the Cantonese version was that all the Cantonese syllables within the trio had the same lexical tone. For example, the Cantonese syllables in Item 2 *hau2*, *teoi2*, *sau2* have the second tone. This ensured that the children could identify the 'odd' Cantonese syllable solely based on the rhymes rather than the tones. The lexical difficulty of the English and Cantonese syllables matched because they were selected from the comparable lexical list (HKSAR Education Bureau, 2007, 2009).

Table 6 Items of the Rhyme Oddity Task in English and Cantonese (First Draft)

Item	English syllable	Syllabic structure	Cantonese syllable (meaning)	Syllabic structure
Practice	sail nail boot	CVC	ce1(car) ze1(umbrella) faa1(flower)	CV
	bell cat hat	CVC	haa1(shrimp) dou1(knife) bou1(pot)	CV
1.	hay day see	CV	fo2(fire) so2(lock) gau2(dog)	CV
2.	peg cot leg	CVC	jap6 (entrance) sit6(tongue) sap6(ten)	CVC
3.	fish dish book	CVC	gai1(chicken) gwai1(tortoise) caa1(fork)	CV
4.	cup fan man	CVC	huk1(cry) bat1(pen) gwat1(bone)	CVC
5.	hen car pen	CVC	hung4 (red), sim4 (cicada) , nung4 (farm)	CVC
6.	bun sun tap	CVC	luk6(six) muk6(wood) jyut6(moon)	CVC
7.	paw boat goat	CVC	syut3(snow) gaap3(pigeon) taap3(tower)	CVC
8.	wall dog ball	CVC	faan6 (rice), seon6 (obey) , baan6 (dress up)	CV

Note: Answers are in **bold**. C=consonant; V=vowel

Initial phoneme Deletion. Two practice items and six testing items were set in each language version. A monosyllable (e.g. *mat* /mæt/) was presented as a picture. The child was asked to ‘say it again without the opening bit of sound’. The child should drop the first phoneme (e.g. /m/) and respond with the remaining syllable (e.g. /æt/). One mark was awarded for each correct response. The maximum score was six for each language set. The first three testing items were nonword items and the next three items were real word items. In total, eight monosyllabic English syllables and eight Cantonese syllables were required to construct this measure. The test items of the English and Cantonese versions of the initial phoneme deletion task are listed in Table 7.

The items across the two languages matched in phonological structure and lexical difficulty. The syllable structure of each syllable perfectly matched across the two languages. For example in Item 2, the English syllable *mat* /mæt/ and its Cantonese counterpart 麵 /min6/ (noodles) have the same CVC structure. The target initial phonemes to be deleted also perfectly matched across the two languages. Three initial phonemes /m, s, f/ were deleted in both the English and Cantonese versions because these phonemes are among the 15 consonants shared by both languages (Chan & Li, 2000). The nasal /m/ was deleted in the

first two items, followed by the fricative /s/ in the next two items and the fricative /f/ in the last two items. The lexical difficulty of the items also matched across the two languages as the English and Cantonese syllables were selected from the Hong Kong Lexical List (HKSAR Education Bureau, 2007, 2009).

Table 7 Items of the Initial phoneme Deletion in English and Cantonese (First Draft)

Item	English Syllable	Syllabic structure	Cantonese syllable	Syllabic structure
Practice	my /maɪ/ → 'I' /aɪ/	CV	摸 /mo2/ (touch) → 鵝 /o2/ (goose)	CV
	May /meɪ/ → 'A' /eɪ/	CV	米 /mai5/ (rice) → 蟻 /ai5/ (ant)	CV
1.	man /mæn/ → 'Ann' /æn/	CVC	抹 /maat3/ (wipe) → 壓 /aat3/ (press)	CVC
2.	see /si:/ → 'E' /i:/	CV	手 /sau2/ (hand) → 嘔 /au2/ (vomit)	CV
3.	four /fɔ:(r)/ → /ɔ:(r)/	CV	火 /fo2/ (fire) → 鵝 /o2/ (goose)	CV
4.	dee /di:/ → /i:/	CV	lui1 → /ui1/	CV
5.	dap /dæp/ → /æp/	CVC	faam2 → /aam2/	CVC
6.	mut /mʌt/ → /ʌt/	CVC	laak3 → /aak3/	CVC

Note: C=consonant, V= vowels.

Final Phoneme Deletion. Two practice items and six testing items were set in each language version. A monosyllable (e.g. *beef* /bi:f/) was represented as a picture. The child was asked to delete the final phoneme (e.g. /f/) and respond with the remaining syllable (e.g. /bi:/). One mark was awarded for each correct response. The maximum score was six for each language set. The first three items were real words whereas the other three items were nonwords. In total, eight monosyllabic English words and eight Cantonese syllables were required to construct this measure. The items for the final phoneme deletion measure in English and Cantonese are listed in Table 8.

All items in the English and Cantonese versions matched in syllable structure and lexical difficulty. The syllables in both versions have a CVC structure. The target final phonemes also perfectly matched across the two languages. The final phonemes to be deleted were /m, n, ŋ, t, p, k/. These six consonants were chosen because they are the only consonants allowed at the final position of an English or Cantonese syllable. The lexical difficulty also

matched across the two languages because the syllables were selected from the words in the comparable lexical list (HKSAR Education Bureau, 2007, 2009).

Table 8 Items of the Final Phoneme Deletion in English and Cantonese (First Draft)

Item	English Syllable	Syllabic structure	Cantonese syllable (meaning)	Syllabic structure
Practice	hide /hard / → high /haɪ/	CVC	參 /caam1/ (participate) → 叉 /caa1/ (fork)	CV
	need /ni:d/ → knee /ni:/	CVC	三 /saam1/ (three) → 沙 /saa1/ (sand)	CV
1.	team /ti:m/ → tee /ti:/	CVC	尖 /zim1/ (pointy) → 芝 /zi1/ (cheese)	CVC
2.	bean /bi:n/ → bee /bi:/	CVC	山 /saan1/ (mountain) → 沙 /saa1/ (sand)	CVC
3.	song /sɔ:ŋ/ → saw /sɔ:/	CVC	釘 /deng1/ (spike) → 爹 /de1/ (grandpa)	CVC
4.	mot /mɒt/ → /mɒ/	CVC	闊 /fut3/ (wide) → 富 /fu3/ (rich)	CVC
5.	bup /kʌp/ → /bʌ/	CVC	葉 /jip6/ (leaves) → 二 /ji6/ (two)	CVC
6.	paik /peɪk/ → /peɪ/	CVC	畫 /waak6/ (draw) → 話 /waa6/ (speak)	CVC

Note: C=consonant, V= vowels.

In summary, the first draft of the four phonological measures was developed, namely syllable deletion, rhyme oddity, initial phoneme deletion, and final phoneme deletion. The English and Cantonese versions of each of the four phonological measures were designed to assess phonological awareness at the same linguistic unit by the same cognitive operation. Items across the two language versions matched in syllable structure and lexical difficulty. The English and Cantonese versions of each measure were sufficiently comparable.

Pilot Test

The first draft of the phonological measures was subjected to a pilot test with the aim to optimise the measures. The participants of the pilot test will be described first, followed by the analysis strategies of the pilot test. Next, the results of each of the four measures in their first draft will be analysed, and the revisions of each measure will be justified and explained.

Participants of the pilot test

Participants in the pilot test were 16 (6 boys, 10 girls) Hong Kong Chinese children. The children's mean age was 72.3 months ($SD = 5.12$ months). All the children are native Cantonese speakers and have been learning English from the age of three at kindergarten. They are normally developing children with no known special education needs (SEN). These children were recruited from a kindergarten run by a major charity in Hong Kong. The kindergarten is in a working-class area in Hong Kong and fully funded by the government.

Analysis strategies for the pilot test

The results of the pilot test would give insights into the appropriateness of the measures. Two methods were used to evaluate the first draft of the four phonological measures in the pilot study (Rust & Golombok, 2009). The first method was to examine the overall difficulty of the measure which could be measured by the distribution of the children's total scores for the task. This analysis could reveal whether the measure had the appropriate difficulty for the five-year-old participants. Any floor effect or ceiling effect could be identified from this analysis so that a decision could be made to revise or remove a measure.

The second method was to examine the item difficulty which could be measured by the proportion of correct responses to each item. This can reveal the difficulty of a particular item in a measure. Ideally, the proportion of correct responses (percentage correct) for an item should lie between 25% and 75%, at 50% for the entire measure on average (Rust &

Golombok, 2009; Urbina, 2014). A particularly easy or difficult item can be revealed by its abnormally high or low percentage correct.

Syllable deletion

The first analysis of the syllable deletion measure was to examine the distributions of the children's total scores. The distributions of scores in the English and Cantonese versions are shown by the respective histograms in Figure 2. The distributions of the scores were highly skewed to the maximum score of 8 with a few children scoring poorly at around 2 to 4 marks. The distribution indicated a ceiling effect in both the English and Cantonese syllable deletion tasks. It was likely that most of the children had developed syllable awareness in English and Cantonese which is supposed to emerge at the age of three (Goswami, 2008).

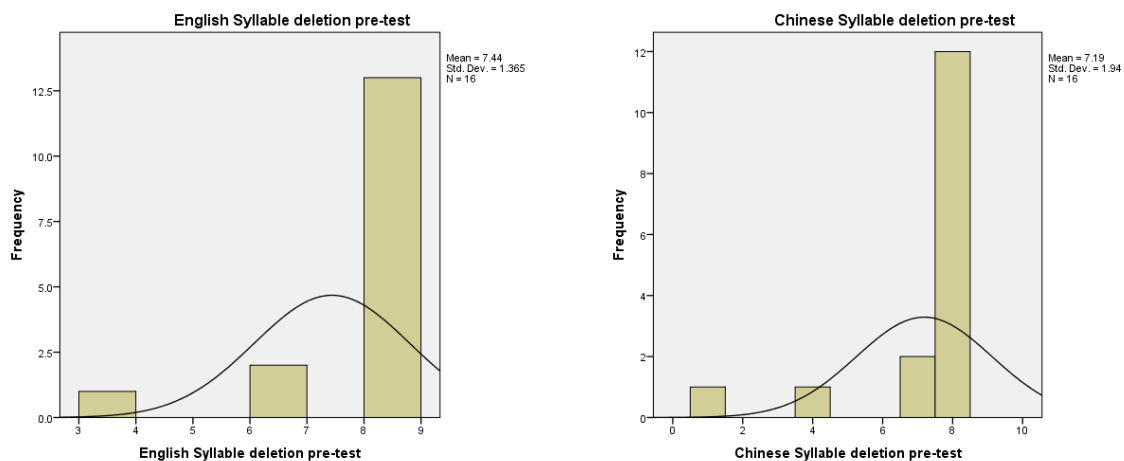


Figure 2 Histograms of English and Cantonese syllable deletion pre-test (first draft)

The second analysis was to examine the children's mean performance in each item of the syllable deletion measure. The mean percentage correct of each item in the English and Cantonese task are listed in Table 9. The percentage correct ranged from 81% to 100% for both language versions and did not drastically differ among the items.

Table 9 The mean percentage correct for each item in the English and Cantonese syllable deletion tasks (first draft)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
English syllable deletion pretest	94%	100%	100%	94%	94%	94%	87%	81%
Cantonese syllable deletion pretest	94%	100%	94%	94%	95%	87%	87%	87%

Based on the findings from the score distributions and the mean scores for each item, it was likely that the syllable deletion measure was too easy for the five-year-old Hong Kong children. The ceiling effect would be found again when the syllable deletion measure was administered to other five-year-old Hong Kong children. Because it was not possible to differentiate the children's performance in a measure with a ceiling effect, the syllable deletion measure will no longer be included in this new set of phonological measures.

Rhyme oddity

Similar to the analyses conducted for the syllable deletion measure, the distribution of the scores of the rhyme oddity measure in English and Cantonese were analysed first. It was noteworthy that it was possible to guess the answer in the rhyme oddity measure. The children had a one-third chance (33.3%) to guess the answer correctly. If the majority of the children had not developed rhyme awareness, the distribution of the scores would have clustered around the score of 2.67 which is 33% of the total score of 8. The distributions of the scores in the English and Cantonese versions are shown by the histograms in Figure 3. Most of the children scored around 3 to 4 marks in the English measure whereas the majority of the children scored 2 to 3 marks in the Cantonese measure. The results indicated that most of the children might have developed some awareness of English rimes but not awareness of Cantonese rimes.

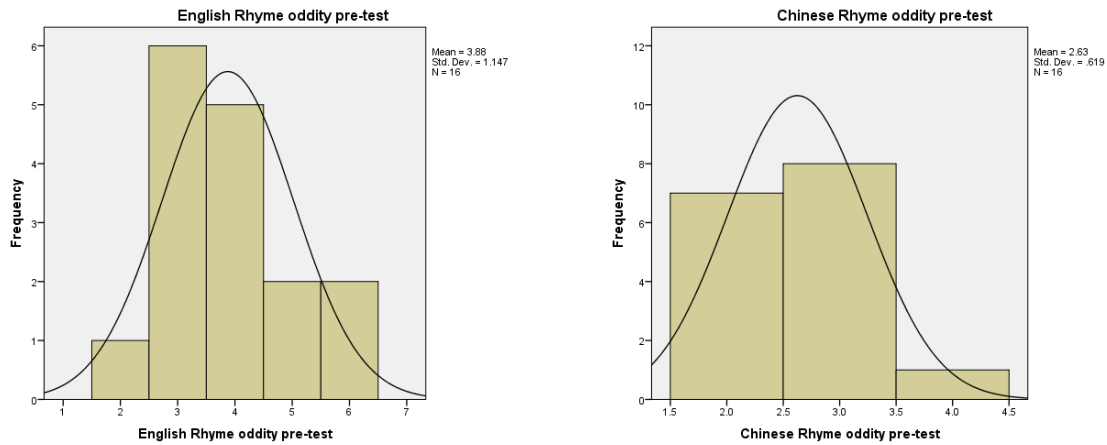


Figure 3 Histograms of English and Cantonese Rhyme Oddity Pre-Test (first draft)

The second analysis was to examine the children’s performance in each item. For an easy item, the mean score for that item was expected to be above the chance level (33%), whereas the expected mean score for a difficult item would cluster around the chance level (33%). If the item was particularly misleading so as to prompt the children to select the wrong syllable, the expected mean score for that misleading item would be well below 33%. The mean scores of percentage correct for each item in the English and Cantonese rhyme oddity tasks are listed in Table 10.

Table 10 The mean percentage correct for each item in the English and Cantonese rhyme oddity tasks (first draft)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
English rhyme oddity pretest	81%	38%	88%	19%	31%	69%	21%	31%
Cantonese rhyme oddity pretest	63%	10%	63%	25%	6%	75%	19%	13%

In the English version, the mean scores for each item could be categorised into three groups. The first group consisted of items 1, 3, 6 that had much higher mean scores than the other items and the scores were above the chance level (33%). These three items were in common because the last syllable among the three syllables in the item was the correct ‘odd’ syllable. The second category consisted of items 2, 5, 8 that had mean scores around the chance level (33%). In these items, the middle syllable was the ‘odd’ syllable in the trio of

syllables. The third category was items 4 and 7 that had mean scores well below the chance level (33%). In both items, the first syllable was the ‘odd’ syllable in the trio.

The results suggested that the children had the tendency to choose the ‘odd’ syllable based on the position of the ‘odd’ syllable in the trio of syllables, rather than based on the dissimilarity of rimes among the trio. Items 1, 3, 6 seemed to be easier than other items not because of the phonological structures or lexical difficulty of the syllables involved, but due to the fact that the correct ‘odd’ syllable was the last syllable in the trio and children liked to choose the last syllable as the answer. Items 4 and 7 appeared to be particularly difficult due to the fact that children tended to avoid choosing the first syllable as the answer. Because there was no abnormality as a result of the inconsistent syllable structures or the lexical difficulty, all items in the English version will remain in this set of phonological measures.

In the Cantonese version, items 1, 3, 6 had much higher mean scores than the other items possibly because the last syllable of the trio was the correct ‘odd’ syllable. The rest of the items received mean scores far below the chance level (33%), suggesting the items might have misled children to select the wrong answers. However, not all these items were misleading after examining the items in detail. Learning from the findings from the English rhyme oddity task, items 4 and 7 might have received low mean scores due to the children’s disinclination to select the first syllable in the trio as the answer. Thus, the low mean scores for items 4 and 7 could be reasonably explained. Then the remaining items 2, 5, 8 might be problematic. Further examination of these items found that the items were misleading for various reasons. In item 2 (*jap6*, ***zik6***, *sap6*), the second syllable *zik6* and the last syllable *sap6* have phonologically close onsets. The onsets /z/ and /s/ in Cantonese are similar because according to the International Phonetic Alphabet (IPA), /z/ represents the Cantonese affricative /ts/ whereas /s/ represents the Cantonese fricative /s/ (Ching, Lee, Lo, & Meng, 2007). It was likely that the children might have mistaken *zik6* and *sap6* as sharing the same

onset and then mistakenly identified *jap6* as the ‘odd’ syllable. Items 5 and 8 were problematic because all the syllables in the trio contained confusing phonemes. In item 5 (*hung4*, ***sim4***, *nung4*), all syllables in the trio ended with the Cantonese nasals /ŋ/ or /m/. At the same time, the initial fricatives /h/ in *hung4* and /s/ in *sim4* were relatively close when contrasted to the initial nasal /n/ in *nung4*. Thus, based on these two clues, many children might have mistaken *hung4* and *sim4* as a pair and identified *nung4* as the ‘odd’ syllable. In item 8 (*faan6*, ***seon6***, *baan6*), all syllables ended with the same nasal /n/. At the same time, *faan6* and *seon6* have a fricative /f/ or /s/ as their onset. Thus, a number of children might have mistaken *faan6* and *seon6* as a pair and identified *baan6* as the ‘odd’ syllable.

The resolution of the rhyme oddity measure was achieved by the English version remaining unchanged whereas items 2, 5, 8 in the Cantonese version were revised. The revised items were constructed from the Cantonese syllables without phonologically confusing phonemes within the trio. Item 2 (*jap6*, ***zik6***, *sap6*) was amended to *hau2*, ***teoi2***, *sau2*. Item 5 (*hung4*, ***sim4***, *nung4*) was revised to *sing1*, ***zuk1***, *bing1*. Item 8 (*faan6*, ***seon6***, *baan6*) was changed to *haai4*, ***wan4***, *caai4*. The revised rhyme oddity measure in English and Cantonese is listed in Table 11.

Table 11 Items of the Revised Rhyme Oddity Measure in English and Cantonese

Item	English syllable	Syllabic structure	Cantonese syllable (meaning)	Syllabic structure
Practice	sail nail boot	CVC	ce1(car) ze1(umbrella) faa1(flower)	CV
	bell cat hat	CVC	haa1(shrimp) dou1(knife) bou1(pot)	CV
1.	hay day see	CV	fo2(fire) so2(lock) gau2(dog)	CV
2.	peg cot leg	CVC	jap6 (entrance) sit6(tongue) sap6(ten) hau2(mouth) teoi2(leg) sau2(hand)	CVC CV
3.	fish dish book	CVC	gai1(chicken) gwai1(tortoise) caa1(fork)	CV
4.	cup fan man	CVC	huk1(cry) bat1(pen) gwat1(bone)	CVC
5.	hen car pen	CVC	hung4 (red) , sim4 (cicada) , nung4 (farm) sing1 (start) zuk1(bamboo) bing1 (ice)	CVC
6.	bun sun tap	CVC	luk6(six) muk6(wood) jyut6(moon)	CVC
7.	paw boat goat	CVC	syut3(snow) gaap3(pigeon) taap3(tower)	CVC
8.	wall dog ball	CVC	faan6 (rice) , seon6 (obey) , baan6 (dress up) haai4(shoe) wan4(cloud) caai4 (firewood)	CV

Note: Answers are in **bold**; the items replaced are in ~~strike through~~; C=consonant, V= vowels.

Initial phoneme deletion

The distributions of the children’s total scores were analysed. In the histograms in Figure 4, the distributions are similar between the English and Cantonese versions. Most of the children scored zero in both versions, suggesting that most of the children had not developed awareness of initial phonemes in both languages. There was a floor effect for the English and Cantonese initial phoneme deletion tasks.

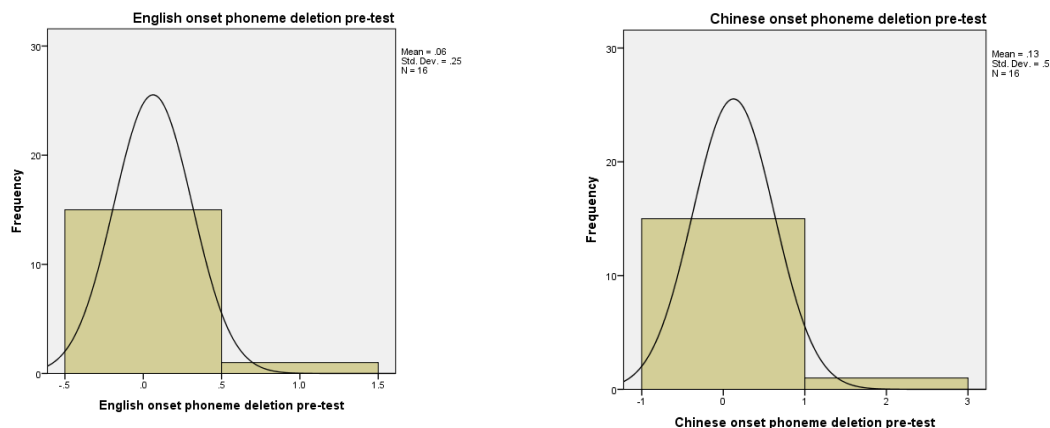


Figure 4 Histograms of English and Cantonese Initial Phoneme Deletion Pre-Test (first draft)

The analysis of each item revealed that a number of items in both measures were unscored by any child. As in Table 12, the mean scores were zero for the English items 4, 5, 6 (*mee*; *sap*; *fit*) and Cantonese items 4, 5, 6 (*mui1*; *saam2*; *faak3*). These unscored items were all constructed from non-words. As expected, deleting the initial phoneme from a nonword syllable in English or Cantonese was too challenging for the five-year-old children.

Table 12 The mean percentage correct for each item in the English and Cantonese initial phoneme deletion tasks (first draft)

	Q1	Q2	Q3	Q4	Q5	Q6
English initial phoneme deletion pretest	6%	6%	6%	0%	0%	0%
Cantonese initial phoneme deletion pretest	6%	6%	6%	0%	0%	0%

The resolution of the initial phoneme deletion measures was achieved by replacing the nonwords by real words. The new real words were constructed from the syllables with the same initial phonemes /m, s, f/ of the first three items in the original version. The revised English and the Cantonese initial phoneme deletion tasks are listed in Table 13.

Table 13 Test Items of the Revised Initial Phoneme Deletion Measure in English and Cantonese

Item	English Syllable	Syllabic structure	Cantonese syllable	Syllabic structure
Practice	my /maɪ/ => 'I' /aɪ/	CV	摸 /mo2/ (touch) => 鵝 /o2/ (goose)	CV
	May /meɪ/ => 'A' /eɪ/	CV	米 /mai5/ (rice) => 蟻 /ai5/ (ant)	CV
1.	man /mæn/ => 'Ann' /æn/	CVC	抹 /maat3/ (wipe) => 壓 /aat3/ (press)	CVC
2.	mut /mʌt/ => /ʌt/ mat /mæt/ => 'at' /æt/	CVC	lui1 => /ui1/ 麵 /min6/ (noodles) => /in6/ (n/a)	CVC
3.	see /si:/ => 'E' /i:/	CV	手 /sau2/ (hand) => 嘔 /au2/ (vomit)	CV
4.	dap /dæp/ => /æp/ sit /sɪt/ => 'it' /ɪt/	CVC	faam2 => /aam2/ 縮 /suk1/ (shrink) => 屋 /uk1/ (house)	CVC
5.	four /fɔ:(r)/ => /ɔ:(r)/	CV	火 /fo2/ (fire) => 鵝 /o2/ (goose)	CV
6.	dee /di:/ => /i:/ far /fɑ:(r)/ => /ɑ:(r)/	CV	laak3 => /aak3/ 花 /faa1/ (flower) => 鴉 /aa1/ (crow)	CV

Note: The items replaced are in ~~strike through~~; C=consonant, V= vowels.

Final phoneme deletion

The histograms of the English and Cantonese final phoneme deletion total scores are shown in Figure 5. The distributions of scores were different between the English and Cantonese versions. Most of the children scored 3 out of 6 marks in the English version, but almost none of them could score a mark in the Cantonese version. The mixed results suggested that the children might have developed some awareness of English final phonemes but not Cantonese final phonemes.

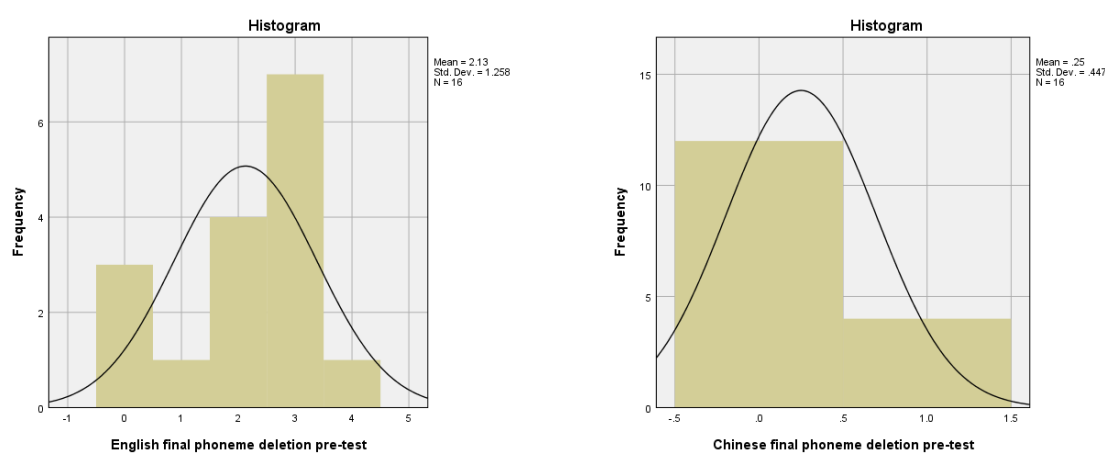


Figure 5 Histograms of English and Cantonese Final Phoneme Deletion Pre-Test (first draft)

The breakdown of the mean scores for each item is listed in Table 14. In the English version, the mean scores for the first three items (*team*; *bean*; *song*) ranged between 6% and 13% whereas the mean scores for the last three items (*mut*; *bup*; *paik*) ranged between 69% and 75%. The children were more aware of the English final plosives /t, p, k/ than the final nasals /m, n, ŋ/, even though the items ending with /t, p, k/ were nonword items. In the Cantonese version, the children performed similarly in the first three items ending with nasals /m, n, ŋ/ (*zim1*; *saan1*; *deng1*) and in the last three items ending with plosives /t, p, k/ (*fut3*; *jiɰ6*; *waak6*). Most of the children had not developed awareness of Cantonese final phonemes at the time of assessment.

Table 14 The mean percentage correct for each item in the English and Cantonese final phoneme deletion tasks (first draft)

	Q1	Q2	Q3	Q4	Q5	Q6
English initial phoneme deletion pretest	6%	13%	6%	69%	69%	75%
Cantonese initial phoneme deletion pretest	0%	6%	6%	6%	0%	6%

From the results above, the children performed particularly well in deleting the English final plosives /t, p, k/, but they barely scored in the items ending with the English nasals /m, n, ŋ/ as well as all the items in the Cantonese task. A possible explanation for this discrepancy is that the English plosives /t, p, k/ are naturally noticeable for Cantonese-speaking children. In Cantonese, when /t/, /p/, or /k/ is placed in the final position of a Cantonese syllable, these three plosives become unreleased consonants. These unreleased Cantonese consonants have no release burst and thus no audible indication of the end of its articulation (Bauer & Benedict, 1997). Such unreleased articulation is similar to the unreleased first plosive of a plosive cluster in English, such as the /k/ in *doctor* /'dɒŋktə(r)/. In *doctor* /'dɒŋktə(r)/, the /k/ sound is not as audible as the /k/ sound in *incur* /ɪn'kɜ:(r)/ because the former /k/ sound overlaps the following plosive /t/ in the articulation of *doctor* /'dɒŋktə(r)/ (Abercrombie, 1967). Compared to the barely audible unreleased Cantonese plosives /t, p, k/, Cantonese-speaking children might find the English final plosives /t, p, k/ particularly noticeable and hence were able to delete these English plosives in the pilot test.

The resolution of the final phoneme measure was achieved by changing the English items ending with /t, p, k/ to non-plosive phonemes. The rationale was that it was difficult to differentiate children's performance in these three items due to the ceiling effect. The original items *mot*, *bup*, *paik* were replaced by *beef*, *bowl*, and *pour* in which the final phoneme was a fricative /f/, a lateral /l/, and an approximant /r/ respectively. For the Cantonese measure, all items remained unchanged. The items of the revised final phoneme deletion measure are listed in Table 15.

Table 15 Test Items of the Revised Final Phoneme Deletion Measure in English and Cantonese

Item	English Syllable	Syllabic structure	Cantonese syllable (meaning)	Syllabic structure
Practice	hide /hard / => high /hai/	CVC	參 /caam1/ (participate) => 叉 /caa1/ (fork)	CV
	need /ni:d/ => knee /ni:/	CVC	三 /saam1/ (three) => 沙 /saa1/ (sand)	CV
1.	team /ti:m/ => tee /ti:/	CVC	尖 /zim1/ (pointy) => 芝 /zi1/ (cheese)	CVC
2.	bean /bi:n/ => bee /bi:/	CVC	山 /saan1/ (mountain) => 沙 /saa1/ (sand)	CVC
3.	song /sɔ:ŋ/ => saw /sɔ:/	CVC	釘 /deng1/ (spike) => 爹 /de1/ (grandpa)	CVC
4.	not /nɒt/ => /nɒ/ beef /bi:f/ => bee /bi:/	CVC	闊 /fut3/ (wide) => 富 /fu3/ (rich)	CVC
5.	cup /kʌp/ => /bʌ/ bowl /bɔ:l/ => bow /bəʊ/	CVC	葉 /jip6/ (leaves) => 二 /ji6/ (two)	CVC
6.	paik /peik/ => /pe/ pour /pɔ:r/ => paw /pɔ:/	CVC	畫 /waak6/ (draw) => 話 /waa6/ (speak)	CVC

Note: The items replaced are in ~~strikethrough~~; C=consonant, V= vowels.

In summary, the syllable deletion measure was excluded from the set of phonological measures because almost all of the five-year-old children could score perfectly in both the English and Cantonese versions. The remaining three measures were rhyme oddity, initial phoneme deletion, and final phoneme deletion. In the rhyme oddity measure, the children tended to choose the last syllable in a trio of syllables as the correct ‘odd’ syllable whereas they appeared to avoid choosing the first syllable as the ‘odd’ syllable. Some syllables in the Cantonese rhyme oddity measure had phonologically confusing phonemes so that some children might have mistaken the syllables with these phonologically confusing phonemes as a pair and then identified the wrong ‘odd’ syllable. For the initial phoneme deletion measure, none of the children could delete the initial phoneme of nonword syllables in both languages. Hence, the nonword syllables were replaced by real word syllables. For the final phoneme deletion measure, the children scored particularly well in deleting the English syllables

ending with /t, p, k/. It was possible that the final phonemes of /t, p, k/ in Cantonese syllables are barely audible and thus the Cantonese-speaking children might find the English /t, p, k/ particularly noticeable and then performed well in deleting the English /t, p, k/. The English syllables ending with /t, p, k/ were replaced.

Evaluation

The final phase of the test development was to evaluate this new set of phonological measures. The evaluation aimed to show that the phonological measures are comparable across the English version and the Cantonese version. Two hypotheses about the comparability of the phonological measures are formulated as follows.

Hypothesis 1: the phonological measures are consistent with the theoretical structure based on Guilford's (1967) model

Hypothesis 2: the English version and the Cantonese version of each phonological measures are comparable to each other

The first hypothesis concerns whether the phonological measures are consistent with the theoretical structure based on Guilford's (1967) theory. By varying the dimensions of operations (cognitive operation) and products (linguistic units), as well as excluding the syllable deletion measure after the pilot test, three phonological measures were constructed, namely rhyme oddity, initial phoneme deletion, and final phoneme deletion. If the phonological measures are consistent with the theoretical design, the data should suggest that the items are best grouped into three factors, each factor corresponding to each of the three measures.

The second hypothesis concerns whether the phonological measures are comparable across the English and Cantonese versions or not. The versions were designed to be as parallel as possible. The items across the language versions matched in syllable structure and lexical difficulty. Thus, it was expected that the cross-language correlations would be stronger between the same kind of measure than between different kinds of measures across the two languages. Each English measure should correlate more strongly with its Cantonese counterpart than with the other two Cantonese measures. Likewise, each Cantonese measure should be more related to its English version than to the other two English measures. For

example, the English rhyme oddity task should correlate more strongly with the Cantonese rhyme oddity task than with the other two Cantonese measures. The Cantonese initial phoneme deletion should correlate more strongly with its English counterpart than with the other two English measures.

To test these two hypotheses, confirmatory factor analysis (CFA) was used. Because this statistical technique is still new to the field of phonology, CFA will be concisely introduced. The introduction will help one to understand and justify the use of CFA for testing the two hypotheses. After the introduction of CFA, the two hypotheses are tested by CFA using the data collected from administering the phonological measures to 162 five-year-old children. Finally, the results of testing the hypotheses are discussed.

Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) belongs to a family of factor analysis techniques designed to identify factors that underline the interrelations among a set of observed variables (Pedhazur & Schmelkin, 1991b). To examine the structure of a measure, one can study the interrelations of each item with every other item. The number of interrelations one should examine is equal to $\frac{k(k-1)}{2}$, where k is the number of items (Pedhazur & Schmelkin, 1991b). Because there were 20 items from the three phonological measures in each language, $\frac{20(20-1)}{2} = 190$ interrelations had to be examined. It is difficult to arrive at an overall picture about the structure of the measures from such a large number of interrelations. By using factor analysis, the large number of interrelations among the items can be condensed to a smaller set of trends called factors (Urdan, 2010). Factor analysis is applied to the interrelations among the items and produces an estimate of the relation between an item and a factor. This estimate is referred as a factor loading. Thus, instead of examining the 190 interrelations among 20 items, only 20 factor loadings would have to be examined if each

item is related to one factor only. It is far more manageable to examine 20 factor loadings than the 190 interrelations among the items.

The process of ‘condensation’ in factor analysis has roots in the ‘common factor model’ (Thurstone, 1947) in which each item in a set of variables is a linear function of one or more common factors (Brown, 2006). What a factor analysis does is partition the variance of each item into common variance and unique variance (Brown, 2006). The common variance refers to the variance accounted for by the factor, which is estimated from the variance shared with other items. The unique variance refers to the sum of the variance specific to the item and random error variance (Brown, 2006). An example of a common factor model is illustrated in Figure 6. In the model, items X_1 to X_3 are grouped under factor A whereas items X_4 to X_6 are grouped under factor B. Within each factor, the only reason why the items are related is that they share common influence on the factor. If the shared influence is partialled out, there will be no relation among the items.

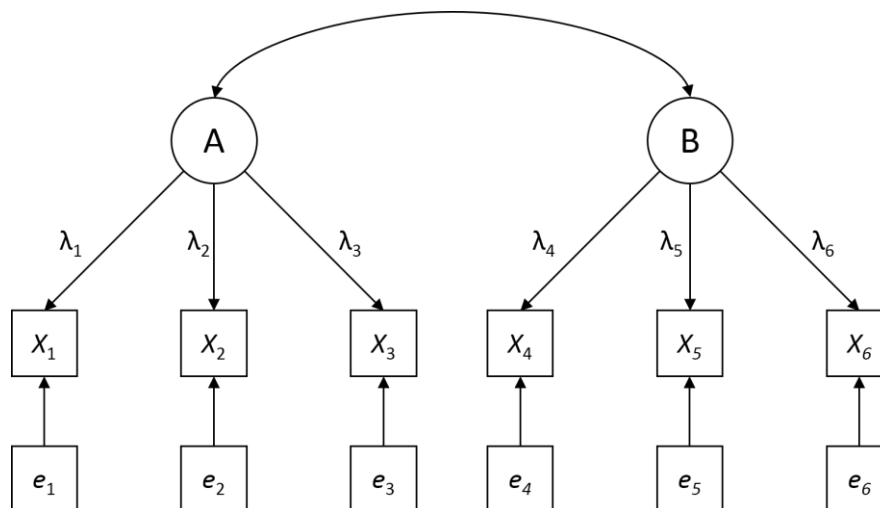


Figure 6 An example model of confirmatory factor analysis (CFA)

According to the common factor model (Thurstone, 1947), an item is a linear function of its factor(s). Using the interrelations (e.g. correlations) among the items, the linear functions can be estimated (Pedhazur & Schmelkin, 1991b). The slope of the linear function is known as factor loading (λ). A factor loading can be thought of as the weight of an item on

a factor, similar to a standardised regression coefficient in a regression predicting the item from its factor(s) (Pedhazur & Schmelkin, 1991b). The higher the factor loading, the greater the impact of the factor on the item. According to the common factor model (Thurstone, 1947), a factor loading represents the common variance of the item. Using the completely standardised model in Figure 6, squaring the factor loading λ_1 is the variance in the item X_1 accounted for by factor A. For item X_1 , the model estimates that $(\lambda_1)^2$ % of its total variance is the common variance accounted for by factor A, whereas the unexplained variance $(1 - \lambda_1^2$ %) is unique variance. In essence, factor analysis partitions the common variance and the unique variance of each item and uses the variances to estimate more interpretable parameters such as factor loadings.

CFA was developed from the common factor model. It aims to test whether the data is consistent with the researchers' predictions about the relations among a set of items, rather than condensing these relations for easier interpretation. CFA reproduces the observed relations among a group of items according to a pre-specified model. The model provides the information about how to estimate the relations among the items, such as the number of factors and how the items are related to the factors. At the end of CFA, several indices will be produced providing information about how close the reproduced relations are to the observed relations. CFA entails three steps: model specification, model estimation, and model evaluation. Each step is introduced in the following.

Model specification. In model specification, the number of factors, the pattern of factor loadings, and the relations between factors and errors are specified (Furr, 2011). An example of a model specification is shown in Figure 6. Factors A and B are depicted by circles, whereas test items X_1 to X_6 are depicted by squares. The curved double-headed arrow indicates the correlation between factors A and B . The single-headed straight arrows represent the relations between the items and factors, and between items and errors. Each item is

loaded on one factor only. Items X_1 to X_3 are loaded on factor A , whereas items X_4 to X_6 are loaded on factor B . λ_1 to λ_6 are the factor loading on Items X_1 to X_6 respectively. The errors es (i.e., measurement error or unreliability in the item) are loaded on their respective items only and do not correlate with other errors (Brown, 2006).

Model estimation. In model estimation, the goal is to find a set of parameters for the pre-specified model to produce a predicted variance-covariance matrix (Σ) that resembles the observed variance-covariance matrix (S) as closely as possible (Brown, 2006). These parameters include factor loadings of the items on their assigned factors, the between-factor relations, and item-error relations. The process of finding these optimal parameters requires fitting a function, a mathematical operation to minimise the differences between Σ and S (Brown, 2006). The fitting is an iterative process that begins with an initial fit. The fit is tested and adjusted and so forth until the fitting criteria are satisfied (Harrington, 2009). Several fitting functions are available for CFA to produce fair estimates of the parameters, depending on the nature of the variables. For continuous variables, maximum likelihood (ML) estimation is most widely used (Kline, 2016). For categorical variables, weighted least squares with mean and variance adjusted (WLSMV) is preferred in the literature (Beauducel & Herzberg, 2006).

Maximum likelihood (ML) estimation aims to find the parameter values that have the maximised probability of resembling the observed data (Harrington, 2009). The idea of ML is to input arbitrary values of population parameters and test the likelihood (probability) of observing certain values of the variables in a single observation drawn from a population (Pedhazur & Schmelkin, 1991a). The process continues until the values of the parameters drawn from a sample of observations have the greatest joint likelihood of finding the true parameters of the population (Mulaik, 2010). ML estimation is widely used because it provides necessary information such as the standard errors (SEs) for each parameter

estimated, allowing for a formal statistical test of overall model fit (Schermelleh-Engel, Moosbrugger, & Müller, 2003). It is also robust against the minor violations of the normality assumption (Chou & Bentler, 1995).

However, for categorical variables such as ordinal and dichotomous variables, the relations between the observed variables and their underlying factors are not linear. Thus, the assumption of a continuous and multivariate normal distribution for ML estimation is severely violated. Simulation studies have shown that using ML estimation for categorical variables results in inaccurate estimation of model parameters (Beauducel & Herzberg, 2006; Finney & DiStefano, 2013; Fouladi, 2000). Instead, weighted least squares with mean and variance adjusted (WLSMV) is preferred by statisticians (e.g. Edwards, Wirth, Houts, & Xi, 2012; Finney & DiStefano, 2013; Flora & Curran, 2004; Muthén, du Toit, & Spisic 1997). WLSMV is a refined form of weighted least squares (WLS) estimation which was designed for categorical variables with asymmetrical distributions (Muthén, 1984). The approach behind WLS estimation is that each categorical variable X is linked to a latent factor variable X^* which is continuous and normally distributed. For dichotomous items such as those in this study, there is a threshold (τ) on latent variable X^* where one response is given (e.g. correct) if the threshold is exceeded and another response is given (e.g. false) if the threshold is not exceeded (Kline, 2016). When latent variable X^* has a mean of 0 and a variance of 1 (i.e. standardised), the threshold (τ) is the value of the standard score (z) that divides a normal distribution into categories and assigns the categorical responses on X to the continuous X^* values (Kline, 2016). For example, as indicated in *Figure 7*, if the observed probability of an incorrect response in a dichotomous item is .64, the threshold (τ) on latent factor variable X^* will be .359.

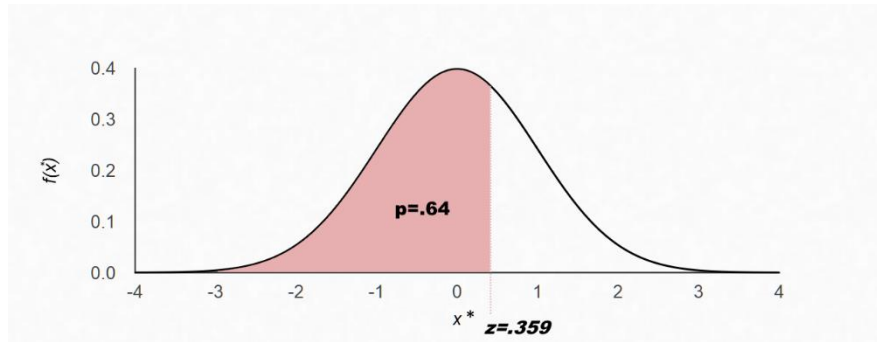


Figure 7 The standardised latent factor variable X^* with a threshold estimate (τ)
 p = the probability of an incorrect response in a dichotomous item X ;
 z = threshold estimate (τ) = the standard score of X^* where $p = f(z)$

For a set of categorical variables, the estimated thresholds (τ) and the observed cross-tabulations of item responses are used to produce a matrix of correlations between the latent factor variables X^* s (Kline, 2016). Next, another matrix called information matrix is generated by using the variances and covariances of each element of the correlation matrix (Wang & Wang, 2012). Finally, the inverse of the information matrix is used as the input matrix in WLS estimation (Kline, 2016). The input matrix of WLS estimation is often referred to as weight matrix (W). There are several major problems in WLS estimation. First, the estimation is overwhelmingly demanding. Because the estimation of the weight matrix W is based on the variances and covariances of each element of a correlation matrix (i.e. the covariances of the covariances), an overwhelming number of variances and covariances are involved in the estimation even for simple models (Brown, 2006). For example, when there are 20 variables in the model, there will be $\frac{20(20+1)}{2} = 210$ elements in the correlation matrix between the latent factor variables X^* s; thus, there will be $\frac{210(210+1)}{2} = 22155$ elements in the weight matrix (W). Second, the sample size must be sufficiently large to obtain positively-defined W (Brown, 2006). Studies have found that WLS is a poor estimation for categorical variables in small and moderate samples even when compared to robust ML estimation (e.g. Chou & Bentler, 1995; Flora & Curran, 2004).

WLSMV is designed to improve WLS estimation by using a different weight matrix W . In WLSMV estimation, only the diagonal elements of the information matrix (i.e. the error variances) were used as the input weight matrix W in its fitting function, instead of inverting the whole information matrix as in WLS estimation (Edwards et al., 2012). The use of diagonal matrix W not only enables faster estimation, but also relaxes the sample size requirement because the W is not inverted and thus not required to be positively defined (Brown, 2006). The use of diagonal matrix W comes with drawbacks of producing biased values of standard errors (SEs) and model test statistics such as χ^2_M (Kline, 2016). To mitigate these problems, the full information matrix is used to compute SEs and χ^2_M separately from the main estimation (Brown, 2006). Such adjustments explain the meaning of ‘with mean and variance adjusted’ in the name of WLSMV. Simulation studies have shown that WLSMV estimation can produce more accurate parameters and test statistics than WLS or ML estimation under a variety of conditions, including varying sample sizes, degrees of non-normality, and model complexity (Beauducel & Herzberg, 2006; Flora & Curran, 2004; Lei, 2007; Muthén et al., 1997).

CFA can produce a completely standardised, standardised, or unstandardised solution for the parameters estimated. The completely standardised solution can offer the most intuitive interpretation of the parameters. In a completely standardised solution, the variances of a factor equal to 1 and the factor loadings are the correlations or standardised regression coefficients (Brown, 2006). Squaring the standardised factor loadings is the proportion of variance explained by the factor. If the standardised factor loading of an item on a factor is .60, the factor explains $.60^2 = 36.0\%$ of the observed variance of that item.

Model evaluation. Model evaluation evaluates how well the model fits the data. Specifically, it evaluates how well the predicted matrix (Σ) produced by the estimated parameters can resemble the observed matrix (S) of the actual data (Pedhazur & Schmelkin,

1991a). When the model fits the data well, using the parameters estimated can accurately reproduce the interrelations between the observed variables. Using the example model in Figure 6 (p.62), if the model fits the data well and the parameters are estimated in a standardised solution, the observed correlation between the items X_1 and X_2 can be accurately reproduced by multiplying the estimated factor loadings of X_1 and X_2 on the factor A : $r_{x_1,x_2} = \lambda_1 \times \phi \times \lambda_2$. In a standardised solution, the factor variance Φ always equals 1 because both items X_1 and X_2 share the same factor (Pedhazur & Schmelkin, 1991b). Thus, the observed correlation between X_1 and X_2 is simply estimated as $\lambda_1 \times \lambda_2$. To reproduce the observed correlation between items X_1 and X_4 which are loaded on different factors, the correlation between the factors A and B is multiplied by the factor loadings of the items X_1 and X_4 : $r_{x_1,x_4} = \lambda_1 \times r_{A,B} \times \lambda_4$. The correlation between factors A and B is used because it is the only relation shared by items X_1 and X_4 (Pedhazur & Schmelkin, 1991b).

A set of fit statistics is produced after the model estimation, providing information about the closeness between the predicted matrix (Σ) and the observed matrix (S). These indices include model chi-square (χ^2_M), root mean square error of approximation (RMSEA; Browne & Cudeck, 1993), and comparative fit index (CFI; Bentler, 1990). Each index provides the fit of the CFA solution from different perspectives. Because no single index can holistically demonstrate the fit of the model, several indices should be examined to determine the acceptability of the model (Brown, 2006).

The chi-square χ^2 represents the differences between the observed and expected frequencies (Field, 2013). The same idea is applied to CFA for comparing the discrepancies between the reproduced matrix and the observed matrix (Pedhazur & Schmelkin, 1991a). A small model χ^2_M indicates small discrepancies between the elements in the predicted matrix (Σ) and the observed matrix (S), suggesting that the model has a good fit to the data. The null hypothesis (H_0) being tested for χ^2_M is that the elements of the predicted matrix reproduced

by the estimated parameters of the model are *not* significantly different from those of the observed matrix (Pedhazur & Schmelkin, 1991a). Thus, when the proposed model fits the observed data satisfactorily, the χ^2_M should *not* exceed the critical χ^2 value ($p < .05$) and the null hypothesis should *not* be rejected. For normally distributed variables, the expected value of χ^2_M is equal to the model's degrees of freedom df_M when the model is correctly specified (Finney & DiStefano, 2013). df_M is the difference between the number of known parameters and unknown parameters in the model (MacCallum, Browne, & Sugawara, 1996). For categorical variables, the computed χ^2_M might not have a χ^2 distribution, leading to inaccurate probability levels of χ^2 even if the model is correctly specified (Tabachnick & Fidell, 2012b). To solve this problem, χ^2_M estimated by WLSMV is adjusted by using corrected degrees of freedom to approximate the theoretical χ^2 distribution. The degrees of freedom are corrected using the distributional characteristics of the data and are lower in value than the standard degrees of freedom (Finney & DiStefano, 2013).

RMSEA is related to model chi-square χ^2_M . What differentiates RMSEA from χ^2_M is that RMSEA measures the departure from an approximate fit whereas χ^2_M measures the departure from a perfect fit (Kline, 2016). RMSEA indicates whether the model-data discrepancy exceeds the limit of approximate fit. Thus, when $RMSEA = 0$, it only indicates that the discrepancy between the observed matrix (S) and the predicted matrix (Σ) does not exceed the limit of approximate fit, but not that the fit is perfect. The limit of approximate fit $\hat{\Delta}_M$ indicates the degree of misspecification of the model, computed as $\hat{\Delta}_M = \chi^2_M - df_M$, where χ^2_M is model chi-square and df_M is the model's degrees of freedom. $\hat{\Delta}_M$ is equal to 0 for a correctly specified model whereas $\hat{\Delta}_M$ is greater than 0 for a mis-specified model (Kline, 2016). The merit of RMSEA is that it is adjusted for the model parsimony and sample size, as

denoted in its formula $RMSEA = \sqrt{\frac{\hat{\Delta}_M}{df_M(N-1)}} = \sqrt{\frac{\chi^2_M - df_M}{df_M(N-1)}}$, where N is the sample size

(Kline, 2016). Model parsimony refers to the fewness of unknown parameters relative to the

number of observations (Mulaik, 2009). A model with good model parsimony will have a large df_M because there are few unknown parameters to be subtracted from the known parameters. In the formula, RMSEA inversely varies with df_M and sample size N . Thus, RMSEA decreases (i.e. showing better fit) when the model has good model parsimony (large df_M) and a large sample size. In the literature, it is widely accepted that RMSEA values lower than .06 are indicative of good model fit (Browne & Cudeck, 1993).

The CFI is used to compare the fit of a user-specified model against a more restricted baseline model which is not specified by the user (Brown, 2006). In the baseline model, the correlations among all the items are fixed at zero. Thus, the items are unrelated to each other in the baseline model. Like RMSEA, the CFI also uses the limit of approximate fit $\hat{\Delta}_M = \chi^2_M - df_M$ as the indication of the degree of misspecification of the model. The CFI is computed as: $CFI = 1 - \frac{\max[\chi^2_T - df_T, 0]}{\max[\chi^2_T - df_T, \chi^2_B - df_B, 0]}$, where χ^2_T and χ^2_B are the χ^2 of the target model and baseline model respectively, and df_T and df_B are the degrees of freedom of the proposed model and baseline model respectively. ‘Max’ indicates to use the largest value within choice(s) in the square brackets. For example, $(\chi^2_T - df_T)$ or 0 is used whichever is larger. CFI values greater than .95 are indicative of good model fit (Hu & Bentler, 1999).

After one model is evaluated, other possible structural models are successively evaluated to determine which of them provides the best fit for the data (Urbina, 2014). By comparing the fit indices of each model, the model with the best fit will be identified for later interpretation.

Factor scores. To produce a score of phonological awareness for each child, one can simply add the scores of all the items (0 or 1). However, the sum of item scores does not give an accurate estimate of the test score because it ignores the relative contribution of each item (Rust & Golombok, 2009). For example, if one item is uncorrelated with other items, it makes no sense to add that item score to other item scores. A better approach is to compute a

factor score. A factor score is weighted for ‘importance’ of each item, thus producing a more accurate test score that represents the actual contribution of the items (Rust & Golombok, 2009). After a CFA was conducted, factor scores for each child were obtained using the parameters estimated in the optimal model.

After introducing CFA, the rationale for using CFA for testing the two hypotheses was evident. CFA allows the empirical data to be compared against the theoretical structure of a measure in detail (Harrington, 2009). In CFA, the detail of the theoretical structure of the phonological measures can be meticulously specified. The CFA results can inform us how well the data fit the proposed structure of the measures. The comparison between the data and the specified structure is a useful tool to test Hypothesis 1 that the phonological measures have the same theoretical structure as designed.

Factors scores can also be obtained from the optimal CFA model as an accurate representation of children’s phonological awareness performance. Then these factor scores can be used to examine how close the items are across the English and Cantonese versions of the phonological measures. Thus, CFA is also useful for testing Hypothesis 2 that the English version and the Cantonese version of each of the phonological measure are comparable.

Administering of the measures

The English and Cantonese versions of rhyme oddity, initial phoneme deletion, and final phoneme deletion were administered to 162 (85 boys, 77 girls) Hong Kong Chinese children. The children’s mean age was 68.64 months ($SD = 4.68$ months). All the children are native Cantonese speakers and have been learning English from the age of three at kindergarten. They are normally developing children with no special education needs or disability. These children were recruited from six kindergartens run by a major charity in Hong Kong. All measures were administered in a single session of 15 minutes. Half of the

children were randomly selected to complete the English measures before the Cantonese measures, and another half completed the Cantonese measures prior to the English measures.

Testing hypothesis 1

Hypothesis 1 states that the phonological measures are consistent with the theoretical structure based on the adapted model of Guilford's (1967) theory. It was predicted that the phonological measures, both the English and Cantonese versions, have three underlying factors. To test Hypothesis 1, the data were fitted into a three-factor, two-factor, and one-factor CFA model sequentially. The model fit indices produced in CFA would inform the fitness of each model and reveal which of the models fitted the data best. It was predicted that the three-factor model would have the best 'relative' model fit among the rival models and have a satisfactory 'absolute' model fit.

Model specification

Three models were hypothesised to be the model of the phonological measures (*Figure 8*). In each model, there were 20 observed variables in each language: eight rhyme oddity test scores (R1 to R8), six initial phoneme deletion scores (O1 to O6), and six final phoneme deletion scores (F1 to F6). In the diagram for each model, the straight arrows represent the relations linking the factor to its items. The curved double-headed arrows represent the correlations among the factors.

In the first model (*Figure 8A*), the 20 items were organised into three factors because the measures were designed based on Guilford's (1967) theory. By varying the dimensions of operations (cognitive operation) and products (linguistic units), three kinds of phonological measures were constructed, namely rhyme oddity, initial phoneme deletion, and final phoneme deletion. Each measure was expected to correspond to one of the three underlying factors. In *Figure 8A*, the eight rhyme oddity items were grouped to the factor of rhyme, the six items of initial phoneme deletion were loaded on the factor of initial phoneme, and the six

items of final phoneme deletion formed the factor of final phoneme. The three factors were correlated as they all measured the construct of phonological awareness.

In the second model (*Figure 8B*), there were two correlated factors namely rhyme and phoneme. The initial phoneme deletion and the final phoneme deletion tasks were considered equivalent because both measures assessed children's awareness of phonemes using the same cognitive operation (i.e. deletion). Thus, a two-factor model was hypothesised to reflect awareness of rhyme and awareness of phonemes in the phonological measures. The eight rhyme oddity items were loaded on the factor of rhyme, whereas the six items of initial phoneme deletion and the six items of final phoneme deletion were loaded on the factor of phoneme.

In the third model (*Figure 8C*), there was only one factor in the phonological measures. Even though the phonological measures were designed to vary in the cognitive operations and linguistic units, the differences in children's phonological performance were hypothesised to be the variations within the same factor of phonological awareness (e.g. Anthony & Lonigan, 2004). All 20 items from the rhyme oddity, initial phoneme deletion, and final phoneme deletion measure were loaded on the same common factor of phonological awareness.

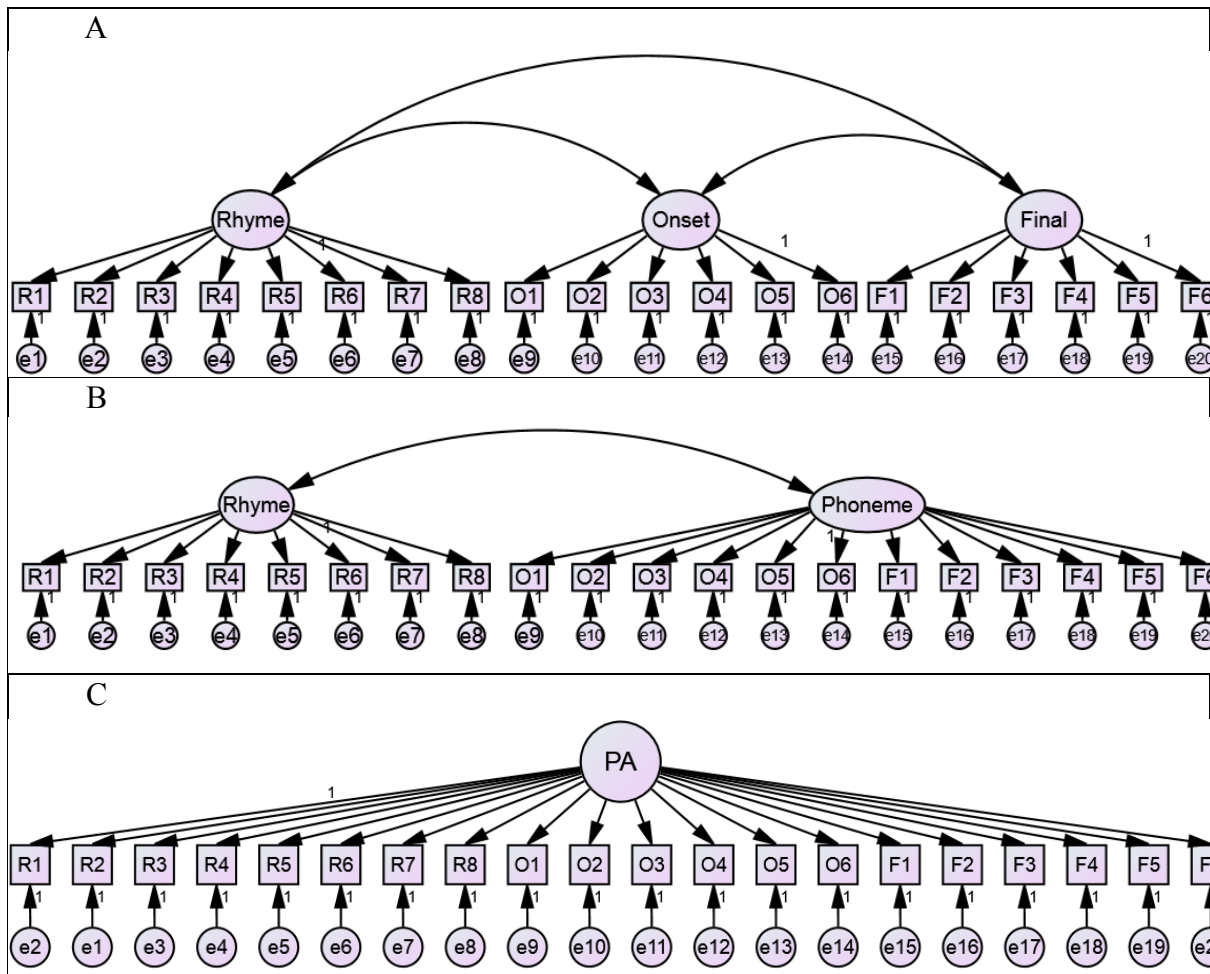


Figure 8 Diagrams of rival hypothesised models of phonological awareness (PA). A: Three-factor model of PA at rhyme, initial phoneme, and final phoneme; B: Two-factor model of PA at rhyme and phoneme level; C: One-factor model of PA; R1-R8: Test scores of Item 1 to 8 in Rhyme Oddity; O1-O6: Test scores of Item 1 to 6 in Initial phoneme Deletion; F1-F6: Test scores of Item 1 to 6 in Final Phoneme Deletion; e1 to e20: the errors of the items.

Model estimation

The next step of CFA was to estimate the parameters for the models. Because each phonological measure has its English and the Cantonese versions, the model estimation was conducted separately for each language. Parameters were estimated according to the models specified above. Because the 20 items were binary (0 or 1), WLSMV estimation was used to compute the parameters. WLSMV can provide an accurate estimation of parameters when the assumption of a continuous and multivariate normal distribution of the variables is violated (Edwards et al., 2012). A completely standardised solution was estimated for the parameters

for the ease of interpretation. The CFA for each of the hypothesised models was fitted in Mplus 8 using WLSMV estimation (Muthén, 1984; Muthén et al., 1997).

Model evaluation

A good model fit suggests that the phonological measures are consistent with the theoretical structure of the measures (Marsh, Hau, & Wen, 2004). The fit indices of each hypothesised model are reported in *Table 16*. The fit indices of the three models were compared to identify the model with the best ‘relative’ model fit. Then, the ‘absolute’ model fit of the best fit model was evaluated. To support Hypothesis 1, the three-factor model should have the best fit among the other two models, and have a satisfactory model fit on its own. The three rival models were evaluated against each other as follows.

Table 16 Fit statistics for the three-factor, two-factor, and one-factor models for the English and Cantonese measures

Model	χ^2_M (df)	p for χ^2_M	CFI	RMSEA	90% CI of RMSEA
English					
Three-factor	243.3 (167)	<.001	.985	.052	[.037, .066]
Two-factor	278.0 (169)	<.001	.978	.062	[.049, .075]
One-factor	498.3 (170)	<.001	.934	.108	[.097, .119]
Cantonese					
Three-factor	253.0 (167)	<.001	.986	.056	[.041, .069]
Two-factor	276.4 (169)	<.001	.983	.062	[.048, .075]
One-factor	386.3 (170)	<.001	.966	.087	[.076, .099]

Indices of model fit: $p > .05$ for model χ^2 test; comparative fit index (CFI) $> .95$; root-mean-square error of approximation (RMSEA) $< .06$;

English measures. The three-factor model (*Figure 8A*) was taken as the base model to compare against the two-factor model (*Figure 8B*) and one-factor model (*Figure 8C*). The two-factor model did not fit well when compared with the three-factor model, $\Delta\chi^2_M(2) = 34.7$, $p < .001$. The CFI (.978) and RMSEA (.062) of the two-factor model were also worse than those of the three-factor model (CFI=.985; RMSEA=.052). The one-factor model also had a worse fit than the three-factor model, $\Delta\chi^2(3) = 255$, $p < .001$. The CFI and RMSEA for the one-factor model (CFI:.934; RMSEA:.108) were worse than those of the three-factor model

(CFI=.985; RMSEA=.052). The results showed that the three-factor model fitted the data best among the models, suggesting that the English phonological measures have a three-factor structure as designed. The completely standardised solution of the parameters of the three-factor model is presented in *Figure 9* (left).

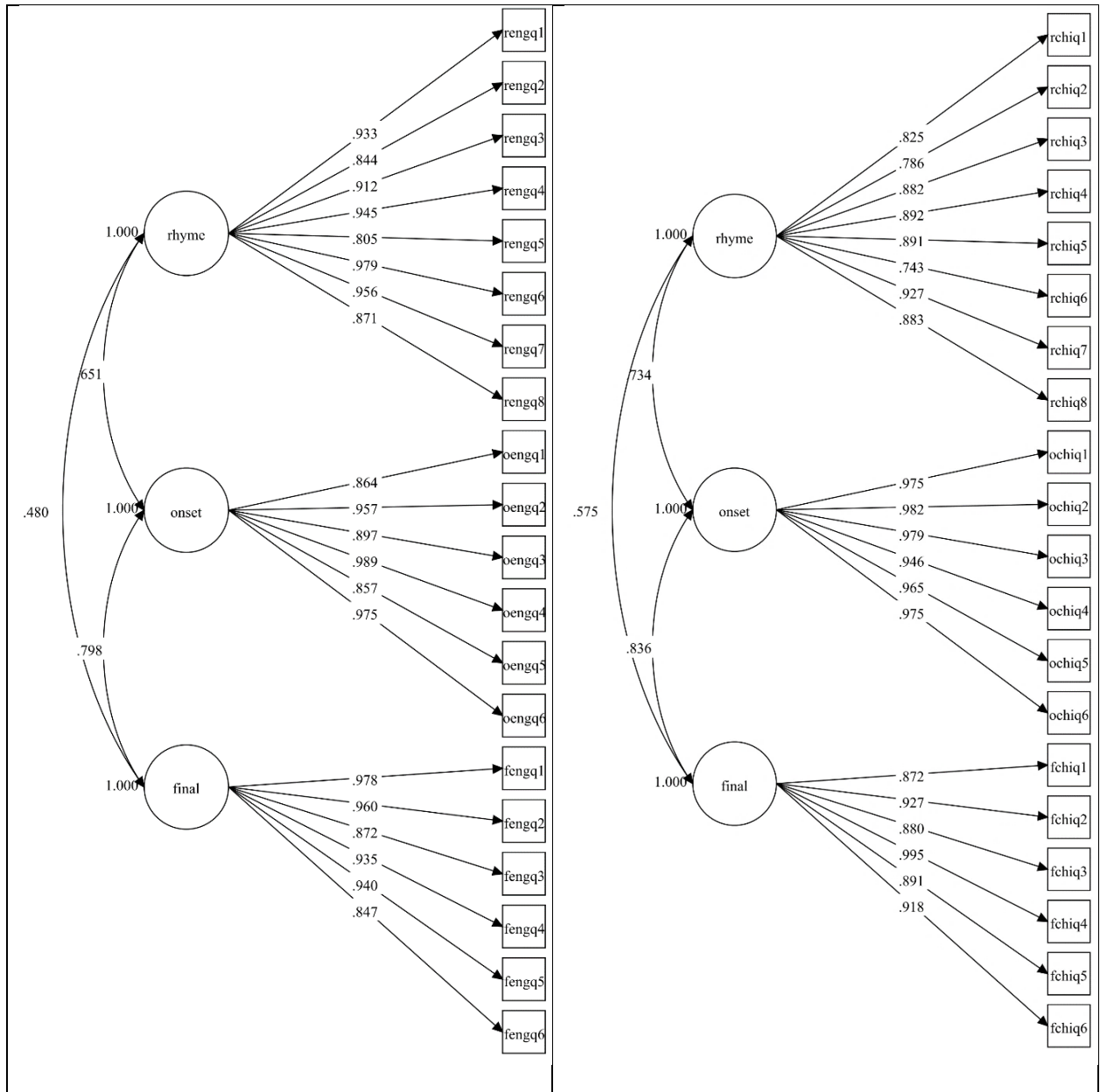


Figure 9 Final models of the English phonological measures (left) and Cantonese phonological measures (right) with fully standardised estimates. The results are for the first model (*Figure 8A*). Onset = initial phoneme; Final = final phoneme; rengq1-rengq8 and rchiq1-rchiq8 = Items 1 to 8 of rhyme oddity measure in English and Cantonese respectively; oengq1-oengq6 and ochiq1-ochiq6 = Items 1 to 6 of the initial phoneme deletion in English and Cantonese respectively; fengq1-fengq6 and fchiq1-fchiq6 = Items 1 to 6 of the final phoneme deletion in English and Cantonese respectively.

Cantonese measures. The first model with three factors (*Figure 8A*) was the base model. The two-factor model (*Figure 8B*) had a worse fit than the three-factor model, $\Delta\chi^2_{M(2)} = 23.4, p < .001$. The CFI (.983) and RMSEA (.062) of the two-factor model were worse than those of the three-factor model (CFI=.986; RMSEA=.056). Likewise, the one-factor model (*Figure 8C*) fitted worse than the three-factor model, $\Delta\chi^2(3) = 133.3, p < .001$. The CFI (.966) and RMSEA (.087) of the one-factor model were poorer than those of the three-factor model. The three-factor model fitted the data best among the three models, indicating that the Cantonese phonological measures might also have a three-factor structure as designed. The completely standardised solution of the parameters estimated for the three-factor model is presented in *Figure 9* (right).

The absolute model fit of the three-factor model for the English measures and the Cantonese measures was evaluated. The three-factor model of the English and Cantonese measures fitted the data satisfactorily (see *Table 16*). Although the Chi-Square Tests of Model Fit (χ^2_M) were statistically significant for the English and Cantonese three-factor models ($p < .001$), two other fit indices were satisfactory. The CFI of the English model (.985) and Cantonese model (.986) were above the .95 threshold (Marsh et al., 2004). The RMSEA of the English model (.052) and Cantonese model (.056) were below the .06 threshold (Marsh et al., 2004). Two out of the three fit indices met their respective good fit thresholds, suggesting that the three-factor model fitted the English and Cantonese phonological measures satisfactorily. The relations among the items of the English and Cantonese phonological measures were adequately explained by the three-factor models.

In conclusion, the results revealed that the three-factor model had the best relative fit than other rival models and had a good absolute model fit. The findings suggested that the English measures and the Cantonese measures were best represented as a three-factor model, consistent with the theoretical structure in the design. Thus, Hypothesis 1 was supported.

Testing Hypothesis 2

The second hypothesis was that the phonological measures are comparable across the English version and the Cantonese version. The cross-language comparability can be revealed by comparing the correlations between the English and Cantonese versions. The cross-language correlations were expected to be strongest between the measures of the same kind. It was predicted that the English version of a measure would relate more strongly with its Cantonese counterpart than with other Cantonese measures and vice versa. Given that both the English and Cantonese measures have a three-factor model, the factor scores were computed based on the parameters estimated in the three-factor model for each language.

Using the factor scores, the interrelations among the English and Cantonese measures were examined by bivariate correlations. The correlations are reported in Table 17. The results showed that all the measures were significantly related to each other ($ps < .01$). In general, the cross-language correlations were the strongest between the measures of the same kind. For example, English rhyme oddity correlated with Cantonese rhyme oddity at $r = .840$, which was higher than its correlations with Cantonese initial phoneme deletion ($r = .731$) and with Cantonese final phoneme deletion ($r = .658$). Similarly, the Cantonese rhyme oddity had a higher correlation with its English counterpart ($r = .840$) than with English initial phoneme deletion ($r = .720$) and with English final phoneme deletion ($r = .602$).

Table 17 Pearson correlations of the factor scores among the English and Cantonese measures

	English initial phoneme deletion	English final phoneme deletion	Cantonese rhyme oddity	Cantonese initial phoneme deletion	Cantonese final phoneme deletion
English rhyme oddity	.755**	.601**	.840**	.731**	.658**
English initial phoneme deletion		.901**	.720**	.825**	.779**
English final phoneme deletion			.602**	.705**	.754**
Cantonese rhyme oddity				.854**	.746**
Cantonese initial phoneme deletion					.928**

Note: ** $p < .01$

Given the observations that the cross-language correlations were the strongest between the measures of the same kind, the next step was to test if the differences between these cross-language correlations were statistically significant. It is noteworthy that these correlations are dependent correlations which were collected from the same sample, this dependence within the data can eliminate some extraneous variables (e.g. IQ) and thus increase the power of the significance test (Field, 2013). The test of the differences in the dependent correlations entailed t -statistic and three correlations r_{xy} , r_{xz} , r_{zy} with one variable y in common in the calculation (Field, 2013), as denoted by:

$$t_{Difference} = (r_{yx} - r_{yz}) \sqrt{\frac{(n-3)(1+r_{xz})}{2(1-r_{yx}^2-r_{xz}^2-r_{yz}^2+2r_{yx}r_{xz}r_{yz})}}, \text{ where } n = \text{sample size}$$

For example, to compare the correlation between English rhyme oddity and Cantonese rhyme oddity with the correlation between English rhyme oddity and Cantonese initial phoneme deletion, the calculation required an additional correlation between Cantonese rhyme oddity and Cantonese initial phoneme. The difference between the two correlations was computed as:

$$t(162 - 3) = (.840 - .731) \sqrt{\frac{(162-3)(1+.854)}{2(1-.840^2-.854^2-.731^2+2 \times .840 \times .854 \times .731)}} = 4.69, p < .001,$$

two-tailed.

The correlation between the English and Cantonese rhyme oddity was significantly stronger than the correlation between English rhyme oddity and Cantonese initial phoneme deletion, $t(159) = 4.69, p < .001$, and stronger than the correlation between English rhyme oddity and Cantonese final phoneme deletion, $t(159) = 5.96, p < .001$. Similarly, the same English-Cantonese correlation of rhyme oddity was significantly stronger than the correlation between Cantonese rhyme oddity and English initial phoneme deletion, $t(159) = 4.11, p < .001$, and stronger than the correlation between Cantonese rhyme oddity and English final phoneme deletion, $t(159) = 6.38, p < .001$.

The correlation between the English and Cantonese initial phoneme deletion was significantly stronger than the correlation between English initial phoneme deletion and Cantonese rhyme oddity, $t(159) = 4.34, p < .001$, and stronger than the correlation between English initial phoneme deletion and Cantonese final phoneme deletion, $t(159) = 2.71, p < .01$. Likewise, the same correlation between the English and Cantonese initial phoneme deletion was significantly stronger than the correlation between Cantonese initial phoneme deletion and English rhyme oddity, $t(159) = 3.13, p < .01$, and stronger than the correlation between Cantonese initial phoneme deletion and English final phoneme deletion, $t(159) = 6.09, p < .001$.

The correlation between the English and Cantonese final phoneme deletion was also significantly stronger than the correlation between English final phoneme deletion and Cantonese rhyme oddity, $t(159) = 4.11, p < .001$, and stronger than the correlation between English final phoneme deletion and Cantonese initial phoneme deletion, $t(159) = 2.48, p < .05$. The same correlation between English and Cantonese final phoneme deletion was significantly stronger than the correlation between Cantonese final phoneme deletion and

English rhyme oddity, $t(159) = 2.24, p < .05$. However, the English-Cantonese final phoneme deletion correlation did not significantly differ from the correlation between Cantonese final phoneme deletion and English initial phoneme deletion, $t(159) = -1.15, p = .252$.

Overall, the cross-language correlations of the same kind of measures were significantly stronger than the cross-language correlations between different kinds of measures. The items across the English and Cantonese versions of each measure were closely related. The findings lent support to Hypothesis 2 that both language versions of each phonological measure were comparable.

Summary of the findings

The results of CFA have shown that the three phonological measures were consistent with the theoretical three-factor structure. Each factor identified by CFA corresponded exactly to each of the three phonological measures. The results of the correlations between the measures within and across the languages also revealed that the English version and the Cantonese version of each measure were closely related, suggesting that the measures were comparable across languages.

Discussion

The newly developed phonological measures have been evaluated. Two major findings were obtained in this study. First, children's scores in the English measures and the Cantonese measures both fitted a three-factor model well using CFA. Each factor in the model corresponded exactly to each of the three phonological measures in each language, namely rhyme oddity, initial phoneme deletion, and final phoneme deletion. The findings supported Hypothesis 1 that the phonological measures are consistent with the theoretical structure based on the adapted model of Guilford's (1967) theory. According to the adapted model, three phonological measures were designed to assess children's awareness of rimes, intimal phonemes, and final phonemes. The data from both the English measures and Cantonese measures showed that the newly developed measures assessed exactly the three kinds of phonological awareness. The findings provide evidence that the phonological measures developed in this study were adequate to assess children's phonological awareness in various linguistic units using consistent cognitive operations.

Second, the correlations between the English version and the Cantonese version of each measure were significantly stronger than any other cross-language correlations between any two different measures. For example, the correlation between the English rhyme oddity task and the Cantonese rhyme oddity task was significantly stronger than the correlation between the English rhyme oddity task and Cantonese initial phoneme deletion task. Hypothesis 2 was to show whether the English version and the Cantonese version of each measure are comparable to each other. The results lend support to Hypothesis 2 because the cross-language correlations between the same kind of measure were significantly stronger than other cross-language correlations between any two other measures. The results suggest that the phonological measures have a comparable structure across the English and Cantonese

versions. The findings provide evidence that the phonological measures in this study are adequate to measure children's phonological awareness in English and Cantonese in parallel.

In this study, the phonological measures were designed to be comparable across English and Cantonese, based on a variety of theories of psychometrics and phonology of English and Cantonese. The findings clearly demonstrate that the newly developed phonological measures have adequate psychometric properties. Most importantly, the measures can be considered comparable across English and Cantonese. Comparable measures are the prerequisite for studying the transfer of phonological awareness. Without comparable measures, it will be difficult to observe the transfer of phonological awareness because the measurement of phonological awareness in each language is based on a different scale. Given the newly developed phonological measures, it is now possible to study the transfer of phonological awareness between English and Cantonese in Study 2 and other future studies.

The processes of developing comparable phonological measures can also provide useful insights into the development of comparable phonological measures between two other languages. Particularly, Guilford's (1967) adapted model can provide a useful framework for researchers to pay attention to the dimensions of cognitive operations and linguistic units for designing developmentally appropriate phonological measures. The detailed comparison in phonology between English and Cantonese can offer a template to cater for the differences specific to any other two languages. These differences are valuable to constructing comparable items across languages through matching the items across languages in terms of the syllable structure and lexical difficulty.

To conclude, after the thorough design, revision, and evaluation of the measures, this set of phonological measures has demonstrated its adequacy to assess children's phonological awareness in parallel across English and Cantonese. The transfer of phonological awareness

between English and Cantonese can be examined using this set of comparable phonological measures in Study 2.

Study 2: The Interventions of Phonological Awareness Transfer Across Languages

Study 2 aims to investigate if children can transfer their phonological awareness between English and Cantonese. Phonological awareness is the awareness of the internal sound structure of words (Goswami & Bryant, 1990). It has been well established that phonological awareness plays a critical role in the process of learning to read in monolingual children (National Institute for Literacy, 2008). However, little is known about how bilingual children develop their phonological awareness of both languages. Do bilingual children develop the phonological awareness of both languages independently? Alternatively, do bilingual children develop the phonological awareness of one language and then transfer the awareness to another language? There is theoretical and practical significance for investigating whether phonological awareness can transfer across languages. The theoretical significance is that studying the transfer of phonological awareness helps us to understand how bilingual children develop the phonological awareness of both languages, and how phonological awareness supports the process of learning to read. If phonological awareness can transfer across languages, phonological awareness will be a language-general ability across languages. Thus, learning to read in different orthographies could be based on the same phonological ability. If phonological awareness cannot transfer across languages, phonological awareness will be a language-specific ability. Then learning to read in each orthography might be based on a unique phonological ability that is developed specifically for that orthography. Either result can improve our understanding of the role of phonological awareness in the process of learning to read different orthographies. The practical significance is that the transfer allows bilingual children to develop phonological awareness in their first language (L1) and transfer the skill to their second language (L2). Educators can arrange programmes for bilingual children to start developing the phonological awareness in L1 and readily transfer the awareness to L2. These programmes can help bilingual children

develop their phonological awareness in L2 easier and faster because no re-learning is required, potentially benefiting billions of children who live with two languages or more (Grosjean, 2010).

This study begins with a literature review of the transfer of phonological awareness across languages. The review includes an introduction of phonological awareness and the key findings of the transfer of phonological awareness across languages. The second section includes a description of the methods for this study in which the participants, design, measures, and interventions are justified. Next in the results section, the strategy for analysing the data is described, before presenting the descriptive statistics and the indices of reliability. After that, the research hypotheses are tested. The findings are critically discussed with reference to the key findings in the literature. Finally, the study is concluded by the limitations and suggestions for future research and teaching practice.

Literature Review

This literature review includes the empirical findings of the transfer of phonological awareness across languages. The review leads to the generation of the hypotheses to be tested in the present study. The first section introduces how children's phonological awareness relates to their reading development. The second section focuses on the two approaches to investigate the transfer of phonological awareness across languages: correlational and training studies. The final section recapitulates the aim and the hypotheses of this study.

Phonological Awareness: An Introduction

Phonological awareness refers to the awareness of the internal sound structure of words (Goswami & Bryant, 1990). Over the past three decades, a wealth of studies have established that phonological awareness plays a critical role in the process of learning to read (Melby-Lervag, Lyster, & Hulme, 2012; National Institute for Literacy, 2008). The

importance of phonological awareness largely lies in its link to word recognition (Goswami & Bryant, 1990; McBride-Chang et al., 2008). Phonological awareness is strongly associated with reading outcomes longitudinally in both native English-speaking children (Torgesen, Wagner, & Rashotte, 1994) and bilingual children learning English as a second language (Chen, Xu, Nguyen, Hong, & Wang, 2010; Lindsey, Manis, & Bailey, 2003).

Different forms of phonological awareness and their developmental sequence have been examined in many different languages. Ziegler and Goswami (2005) conducted an extensive review of phonological awareness across different languages. They concluded that available evidence suggests that children develop a phonological system before learning to read (Ziegler & Goswami, 2005). This phonological system is built on the understanding of large sound units including syllables, onsets, and rimes. An awareness of phonemes, the smallest units of speech, is likely to develop as a consequence of learning to read (Ziegler & Goswami, 2005). The development of phonological awareness across various languages follows a similar hierarchical developmental sequence (Goswami & Bryant, 1990). An awareness of large units emerges first, followed by an awareness of small units, as shown in Figure 10.

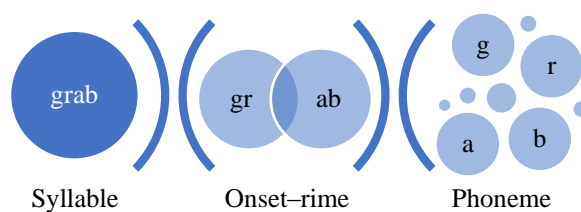


Figure 10 Development of phonological awareness from large units (left) to small units (right)

Prior to reading instruction, syllable awareness usually emerges by the age of three (Anthony & Francis, 2005). An awareness of onsets and rimes is present between the age of three and four (Goswami, 2008). Finally, children become aware of phonemes after they are taught to read in school (Ziegler & Goswami, 2005).

Transfer of Phonological Awareness

The empirical studies of the transfer of phonological awareness are based on two major approaches: correlational and training studies. The review of these empirical studies can help identify the gap in the literature and the methodological problems about the parallel assessment of phonological awareness across languages.

Correlational Studies

Correlational studies assume that if phonological awareness has transferred across languages, children's phonological performance across languages should show strong concurrent and predictive relations. The logic is that when children transfer phonological awareness across languages, they should have abstracted the general skills of manipulating sound units. This general underlying ability can be reflected by the strong correlations between the phonological measures across the languages. These studies usually include controls for extraneous variables that might be related to children's progress in literacy (e.g. vocabulary) and general cognitive abilities (e.g. intelligence). Such controls are necessary because the phonological measures of two languages can correlate each other via their shared relation with some third variables that are unrelated to phonological awareness, such as nonverbal intelligence. The merit of correlational studies is that they can demonstrate the relations between two phonological measures in different languages (Bradley & Bryant, 1983). When a definite relation does exist between two phonological measures in different languages, one can proceed to check if such relation is a causal one (Bradley & Bryant, 1983). Thus, correlational studies still provide valuable information about the cross-language relations of phonological awareness, although this approach cannot establish a cause-effect relation between two phonological measures in different languages (Wagner & Torgesen, 1987).

To test if phonological measures in different languages strongly correlate each other, López and Greenfield (2004) assessed 100 Spanish-speaking children at age four using rhyme oddity tasks and initial phoneme oddity tasks in English and Spanish. The phonological measures were specifically designed by López and Greenfield (2004) to assess children's phonological awareness of English and Spanish in parallel. After controlling for receptive vocabulary, expressive vocabulary, listening comprehension, and morphological awareness in both English and Spanish, children's Spanish phonological composite score still explained 6.1% of the unique variance in the English phonological composite score. The results provide strong evidence that phonological awareness is closely related between Spanish and English because a number of variables were controlled in the regression model and the phonological measures were comparable between English and Spanish. A major limitation of López and Greenfield (2004) is that the scores of the rhyme and initial phoneme tasks were aggregated to form a composite score. It is difficult to determine how phonological awareness in different languages is related at subsyllable (onset-rime) or phoneme levels.

To examine the cross-language relations at phoneme level, Atwill, Blanchard, Gorin, and Burstein (2007) administered two phoneme tasks in English and Spanish to 68 Spanish-speaking children at age five. The two tasks were initial phoneme recognition and phoneme segmentation tasks. The English and Spanish versions of the phonological tasks were developed to be comparable to each other. After controlling for receptive vocabulary in English and Spanish, the Spanish initial phoneme recognition task contributed 7.0% of the unique variance to the English initial phoneme recognition task. Similarly, the Spanish phoneme segmentation task explained 32.0% of the unique variance in the English phoneme segmentation task. The results demonstrated that children's phonological awareness at phoneme level was closely related between Spanish and English. An interesting finding was that although both tasks measured children's awareness of phonemes, the cross-language

relation between the segmentation tasks was much stronger than that between the recognition tasks. A possible explanation was that the segmentation tasks entailed retaining the phonemes in memory while identifying each phoneme. Thus, the cross-language relation between the segmentation tasks was large to reflect the fact that the segmentation tasks were related not only via their shared relation with phonological awareness, but also via other cognitive abilities such as working memory.

Research has also examined how phonological awareness is related between languages with disparate forms of phonology such as between English and Cantonese (e.g., Bialystok, McBride-Chang, et al., 2005; Cheung et al., 2010). Cheung et al. (2010) measured the phonological awareness of 141 Cantonese-speaking children aged between five and nine using a syllable deletion task and an initial phoneme deletion task in English and Cantonese. The English and Cantonese measures were not comparable at all. For example, there were 15 real word items and 14 nonword items in the Cantonese syllable task, whereas there were 8 real word items and 8 nonword items in the English syllable task. The results showed that the Cantonese phonological composite scores strongly correlated with the English phonological composite scores ($r = .58, p < .001$), after controlling for the age and nonverbal intelligence. The strong correlation suggested that phonological awareness was closely related between English and Cantonese, even if both languages are vastly different from each other in phonology. The finding was consistent with those of studies examining languages with relatively close phonology such as between English and Spanish (e.g., Atwill et al., 2007; López & Greenfield, 2004). The study had a similar limitation as López and Greenfield (2004) that composite scores were used to aggregate the scores of the syllable deletion task and initial phoneme deletion task. It is difficult to determine how phonological awareness was related between English and Cantonese at syllable and phoneme levels. The lack of

comparable measures between English and Cantonese also undermined the rigour of the study.

Bialystok, McBride-Chang, et al. (2005) were interested in exploring whether the cross-language relations varied with different bilingual profiles and age, even the children spoke the same two languages. Bialystok, McBride-Chang, et al. (2005) administered a syllable deletion task and an initial phoneme deletion task in English and Cantonese to 140 bilingual children speaking Cantonese and English. Half of the children were Hong Kong Cantonese-English bilinguals and the other half were Canadian English-Cantonese bilinguals. Within each group, half of the children were kindergarteners aged at five and the other half were first graders at age six. The phonological measures were designed to be comparable between English and Cantonese. For the Hong Kong kindergarteners, the English syllable task significantly correlated with the Cantonese syllable task at $r = .65$ and the phoneme tasks also correlated significantly at $r = .86$, both after the receptive vocabulary of English and Cantonese was controlled for. For the Hong Kong first graders, the cross-language correlation between the syllable tasks was $r = .83$ and the cross-language correlation between the phoneme tasks was $r = .55$, after controlling for the receptive vocabulary in English and Cantonese. For the Canadian kindergarteners, the English syllable task significantly correlated with the Cantonese syllable task at $r = .54$ whereas the phoneme tasks between English and Cantonese significantly correlated at $r = .52$. For the first graders, the English and Cantonese syllable tasks significantly correlated at $r = .68$ whereas the phoneme tasks between the languages correlated at $r = .67$. To sum up, strong and significant cross-language correlations were found in different bilingual profiles (Hong Kong Cantonese-English bilinguals and Canadian English-Cantonese bilinguals), different age groups (kindergarteners and first graders), as well as at different levels of linguistic units (syllable and phoneme). Although the study did not offer sufficient information to compare the correlations, the

results were sufficient to indicate that phonological awareness in English and Cantonese was closely related at syllable and phoneme levels for bilingual children speaking English and Cantonese.

In summary, correlational studies have provided evidence that phonological awareness is closely associated across languages at syllable, subsyllable (onset-rime), and phoneme levels. A definite relation does exist between the phonological awareness of two languages. The strong associations across languages can be affected by a number of factors, including cognitive operations of the tasks, linguistic units being manipulated, age, and bilingual profiles. A major limitation of correlational studies is that the correlations between the two phonological measures in different languages may derive from their relations to a third variable rather than the transfer of learning across languages. Controlling for all the possible 'third variables' is impossible in reality. Thus, the findings from the correlational studies should not be interpreted as direct evidence of the transfer of phonological awareness.

Training Studies

Training studies manipulate the provision of phonological awareness training. In a training study, the training group is given phonological awareness training in a language whereas the control group is given unrelated training that does not relate phonological awareness. The phonological training gives the training group a clear advantage over the control group. Thus, the training group should outperform the control group in phonological tasks of the language in which phonological awareness was taught. The learning of the phonological awareness from that language can then transfer to another language. Training studies assume that if phonological awareness is a general ability that can transfer across languages, the training group should also outperform the control group in phonological tasks of another language. This cross-language outperformance can offer direct evidence of the transfer of phonological awareness.

Before the transfer of learning occurs, it is essential to investigate the learning of the phonological awareness in the language in which phonological was taught. Research has widely investigated the effect of phonological awareness training on the phonological awareness of the same language used in training. Meta-analyses have revealed that English phonological awareness interventions were effective to improve English phonological awareness (Bus & van Ijzendoorn, 1999; Melby-Lervag et al., 2012; National Institute for Literacy, 2008). These phonological interventions yielded a large effect on phonological measures on average, ranging from $d = .73$ to $.87$ (Bus & van Ijzendoorn, 1999; Melby-Lervag et al., 2012; National Institute for Literacy, 2008). The training was particularly effective when phonological awareness was taught in certain ways. For example, National Institute for Literacy (2008) reported that interventions that concentrated specifically on phonological awareness yielded larger effects than those involving a range of foci. Studies with rigorous randomised control trial design tended to yield larger effects than those with less rigorous quasi-experimental design (Bus & van Ijzendoorn, 1999; National Institute for Literacy, 2008).

While there is no shortage of phonological interventions that focus on improving the phonological awareness of the language that is taught in training, whether this learning can transfer to another language is not widely studied. Few training studies of the transfer of phonological awareness are available to date.

Farver, Lonigan, and Eppe (2009) conducted a randomised control trial to study the transfer of phonological awareness from L2 (English) to L1 (Spanish) in 63 Spanish-speaking four-year-olds. These children are English language learners enrolled in a Head Start preschool programme in Los Angeles. The children were randomly assigned to a control group ($n = 32$) that received their regular English-Spanish bilingual instruction, or a training group ($n = 31$) that received English phonological awareness training in addition to the

regular English-Spanish bilingual instruction. The regular English-Spanish bilingual instruction aimed to improve children's language development in both English and Spanish. The English phonological training focused on children's oral language and emergent literacy. The phonological training entailed activities of dialogic reading, phonological awareness, and print knowledge. Particularly, the phonological training used word games to teach children to recognise that words are made up of individual units of sounds. The phonological training focused on the awareness of large linguistic units (syllables and rimes) and progressed to small linguistic units (phonemes). The intervention was delivered by trainers in small groups of four to five children for 20 minutes, four times a week over the course of 21 weeks. The children were pre- and post-tested by deletion tasks and blending tasks which assessed the awareness of syllables and phonemes in English and Spanish. The deletion tasks were comparable between English and Spanish, but the blending tasks were not comparable between the two languages. In the English blending task, there were 9 multiple-choice items and 12 open-end items. In the Spanish blending task, there were 9 multiple-choice items and 9 open-end items. The results showed that the English training group had significantly higher improvement in the English phonological tasks than did the children in the control group. However, the improvement in the Spanish tasks was not significantly different between the English training group and the control group. Children who received English training did not outperform their control group peers in the Spanish phonological tasks, despite the intensity of the intervention. The findings suggested that the English literacy training improved children's English phonological awareness, but such learning did not transfer to Spanish phonological awareness. The mixed training outcomes could be attributed to two reasons. First, the intervention had too many foci where English phonological awareness was taught along with dialogic reading and print knowledge. The intervention would have worked better if phonological awareness was the only focus. Second, the English and Spanish measures

were not comparable so that the measures might have failed to capture the transfer of phonological awareness from English to Spanish. The Spanish blending task had three fewer open-end items than the English task. Children might have had three fewer chances to demonstrate their transfer of learning from the English phonological training. This might explain why children showed an improvement in English phonological awareness, but not in Spanish phonological awareness. Children might have transferred their learning from English to Spanish, but the Spanish measure was not as sensitive as the English measure to capture the transfer of learning.

Training studies have also examined the transfer of phonological awareness between English and Mandarin. Chen et al. (2010) conducted a two-year training study following 159 Mandarin-English six-year-olds recruited from two sister schools. Both schools offered the same Chinese instruction in which the romanisation system for Chinese characters named Pinyin was taught to all children. Using quasi-experimental design, 79 children from the first school received an intensive English intervention whereas 80 children from the second school received regular English instruction. The intensive English intervention offered 10 hours of English instruction every week by school teachers, in addition to the regular English instruction. Every day there was a 40-minute session and three to four 20-minute sessions. The intensive English intervention did not involve phonological awareness training at all. Children watched recorded English TV programmes and imitated, practised, and carried out prescribed group activities in English. Children's phonological awareness was assessed by rhyme oddity, initial phoneme oddity, and final phoneme oddity tasks in Mandarin and English five times over the two-year span. The English and the Mandarin measures were designed to be parallel by the researchers. Given that both groups performed comparably before the training, analyses revealed that the intensive English training group outperformed the control group in all the English phonological tasks over the years. Children in the

intensive English programme also outperformed the control group in all the Mandarin phonological tasks. Although the English intervention appeared to improve children's Mandarin phonological awareness at subsyllable and phoneme levels, the finding was not conclusive. The major weakness of this study is that the intensive English programme, which was the manipulation of the independent variable, did not involve phonological awareness training at all. The actual phonological training in this study was the teaching of Pinyin, the standard system of Roman spelling in Chinese characters. The teaching of Pinyin indeed acted as phonological training in Mandarin. The problem was that Pinyin was taught to every child in the study, so there was no manipulation of the independent variable at all. Children in the intensive English programme and the control group were all expected to have improvements in Mandarin phonological awareness because they were taught Pinyin over the years. It was possible that the learning of Mandarin phonological awareness from Pinyin might have transferred to English, but there was no way to investigate this possibility. Another weakness of the study is about the quasi-experimental design. The intervention group and the control group were not equivalent. Children of the intervention group and the control group came from two different schools. Despite the fact that both groups had a similar onset of phonological awareness of Mandarin and English, the intervention group might have had better Chinese instruction at their school than the control group who came from another school. Thus, the intervention group might outperform the control group because of the school effect rather than the transfer of phonological awareness between English and Mandarin.

Research has also examined the bidirectional transfer of phonological awareness between L1 and L2. Vaughn et al. (2006) conducted two training studies to examine the bidirectional transfer of phonological awareness between Spanish and English. In the Spanish study, 80 Spanish-speaking first graders were randomly assigned to the Spanish intervention

group ($n = 35$) or control group ($n = 45$). Children in the Spanish intervention group received an integrated Spanish literacy programme that covered letter-sound knowledge, phonemic awareness, word recognition, fluency, and comprehension strategies. In the English study, 91 Spanish-speaking first graders were randomly assigned to the English intervention group ($n = 43$) or control group ($n = 48$). The English intervention offered an integrated English programme that entailed phonemic awareness, letter knowledge, word recognition, connected text fluency, and comprehension strategies. The interventions offered in the Spanish and English studies were delivered by trainers in small groups of 3 to 5 children for 50 minutes every day, five days a week over the course of 7 months. Both interventions were provided in addition to the everyday reading instruction at school. Children in both studies were administered a pair of comparable phonological measures in English and Spanish. The phonological measures were Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999) and its Spanish equivalent Test of Phonological Processing in Spanish (TOPPS, Francis et al., 2001). Both phonological measures comprised subtests that assessed children's phonological awareness at phoneme level using a variety of cognitive operations including deleting, blending, segmenting, and matching. A composite score was created for each language from the subtest scores. The results of the Spanish study showed that the Spanish intervention group significantly outperformed its control group on both the Spanish and the English phonological awareness composite scores. This finding suggested that the learning of phonological awareness in Spanish has transferred to the English in the Spanish study. However, in the English study, the English intervention group only outperformed its control group on the English measures, but not on the Spanish phonological measures. The Spanish study provided evidence that phonological awareness could transfer from L1 (Spanish) to L2 (English) at phoneme level, but the English study could not provide any evidence that phonological awareness could also transfer from L2 to

L1. Vaughn et al. (2006) pointed out that the Spanish and the English interventions were ‘different in terms of the sequence and focus of instructional content’ (p. 460). It was possible that the English intervention group did not outperform its control group because the English intervention they received was not as effective as the Spanish intervention.

Contrary to the multi-foci phonological training which often yielded mixed findings, Rao (2014) set up a training study dedicated to phonological awareness training. The study aimed to investigate the effect of training Hindi phonological awareness on kindergarteners’ English phonological awareness. Fifty-eight Indian four-year-olds were randomly assigned to receive Hindi phonological awareness training ($n = 30$) or Hindi print concepts training serving as an active control ($n = 28$). Both groups received four thirty-minute sessions individually. Before and after the interventions, all children were assessed on Hindi and English phonological awareness using rhyme oddity, initial phoneme oddity, and initial phoneme substitution tasks. In the Hindi phonological intervention which was based on Nunes, Bryant, and Olsson (2003), each child was taught to manipulate Hindi initial phonemes and final phonemes using identification tasks, deletion tasks, and Spoonerisms tasks. In the identification task, the child was taught to identify a syllable that began with the target phoneme from three syllables with different initial phonemes. In the deletion tasks, the child was taught to drop the initial phoneme or the final phoneme from a monosyllable. In the Spoonerisms tasks, the child was taught to swap the initial phonemes or the final phonemes of two syllables. In the Hindi print concept training which was based on Clay (1979), the child was taught to pay attention to the structure and organisation of the Devanagari print. The teaching covered concepts such as book orientation, punctuation, as well as the understanding of the sentences, words, and the constituents of Devanagari words. The mixed-design analysis of variance revealed that the Hindi phonological training group improved significantly more than the print concepts control group in both Hindi and English

phonological awareness. The finding provided strong evidence that children's phonological awareness can transfer from L1 (Hindi) to L2 (English). The positive outcomes can be attributed to the focused approach to training phonological awareness. A critique of this study was that some of the assessment tasks were too similar to the training tasks. For example, the phoneme substitution task in the assessment involved children replacing the initial phoneme of a syllable with a target phoneme. This substitution assessment task was similar to the Spoonerisms task in the phonological training in which the initial phonemes of two syllables were replaced by each other. There might be a situation of 'teaching to the test' that the children were prepared to pass the phonological tests without grasping the concepts of phonological awareness.

In summary, few training studies have investigated the transfer of phonological awareness across languages. The outcomes of the cross-language interventions were mixed. On the one hand, Chen et al. (2010) successfully demonstrated that phonological awareness could transfer from L2 (English) to L1 (Mandarin) at subsyllable and phoneme levels. Rao (2014) also demonstrated that phonological awareness could also transfer from L1 (Hindi) to L2 (English) at phoneme level. On the other hand, Farver et al. (2009) failed to show that phonological awareness can transfer from English (L2) to Spanish (L1). The two-way research of Vaughn et al. (2006) only demonstrated the transfer from Spanish (L1) to English (L2), but not from English (L2) to Spanish (L1). Much evidence from training studies is needed.

The mixed cross-language training effect could be attributed to three reasons. First, the phonological training might not be sufficiently effective to elicit improvement in another language that was not taught in training, although these phonological interventions were very effective to improve the phonological awareness of the same language used in training. Often these training studies offered phonological training along with other literacy training (Chen et

al., 2010; Farver et al., 2009; Vaughn et al., 2006). The training offered by these studies might have had too many foci and efforts were not channelled to phonological training.

The second explanation is that the phonological measures used across languages were not comparable. For example, when the Spanish measure was unfavourable in the study of Farver et al. (2009), it would be more difficult for children to show their improvement in Spanish phonological awareness. Thus, the transfer of phonological awareness might not be found simply because the Spanish measure was more difficult than the English measure.

The third explanation is about the design of the training studies. Training studies with quasi-experimental design offered limited evidence about the transfer of phonological awareness. For example, although Chen et al. (2010) demonstrated that children who received English phonological training outperformed the control group in the Mandarin measures, the outperformance could be explained by other alternatives. For instance, the differences between the intervention group and the control group before the interventions can always confound the positive outcomes. If a group of children come from a better school or more privileged family background, it is likely that these children will have larger gain in phonological awareness than the other groups. The outperformance of the intervention group could be a result of the between-group differences, instead of the transfer of phonological awareness.

The Present Study

There are gaps in the literature about the transfer of phonological awareness. The first gap is that there is a lack of comparable measures to assess children's phonological awareness of English and Cantonese in parallel. Without comparable measures, the measurement in each language will become inconsistent, thus obscuring the transfer of phonological awareness across languages. This gap has been addressed by Study 1 where a

set of phonological measures were developed to be comparable between English and Cantonese.

The literature gap needed to address here is the lack of training studies examining the bidirectional transfer of phonological awareness across languages. As a transfer of learning is to share the underlying skill in the two contexts, the transfer of phonological awareness should be bidirectional and at various levels of linguistic units (Judd, 1908). No study so far has investigated whether phonological awareness can transfer bidirectionally between L1 and L2 at various levels of linguistic units (e.g. subsyllable and phoneme levels). This study addresses this gap. Two hypotheses are formulated as follows.

Hypothesis 3: Training English phonological awareness leads to a greater gain in Cantonese phonological awareness when compared to the control group.

Hypothesis 4: Training Cantonese phonological awareness leads to a greater gain in English phonological awareness when compared to the control group

Methods

The study begins by describing the participants. In the second section, the design of this study is explained. The third section presents the measures. Finally, the interventions are described.

Participants

Participants were 162 (85 boys, 77 girls) Hong Kong Chinese children. The children's mean age was 68.64 months ($SD = 4.68$ months). All children are native Cantonese speakers and have been learning English from the age of three at kindergarten. They are normally developing children with no special education needs (SEN). These children were recruited from six kindergartens run by a major charity in Hong Kong. A consent form was sent to the charity running the kindergartens. After obtaining the consent of the charity and the head teachers, parents were given a consent form and an information pack explaining the study. There was a loss of two participants (1.22%) because they did not complete any posttest due to sickness. The two children were excluded from the 162 participants because there was insufficient information to determine the improvements of their respective training. The exclusion of the participants complied with the international guidelines of intention-to-treat research (Lewis, 1999).

Cantonese-speaking Hong Kong children at age five were chosen because it was the optimal age for investigating the development of phonological awareness. Children at that age are developing their awareness of onset-rime in English and in Cantonese. Their performance in onset-rime tasks in English and Cantonese was correct in about 60% of the trials (Ho & Bryant, 1997a). Phonemic awareness also starts to emerge at this age. Their performance in phoneme tasks were between 2% and 14% correct (Bialystok, McBride-Chang, et al., 2005; Luk & Bialystok, 2008; McBride-Chang et al., 2004; McBride-Chang et al., 2006). Thus offering phonological awareness training to five-year-olds in Hong Kong was

both developmentally and practically appropriate. It was developmentally suitable to train five-year-olds awareness of onset-rime and phonemes because they were still developing the awareness of both. For younger children, phonemic awareness might have been too challenging, and the intervention would have limited success, if any. For older children, the awareness of onset-rime might have been fully developed, and the beginning of the intervention would be of reduced importance, as it would offer simply more practice on a skill already present to a large extent. The age of five was the optimal age for training onset-rime and phonemic awareness. Practically, it is appropriate to teach children the skills that are still developing. At the age of five, children were developing the awareness of onset-rime and phonemes. They could benefit from the phonological training of the present study so that their phonological awareness can develop sooner than that of the peers in the control group.

Design

Outline of the design. The present study has a randomised control trial design with pretest and posttest assessments, which has been set out in Figure 11.

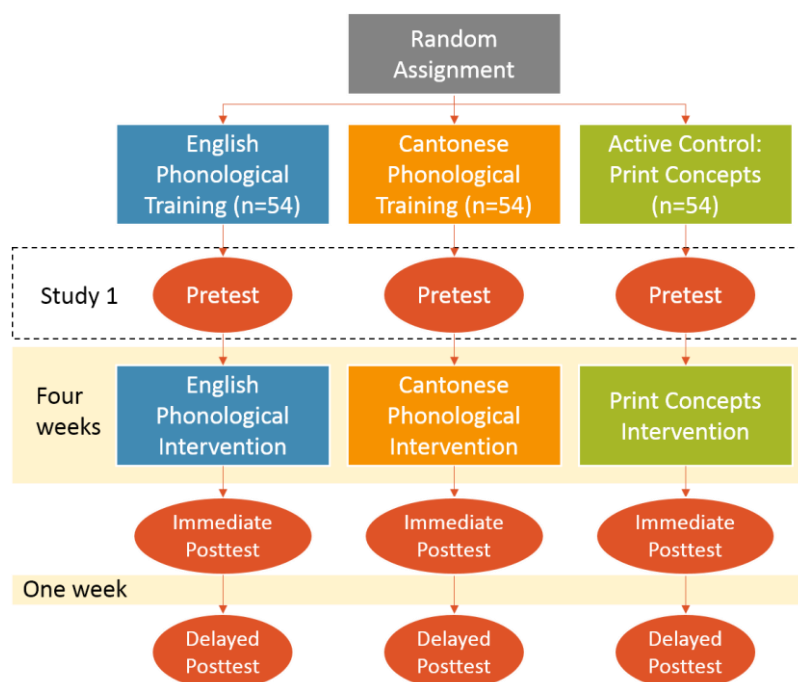


Figure 11 Design of the present study

First, the children were randomly assigned to one of the three experimental groups: English phonological training, Cantonese phonological training, and an active control of print concepts. The randomisation was done at the individual level within the classroom by using random numbers. Each child was given a random number generated by IBM SPSS version 23. The random numbers were generated from the standard uniform distribution, creating a range of random values between 0 and 1 with the expected mean of 0.5 and the expected variance of 0.0833. Then, all children were ranked according to their assigned random numbers in ascending order. The first one-third of the children were assigned to the English phonological awareness training. The next one-third of the children were assigned to the Cantonese phonological awareness training. The final one-third of the children were assigned to the active control of print concepts.

Next, children's English and Cantonese phonological awareness was pretested by the phonological awareness measures developed in Study 1, namely rhyme oddity, initial phoneme deletion, and final phoneme deletion tasks. All tests were administered individually in a single session in 15 minutes using Cantonese which is the first language of the children. Half of the children completed the English measures followed by the Cantonese measures, and the other half completed the Cantonese measures prior to the English measures. All children were also given the print concept measure at the pretest. The pretest scores were used to evaluate the phonological measures in Study 1.

Next, each child received the assigned individual intervention, for which children would be analysed according to the condition they were assigned even if they did not complete the assigned intervention. Each intervention lasted for four consecutive weeks. In total eight individual training sessions were provided to each child. Two training sessions were arranged per week, and each session lasted for around 15 minutes.

Soon after the end of the intervention, all the children were posttested on the same set of phonological awareness tasks and print concept task used at pretest. This posttest was labelled as ‘immediate posttest’ that measured the progress made by the three groups as a result of the different kinds of intervention they received. The order of administering the English and Cantonese measures was counterbalanced. The order of administering the measures was reversed at the posttest in which those who took Cantonese measures first at pretest were given English measures first at immediate posttest.

One week after the immediate posttest, the children were given a ‘delayed posttest’ that was as same as the pretest and immediate posttest, except that the print concepts task was not given. The delayed posttest aimed to test how well children retained the phonological skills after they had been taught about it.

Rationale of the design. The present study was designed with great care using high scientific standards: random assignment to conditions with pretest and posttest assessments, the training and assessment procedures described in detail, control groups exposed to appropriate experiences, and relatively large samples of homogeneous participants.

Children were randomly assigned to the conditions so that the confounding between-group differences such as socioeconomic status could be minimised across groups. Because randomisation in reality is not always perfect, there would be pre-existing differences between groups. Thus, the pretest and posttest assessments were used to strengthen the randomised design. The pretest-posttest design allowed the researcher to take into account the pretest scores that might have been influenced by the confounding between-group differences. The groups would be compared using the differences between the pretest and posttest scores, rather than using the posttest scores only.

A number of precautions were taken to minimise potential biases of the researcher and participants in training and assessments. First, written procedures for the assessment

(Appendix 1) and training (Appendix 2) were implemented throughout the study. The researcher who was also the assessor must follow the written procedures to deliver the interventions and conduct the assessment in a standardised manner. The detailed procedures helped minimise the intentional or subconscious bias of the researcher who might show favour to the phonological training groups to demonstrate the transfer of phonological awareness. Second, the assignment of the interventions was masked from the participating children (i.e. the children were blinded) so that the children's improvement in the phonological awareness was not influenced by children's preferences or expectations of the intervention they received. The risk of contamination among the experimental conditions was low because these children were trained by the researcher who delivered the training strictly according to the training manual.

The control group was an active control offering print concepts training. The control group children received exactly the same amount of instruction as the children in the English and Cantonese phonological training groups but were taught about skills that were entirely different from phonological awareness. The use of an active control can minimise the Hawthorne effect that the new experience of being research participants might lead to temporary improvements in phonological awareness (Ehri et al., 2001; Troia, 1999). There is strong evidence that phonological awareness and print concepts are two separate constructs in children's early literacy (Sénéchal & LeFevre, 2002). Both phonological awareness and print concepts are metalinguistic knowledge, but the former focuses on the ability to manipulate the spoken words whereas the latter focuses on children's developing notions about the functions and conventions of written words (Clay, 1979). Research has shown that print concepts play a role in literacy development because they are related to letter discrimination ability (Lomax & McGee, 1987; National Institute for Literacy, 2008; Sénéchal & LeFevre, 2002). Thus, print concepts training served as an excellent active control because it offered

literacy training without involving phonological awareness. The detail of the print concepts training will be described separately in the ‘Interventions’ section.

The sample size of each group exceeds the sample size estimated by priori sample size calculation. Meta-analyses have reported that the effect sizes of phonological awareness training in studies using randomised control trial design ranged from $d = .73$ to $.87$ (Bus & van Ijzendoorn, 1999; Ehri et al., 2001; National Institute for Literacy, 2008). A priori sample size calculation was computed by G*Power 3.1.9.2 with the stringent parameters: the effect size of $.73$ (the lowest effect size reported in meta-analyses), power equal to $.95$, an alpha level at $.05$, and two-tailed p -value. The result suggested that there should be at least 50 participants in each group and 150 participants in the total sample. In the present study, there were 54 participants in each group and 162 children in the total sample. Thus, the sample size of this study has achieved sufficient power to detect any effects that might exist in the interventions. The manual for the phonological awareness measures is in Appendix 1.

Measures

Phonological awareness measures

Three phonological measures were used for assessing children’s English and Cantonese phonological awareness, namely rhyme oddity, initial phoneme deletion, and final phoneme deletion. Each phonological measure is described in turn. The administration procedures are described first, followed by how items were matched between the English and Cantonese versions of that measure. Noted that these descriptions have been presented in Study 1.

Rhyme oddity. Two practice items and eight testing items were used in each language version. In each item, three real word monosyllables (e.g. ‘cat’, ‘hat’, ‘bell’) were presented as pictures. The child was asked to identify the syllable that did not rhyme with the other two rhyming syllables. One mark was awarded for each correct response. The maximum score

was eight for each language set. The items of the English and Cantonese versions of the rhyme oddity measure are listed in Table 18.

Table 18 Items of the Rhyme Oddity Measure in English and Cantonese

Item	English syllable	Syllabic structure	Cantonese syllable (meaning)	Syllabic structure
Practice	sail nail boot	CVC	ce1(car) ze1(umbrella) faa1(flower)	CV
	bell cat hat	CVC	haa1(shrimp) dou1(knife) bou1(pot)	CV
1.	hay day see	CV	fo2(fire) so2(lock) gau2(dog)	CV
2.	peg cot leg	CVC	hau2(mouth) teoi2(leg) sau2(hand)	CV
3.	fish dish book	CVC	gai1(chicken) gwai1(tortoise) caa1(fork)	CV
4.	cup fan man	CVC	huk1(cry) bat1(pen) gwat1(bone)	CVC
5.	hen car pen	CVC	sing1 (start) zuk1(bamboo) bing1 (ice)	CVC
6.	bun sun tap	CVC	luk6(six) muk6(wood) jyut6(moon)	CVC
7.	paw boat goat	CVC	syut3(snow) gaap3(pigeon) taap3(tower)	CVC
8.	wall dog ball	CVC	haai4(shoe) wan4(cloud) caai4 (firewood)	CV

Note: Answers are in **bold**. C=consonant; V=vowel

The items in the English and Cantonese versions were matched in regard to syllable structure and lexical difficulty as best as possible. All the syllables in the English version and the Cantonese version had CV or CVC structures. Five out of the eight testing items were perfectly matched in regard to syllable structure across the two languages, whereas the remaining three items were not perfectly matched. The reason for the partial matching of syllable structure was that there are insufficient English syllables with a CV structure. Only 4.5% of English syllables have a CV structure (De Cara & Goswami, 2002) whereas 46.4% of Cantonese syllables have a CV structure (Leung et al., 2004). The lexical difficulty of the English and Cantonese syllables matched because they were selected from the comparable lexical list (HKSAR Education Bureau, 2007, 2009).

Initial phoneme Deletion. Two practice items and six testing items were in each language version. A real word monosyllable (e.g. mat /mæt/) was presented as a picture. The child was asked to ‘say it again without the opening bit of sound’. The child should drop the first phoneme (e.g. /m/) and respond with the remaining syllable (e.g. /æt/). One mark was awarded for each correct response. The maximum score was six for each language version.

The test items of the English and Cantonese versions of the initial phoneme deletion task are listed in Table 19.

Table 19 Test Items of the Initial Phoneme Deletion Measure in English and Cantonese

Item	English Syllable	Syllabic structure	Cantonese syllable (meaning)	Syllabic structure
Practice	my /maɪ/ => 'I' /aɪ/	CV	摸 /mo2/ (touch) => 鵝 /o2/ (goose)	CV
	May /meɪ/ => 'A' /eɪ/	CV	米 /mai5/ (rice) => 蟻 /ai5/ (ant)	CV
1.	man /mæn/ => 'Ann' /æn/	CVC	抹 /maat3/ (wipe) => 壓 /aat3/ (press)	CVC
2.	mat /mæt/ => 'at' /æt/	CVC	麵 /min6/ (noodles) => /in6/ (n/a)	CVC
3.	see /si:/ => 'E' /i:/	CV	手 /sau2/ (hand) => 嘔 /au2/ (vomit)	CV
4.	sit /sɪt/ => 'it' /ɪt/	CVC	縮 /suk1/ (shrink) => 屋 /uk1/ (house)	CVC
5.	four /fɔ:(r)/ => /ɔ:(r)/	CV	火 /fo2/ (fire) => 鵝 /o2/ (goose)	CV
6.	far /fɑ:(r)/ => /ɑ:(r)/	CV	花 /faa1/ (flower) => 鴉 /aa1/ (crow)	CV

Note: C=consonant, V= vowels.

The items across the two languages matched in phonological structure and lexical difficulty. The syllable structure of each syllable perfectly matched across the two languages. The target initial phonemes to be deleted also perfectly matched across the two languages. Three initial phonemes /m, s, f/ were deleted in both the English and Cantonese versions because these phonemes are among the 15 consonants shared by both languages (Chan & Li, 2000). The nasal /m/ was deleted in the first two items, followed by the fricative /s/ in the next two items and the fricative /f/ in the last two items. The lexical difficulty of the items also matched across the two languages as the English and Cantonese syllables were selected from the Hong Kong Lexical List (HKSAR Education Bureau, 2007, 2009).

Final Phoneme Deletion. Two practice items and six testing items were set in each language version. A real word monosyllable (e.g. *beef* /bi:f/) was represented as a picture. The child was asked to delete the final phoneme (e.g. /f/) and respond with the remaining syllable (e.g. /bi:/). One mark was awarded for each correct response. The maximum score was six for each language set. The items for the final phoneme deletion measure in English and Cantonese are listed in Table 20.

Table 20 Test Items of the Revised Final Phoneme Deletion Measure in English and Cantonese

Item	English Syllable	Syllabic structure	Cantonese syllable (meaning)	Syllabic structure
Practice	hide /haɪd / => high /haɪ/	CVC	參 /caam1/ (participate) => 叉 /caa1/ (fork)	CV
	need /ni:d/ => knee /ni:/	CVC	三 /saam1/ (three) => 沙 /saa1/ (sand)	CV
1.	team /ti:m/ => tee /ti:/	CVC	尖 /zim1/ (pointy) => 芝 /zi1/ (cheese)	CVC
2.	bean /bi:n/ => bee /bi:/	CVC	山 /saan1/ (mountain) => 沙 /saa1/ (sand)	CVC
3.	song /sɔ:ŋ/ => saw /sɔ:/	CVC	釘 /deng1/ (spike) => 爹 /de1/ (grandpa)	CVC
4.	beef /bi:f/ => bee /bi:/	CVC	闊 /fut3/ (wide) => 富 /fu3/ (rich)	CVC
5.	bowl /bəʊl/ => bow /bəʊ/	CVC	葉 /jip6/ (leaves) => 二 /ji6/ (two)	CVC
6.	pour /pɔ:r/ => paw /pɔ:/	CVC	畫 /waak6/ (draw) => 話 /waa6/ (speak)	CVC

Note: C=consonant, V= vowels.

All items in the English and Cantonese versions matched in syllable structure and lexical difficulty as best as possible. The syllables in both versions have a CVC structure. The target final phonemes also perfectly matched across the two languages for the first three items (/m, n, ŋ/). The target final phonemes were not matched in the last three items because the results of the pilot test in Study 1 suggested that Cantonese-speaking children were found inherently sensitive to the English final phonemes /t, p, k/. Almost all the children in the pilot test can delete final phonemes /t, p, k/ from English syllables. Cantonese-speaking children might find the English final phonemes /t, p, k/ noticeable because the Cantonese final phonemes /t, p, k/ are barely audible. The lexical difficulty also matched across the two languages as the syllables were selected from the words in the comparable lexical list (HKSAR Education Bureau, 2007, 2009).

In summary, the English and Cantonese versions of each of the three phonological measures were designed to assess phonological awareness at the same level of linguistic unit using the same cognitive operation. Items across the language versions matched in regard to

the phonological structure and lexical difficulty. The findings in Study 1 have shown that the English and Cantonese versions of each measure were comparable to each other.

Print concepts measure

This 24-item test was adopted from Clay's (1979) Concepts about Print Test. This individually administered test assessed children's knowledge of print conventions (e.g. left-right, front-back) and concepts (book cover, author, text) in English text. The child was asked questions about concepts about print while he/she was reading aloud a designated reader with the assessor. The readers were *Stones* (Clay, 1972b) and *Sand* (Clay, 1972a). Ten of the items (1-9 and 11) assessed the knowledge of book-orientation (e.g. front versus back, print versus picture) and print direction concepts (e.g. left-to-right, top-to-bottom, word-by-word reading). The remaining items assessed punctuation, letter concepts, and word concepts (e.g. letter and word orders). One mark was awarded for each correct response. The maximum score was 24. The manual for the concepts about print task is in Appendix 2.

Interventions

Each child received one of the three interventions according to the random assignment. The three interventions were English phonological awareness intervention, Cantonese phonological awareness intervention, and print concepts intervention. The three interventions offered the same amount of instruction: eight individual training sessions that lasted for 15 minutes per session. Two sessions were provided every week for four consecutive weeks. The three interventions were also based on the same theme about the adventure of a puppet cow named 'Little Cow' (Figure 12). The child was asked to help Little Cow solve the mysteries in his adventure.



Figure 12 The hand puppet 'Little Cow'

Phonological awareness interventions.

The phonological awareness interventions aim to promote children's phonological awareness of the target language. The English and Cantonese versions of the phonological interventions were developed. The English version was for the English phonological training group whereas the Cantonese version was for the Cantonese training group. Both versions had exactly the same activities, but the syllables manipulated in each version were in different languages. In the English version, children worked with English syllables. Likewise in the Cantonese version, children worked with Cantonese syllables. The complete training manual for the English and Cantonese phonological interventions is in Appendix 3. Box 1 provides an example that the English and Cantonese versions of an activity are identical, except the syllables manipulated in each version are in different languages.

Syllable Size Ordering

The plot of the activity was that the puppet Little Cow needed to help other three calves to queue for magic snacks.

The researcher showed three pictures representing three words with a different number of syllables in random order. The researcher also said these three words to the child. These words are the names of the calves. The child was asked to help Little Cow to get the calves to queue in the correct order. To get the snacks, the queue must start with the calf whose name contains the fewest syllables, followed by those with more syllables in their names.

There following are two ‘queues’ in the English and Cantonese versions.

English		Cantonese	
Queue 1	Queue 2	Queue 1	Queue 2
bus	milk	syun4 (boat)	gai1 (chicken)
lorry	chicken	fo3 ce1 (train)	ngau4 naai5 (milk)
bicycle	banana	din6 daan1 ce1 (motorbike)	ce1 lei4 zi2 (cherries)

The phonological interventions offered training of phonological awareness across the full spectrum of linguistic units, ranging from syllables to subsyllables (rimes) to phonemes (initial and final phonemes). Covering all levels of phonological awareness was to provoke the full development of phonological awareness for the children. The phonological training started from teaching large linguistic units such as syllables to small units such as subsyllables (rimes) and phonemes. The teaching progressed from syllables to phonemes, which is shown in Figure 13. The sequence of teaching from large to small units was in line with the developmental sequence of phonological awareness in that awareness of syllables emerges before awareness of subsyllables and phonemes (Anthony & Francis, 2005; Goswami, 2008; Goswami & Bryant, 1990).

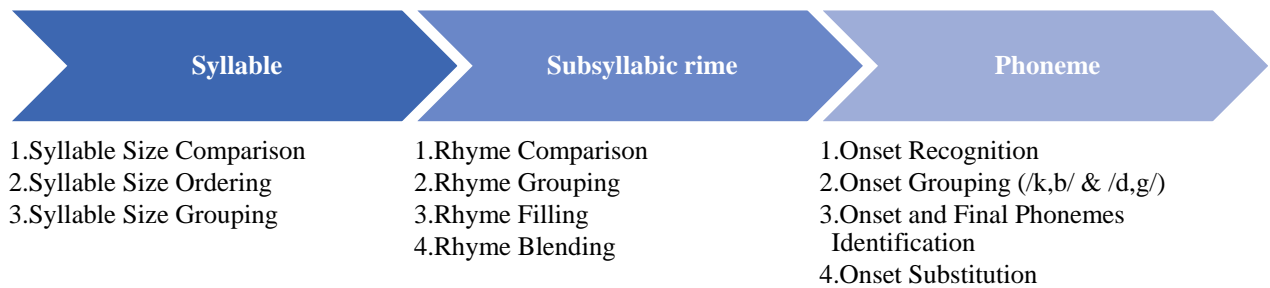


Figure 13 The sequence of training sessions of the phonological interventions

The progression of the phonological training sessions is described as follows. Every child was given the first session of the Syllable module, i.e. Syllable Size Comparison. If a child completes the Syllable Size Comparison session without making any mistake, the child would progress directly to the first session of the Subsyllable module, i.e. Rhyme Comparison. Otherwise, the child would remain in the Syllable module and receive the next two training sessions about syllable awareness (i.e. Syllable Size Ordering and Syllable Size Ordering Grouping). These children would automatically progress to the Subsyllable model after they have completed all three sessions of the Syllable module. If a child can complete the first session of the Subsyllable module without making any mistake, the child would progress directly to the first session of the Phoneme module (i.e. Onset Recognition). Otherwise, the child would remain in the Subsyllable module and complete the next three sessions about awareness of subsyllabic rimes. These children would automatically progress to the Phoneme module after they have completed all four sessions of the Subsyllable module. All children would complete each session of the Phoneme module, regardless of how they progress to the Phoneme module.

The rigour of the phonological interventions was that the interventions were sufficiently distinct from the three phonological measures. The cognitive operations and the phoneme stimuli used in the phonological measures were not re-used in the interventions. This distinction could minimise the risk of obtaining a misleading training effect. Wagner and Torgesen (1987) pointed out that a training effect can be obtained even when the targeted

skill has not been affected by the training, especially when the training activities and the assessment criteria share task characteristics. For example, when both training and assessment are based on the same cognitive operation or manipulate the same set of phonemes, there will be a training effect simply due to children’s familiarity with the assessment task, rather than the training itself.

In the present study, the cognitive operations and phoneme stimuli used in the phonological interventions were completely different from those used in the three phonological measures. The two cognitive operations used in the phonological measures, oddity and deletion, were not used in the phonological interventions. Instead, a wide variety of cognition operations were used in the phonological interventions other than these two operations. Table 21 lists all the operations used in each phonological training session.

Table 21 The cognitive operations used in each phonological training session

Syllable	Operations	Subsyllabic rime	Operations	Phoneme	Operations
1. Syllable Size Comparison	Recognition	1. Rhyme Comparison	Recognition	1. Onset Recognition	Recognition
2. Syllable Size Ordering	Identification	2. Rhyme Grouping	Matching	2. Onset Grouping (/k,b/ & /d,g/)	Matching
3. Syllable Size Grouping	Matching	3. Rhyme Filling	Production	3. Onset and Final Phonemes Identification	Identification
		4. Rhyme Blending	Blending	4. Onset Substitution	Substitution

The phoneme stimuli were also completely different from those used in the three phonological measures. For example, the initial phoneme deletion measure was about deleting the initial phonemes /m, s, f/ from English or Cantonese syllables. The initial phonemes /m, s, f/ and their rimes (e.g. ‘an’, ‘at’, ‘in’, ‘au’) were not used in the phonological interventions. In the phonological interventions, children learned to manipulate the initial phonemes /k, b, d, g/ using recognising, matching, identifying, and substituting operations.

The rimes used in the interventions were also completely different from those used in the phonological measures. Box 2 gives the details of an activity training children’s awareness of initial phonemes using completely different operations and phoneme stimuli than the phonological measures.

Box 2 Initial phoneme pairing

Initial Phoneme (k,b) Pairing

The plot was that the puppet Little Cow needed to deliver goods to different farms. There were two farms: Farm K and Farm B. Little Cow needed to deliver the goods to the correct farms.

The researcher showed 16 pictures representing the ‘goods’ one by one in random order. These pictures represent monosyllables that begin with a /k/ sound or a /b/ sound. If the picture represents the syllable that begins with a /k/ sound, the ‘goods’ should be sent to Farm K. Similarly, if the picture represents a syllable that begins with a /b/ sound, the ‘goods’ should be sent to Farm B. The child was asked to sort the ‘goods’ according to the initial phoneme of the syllable that represented by the picture.

The syllables to be sorted in the English and Cantonese versions are listed as follows.

English Initial Phoneme Training				Cantonese Initial Phoneme Training			
Farm K		Farm B		Farm K		Farm B	
cow	key	bird	bed	kaat1 (card)	kiu4 (bridge)	beng2 (biscuits)	baak3 (hundred)
cup	cook	bag	bun	kat1 (cough)	kap1 (breathe)	baau1 (bun)	bei6 (nose)
cake	cap	bus	bin	kei2 (stand)	kei4 (flag)	bui1 (cup)	bing1 (ice)
cook	cold	ball	bear	kyun4 (fist)	kam4 (panino)	beng6 (sick)	bou6 (notebook)

For the references, the following are the syllables used in the initial phoneme deletion measure. The initial phonemes and rimes are different from those used in training.

English Initial Phoneme Deletion Measure		Cantonese Initial Phoneme Deletion Measure	
man	mat	maat3 (wipe)	min6 (noodles)
see	sit	sau2 (hand)	suk1 (shrink)
four	far	fo2 (fire)	faa1 (flower)

The phonological interventions started with the least demanding cognitive operation. For example, when teaching subsyllable rime awareness, the training began by identifying if two monosyllables rhyme or not. In the next session, the child was asked to group nine monosyllables into three groups according to the rimes of the syllables. The next session prompted the child to choose a rhyming monosyllable from three monosyllables to complete a poem.

Box 3 and Box 4 show the details of these two tasks with increasing difficulty in cognitive operations.


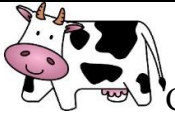
Box 3 Rhyme Comparison (English and Cantonese versions)

Rhyme Comparison

The plot of the task was to help Little Cow to feed the magic calves. These magic calves did not feed on grass. They fed on things that rhyme with their names.

The researcher showed a picture representing the name of a calf (e.g. moon) and said the name to the child. Then the researcher showed three pictures representing three ‘food’ items (e.g. spoon, man, pen) and said the ‘food’ items to the child. One of ‘food’ items (e.g. spoon) rhymes with the calf’s name (e.g. moon). The child was asked to recognise which one of the ‘food’ items rhymes with the calf’s name so that the calf would eat the ‘food’ item. After feeding the calf, the child was asked to feed another calf with a different name with a different set of food items.

Here, as examples, are two calves to be fed in the English and Cantonese versions. Their names and the ‘food’ items are also shown. The rhyming ‘food’ items are underlined.

 Calf 1		 Calf 2			
	English	Cantonese		English	Cantonese
Calf’s name	moon	gail(chicken)	Calf’s name	pan	zoek3 (bird)
Food items	<u>spoon</u> man pen	<u>gwail</u> (tortoise) gul (mushroom) baaul (bun)	Food items	pie <u>can</u> cat	<u>goek3</u> (leg) zin3 (arrow) jyu4 (fish)

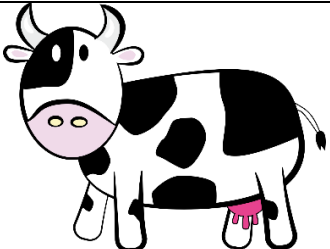
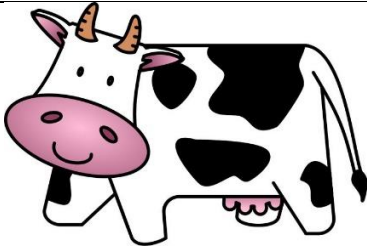
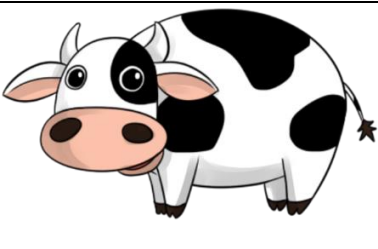
Rhyme Grouping

The plot was to help the puppet Little Cow to feed multiple magic calves at the same time. These magic calves only fed on things that rhyme with their names.

The researcher introduced three calves to be fed to the child by showing three pictures representing the names of the calves. The researcher also said the names of the calves to the child. These names were monosyllabic words such as ‘fun’, ‘dog’, and ‘look’.

Next, the researcher showed six pictures representing the food items (e.g. run, sun, frog, dog, cook, book) in random order. These food items were monosyllables that rhyme with one of the names of the calves. The child was asked to feed these six food items to the three calves at the same time. For example, the calf named ‘fun’ would eat the ‘food’ items ‘run’ and ‘sun’.

The following is an example of the three magic calves to be fed. The ‘food’ items that they would eat are grouped under their names.

						
	English version	Cantonese version	English version	Cantonese version	English version	Cantonese version
Name	fun	tau4 (head)	dog	baau1 (bun)	look	zyu1(pig)
Food	run sun	lau4 (building) ngau4 (cow)	frog log	maau1 (cat) gaau1 (plastic)	cook book	cyu1(chef) syu1(book)

Print Concepts Intervention.

The print concepts training was constructed based on Clay (1979) and the Literacy Continuum (K6) in New South Wales, Australia (NSW Department of Education and Training, 2011). The print concepts training consisted of two elements: the storybooks and the complementary questions to be asked while share-reading the storybooks (Figure 14).

Storybooks	Questions
<ul style="list-style-type: none"> •Happy Birthday Little Cow (English) •A Hungry Little Cow (English) •Hide-and-seek with Little Cow (Chinese) •Where's Little Cow's cakes? (Chinese) 	<ul style="list-style-type: none"> •Book-orientation •Print direction •Punctuation •Letter concepts •Word concepts

Figure 14 The two elements of the print concepts intervention

Four storybooks were specially written by the researcher for the print concepts intervention (Table 22). Half of the storybooks were written in English and other half were written in Chinese. These storybooks were about the adventure of the puppet Little Cow.

Table 22 The four storybooks written for the print concepts intervention

<p>Happy Birthday Little Cow (English)</p>  <p>Brad Chan</p>	<p>A Hungry Little Cow (English)</p>  <p>Brad Chan</p>
<p>Hide-and-seek with Little Cow (Chinese)</p>  <p>麵包哥哥</p>	<p>Where's Little Cow's cakes? (Chinese)</p>  <p>麵包哥哥</p>

The storybooks were based on the readers written by Marie Clay (1979) which were used in identifying children with reading difficulties. In the new storybooks, there were deliberate ‘errors’ throughout the storybooks to prompt children to think about the print concepts. The mistakes included illustrations inverted, text inverted, sentences, words, and letters arranged in wrong order. Table 23 lists some examples of these deliberate ‘errors’ in English, whereas Table 24 lists some of the ‘errors’ in Chinese.

Table 23 Some deliberate errors in the storybook ‘A Hungry Little Cow’

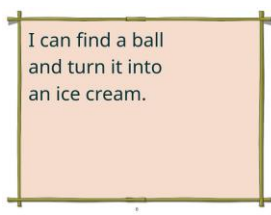

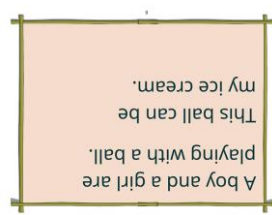

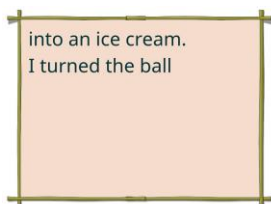

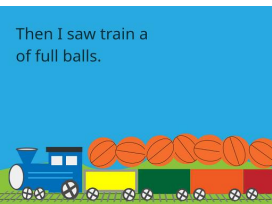
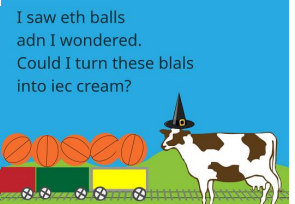


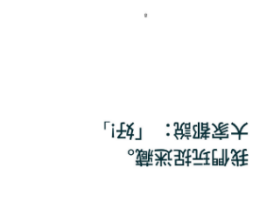

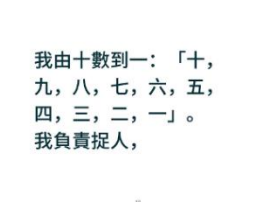



<p>Illustration inverted</p> 		<p>Text inverted</p> 	
<p>Sentences in wrong order</p> 		<p>Words and letters in wrong order</p> 	

Table 24 Some deliberate errors in the storybook ‘Where's Little Cow's cakes?’

<p>Illustration inverted</p> 	<p>Text inverted</p> 	<p>Text inverted</p> 	
<p>Sentences in wrong order</p> 		<p>Chinese characters and radicals in wrong order</p> 	

In the eight training sessions of print concepts, a storybook was read for every two sessions. The storybooks used in each training session are listed in Table 25.

Table 25 The storybooks used in each print concept training session

Session	Storybook
1	Hide-and-peek with Little Cow (Chinese)
2	Hide-and-peek with Little Cow (Chinese)
3	A Hungry Little Cow (English)
4	A Hungry Little Cow (English)
5	Where's Little Cow's cakes? (Chinese)
6	Where's Little Cow's cakes? (Chinese)
7	Happy Birthday Little Cow (English)
8	Happy Birthday Little Cow (English)

For the complementary questions, there were five groups of questions: book-orientation, print direction, punctuation, letter concepts, and word concepts, as shown in Table 26. Each group of questions were asked to promote children to achieve specific sets of training objectives as shown in Table 26.

Table 26 The five modules of the print concepts intervention and the training objectives

Modules	Training objectives
Book-orientation	Identifies writing in a picture or poster. Knows how to handle books, e.g. turns pages, looks at detail in pictures. Shows awareness that print and images are different (in print and on screen). Indicates left to right as the direction for reading in English and Chinese.
Print direction	Shows beginning awareness that print relates to spoken language. Recognises the meaning of some letters and symbols, e.g. Common logos, street signs. Reads left page before right (both English and Chinese). Indicates return sweep to left at the end of a line of text (English and Chinese). Understands that words are read the same way each time. Understands that punctuation support meaning.
Punctuation	Identifies a full stop and knows its purpose. Identifies a sentence. Identifies a comma and knows its purpose. Identifies a question mark and knows its purpose. Identifies quotation marks and knows their purpose. Identifies an exclamation mark and knows its purpose.
Letter/ radical concepts	Identifies one or more capital letters (English) or radicals (Chinese). Identifies a letter (English) or a radical (Chinese) in print. Identifies a capital letter (English only). Identifies the first letter in a word (English) or the left radical (Chinese). Identifies the last letter in a word (English) or the right radical (Chinese). Identifies a number of capital letters (English) or radicals (Chinese). Uses capital letters for names (English only).
Word concepts	Identifies a word in print. Points to the first word to read. Understands that words and the spaces between words contribute to meaning.

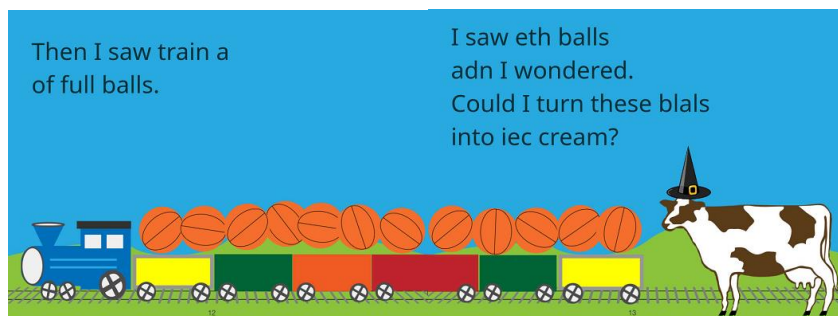
Each session followed the same share-reading routine. The researcher share-read the storybook designated for that session with a child. While reading the storybook, the researcher stopped at a particular page and asked the child questions about the area of focus (e.g. letter concepts) with reference to the storybook, prompting the child to think about what, when, and why certain elements of prints were used (e.g. letter order). The only difference between each session was the kinds of questions asked by the researcher, which depended on the child's progress. The area of focus was Book-orientation for the child, the questions focused on the clues about the orientation of the books such as the orientation of the print and images. All children started with the Book-orientation questions. If the child has achieved all the training objectives of the module, the child would progress to the next module and so on. The training manual for the print concepts intervention is in Appendix 4. Box 5 provides an example of how the storybooks were used to teach the child concepts about letter concepts.

Box 5 Training of letter concepts using the storybook 'A Hungry Little Cow'

Training of letter concepts

The session followed the routine of share-reading. The focus of the session was about letter concepts in English.

The researcher read the page as if there were no errors on the page (e.g. 'I saw the balls and I wondered.'). Then the researcher asked the child 'What's wrong on this page?' while pointing to the page number 13 but not the text. If the child gave the wrong response, the researcher asked follow-up questions prompting the child to pay attention to the letter order. For example, the researcher asked the child to pay attention to the letter order of word 'balls' in the first line and the third line. The child was also asked to look at the letter order of some basic words such as 'the' on sight.



Ethical Considerations

This research was approved by the University of Oxford Central University Research Ethics Committee (CUREC) (Appendix 5). Because the participants were under eighteen years old, the research project was covered by CUREC approved procedure 25. The researcher submitted the CUREC/1A Checklist for the Social Sciences and Humanities describing the rationales for the project, the instruments, the procedures, and any potential risks involved in the research (Appendix 6). Samples of the invitation letter to head teachers (Appendix 7), as well as the information sheet for the parents and the parental consent form (Appendix 8) were submitted along with the CUREC/1A Checklist. The researcher also obtained Sexual Conviction Record Check from Hong Kong Police and was eligible to work with young children.

After the University approved the study, the researcher contacted schools and obtained informed consent from the head teachers and parents before conducting any assessment. The researcher's email address and telephone number were provided in both the invitation letter to head teachers and the information sheet for parents in case they have any enquiry about the study.

A series of cautious procedures were taken to protect students' privacy while drawing samples from students with no special educational needs (SEN). First, all the children, including SEN students, were invited to participate so that no one would feel being excluded. Next, the teachers were asked to screen out SEN students from the consented pool according to the confidential SEN list. The teachers then compiled a list of consented students which excluded SEN and non-consented children for the researcher. Therefore, the privacy and confidentiality of all the children were protected because the researcher did not have access to the confidential list of SEN and non-consented children.

Before the assessments, the researcher also informally obtained consent from the child. The child was briefed about what assessments they would engage and was asked if they were ready for these assessments. Children and parents were told the right to withdraw at any time without any consequence at the very beginning. No child and parent withdrew from this study, and many children appeared to enjoy the tasks.

After the data collection, the test scores were labelled completely anonymous and identified by numbers only. The data collected were kept strictly confidential in a password protected computer file, available only to the researcher and his supervisor. All materials, including the test scripts will be destroyed soon after the end of the research project.

A summary of the findings was given to the schools and parents, but the names of the schools and children would remain anonymous in the research summary and in this thesis.

Results

There are three parts of the analysis. The first part is to present the descriptive statistics and the indices of reliability. The descriptive statistics will help reveal if there was a trend of improvements in phonological awareness after the phonological training, and show why particular statistical tests are chosen for the data.

The second part is to examine the effects of the phonological awareness interventions. There were two kinds of intervention effects: the learning effect and the transfer effect. The learning effect was the learning of phonological awareness in the language in which phonological awareness was taught. The transfer effect was the transfer of the learning of the phonological awareness to another language that was not taught. The learning effect must be established before the transfer effect because the transfer of learning exists only when the learning has occurred.

The third part is about the effect of the print concepts intervention. The print concepts intervention acted as an active control for the English and Cantonese phonological interventions. The effect of the print concepts intervention can demonstrate that the intervention was an appropriate active control for the two phonological interventions respectively.

Descriptive Statistics

The mean scores of each experimental group for each measure are presented in Table 27. From the table, the pretest scores of the three experimental groups were close. The three groups were tested whether they were significantly different from each other before the interventions. The reason was that although children were randomly assigned to one of the three experimental groups, the groups might still have differed at pretest in the English and Cantonese measures.

Table 27 Descriptive Statistics of the Phonological Measures in English And Cantonese by Group

	English phonological training		Cantonese phonological training		Concepts about print control	
	M	SD	M	SD	M	SD
Rhyme oddity (Max = 8)						
English rhyme T ₁	4.46	1.48	4.31	1.54	4.30	1.36
English rhyme T ₂	6.13	1.30	6.00	1.13	4.54	1.61
English rhyme T ₃	6.19	1.12	6.07	1.13	4.57	1.40
Cantonese rhyme T ₁	4.22	1.22	4.48	1.51	4.39	1.49
Cantonese rhyme T ₂	5.78	1.18	5.87	1.07	4.63	1.43
Cantonese rhyme T ₃	5.78	1.21	5.89	1.13	4.69	1.24
Initial phoneme deletion (Max =6)						
English initial phoneme T ₁	0.78	0.82	0.80	0.98	0.81	1.17
English initial phoneme T ₂	2.11	1.57	2.04	1.57	0.78	1.08
English initial phoneme T ₃	2.13	1.59	2.07	1.68	0.83	1.16
Cantonese initial phoneme T ₁	1.09	1.15	1.04	1.03	1.06	1.19
Cantonese initial phoneme T ₂	2.00	1.64	2.15	1.64	1.02	1.19
Cantonese initial phoneme T ₃	1.91	1.57	2.20	1.64	1.04	1.24
Final phoneme deletion (Max =6)						
English final phoneme T ₁	2.96	0.97	3.04	1.01	2.91	1.19
English final phoneme T ₂	4.80	1.11	4.48	0.97	3.02	1.16
English final phoneme T ₃	4.78	1.02	4.52	0.84	2.94	1.20
Cantonese final phoneme T ₁	0.35	0.71	0.39	0.66	0.37	0.62
Cantonese final phoneme T ₂	1.52	1.31	1.72	1.34	0.43	0.63
Cantonese final phoneme T ₃	1.43	1.21	1.74	1.46	0.44	0.63
Concepts About Print (Max = 24)						
Concepts about Print T ₁	17.31	2.24	17.04	2.26	16.94	2.18
Concepts about Print T ₂	17.19	2.12	16.98	2.25	19.35	2.71

Note: N=54 for each group. T₁ = Pretest; T₂ = Immediate Posttest; T₃ = Delayed Posttest

Whether the three groups differed in pretest measures was assessed by means of analyses of variance (ANOVAs) in each of which the dependent variable was one of the six pretest measures (three measures in each language). The pretest measures were rhyme oddity, initial phoneme deletion, and final phoneme deletion in English and Cantonese respectively. The results revealed that the group difference was not significant in the analyses of any six pretest measures ($p > 0.5$). The groups were not significantly different in the English rhyme oddity pretest, $F(2, 161) = 0.212, p = .809$, English initial phoneme deletion pretest, $F(2, 161) = 0.019, p = .982$, and English final phoneme deletion pretest, $F(2, 161) = 0.204, p = .816$. Likewise, the groups were not significantly different in the Cantonese rhyme oddity pretest,

$F(2, 161) = 0.467, p = .628$, Cantonese initial phoneme deletion pretest, $F(2, 161) = 0.034, p = .966$, and Cantonese final phoneme deletion pretest, $F(2, 161) = 0.042, p = .959$.

Another trend found from the mean scores was that there were improvements of the phonological measures in both English and Cantonese over time. The improvements will be tested in the second part of the analysis to reveal whether such improvements can be attributed to the phonological awareness interventions received by some of the children.

Reliability of Measures

Internal consistency of all measures was assessed with Cronbach’s alpha coefficient using the pretest scores. Only the pretest scores were used to evaluate the internal consistency of the measures because the scores at the immediate posttest and delayed posttest have been influenced by the interventions given to the children. Using the pretest scores should be sufficient for the purpose of evaluating the reliabilities of the measures.

The alpha values of each pretest measure are presented in Table 28. All the English and Cantonese phonological measures attained a value over 0.85, indicating a good level of internal reliability of the phonological measures developed in Study 1. The concepts about print measure had a value of 0.710, which demonstrated a satisfactory level of internal reliability.

Table 28 Internal Consistency of all Measures at Pretest

	Cronbach’s alpha	
	α	
	English	Cantonese
Rhyme Oddity Pretest	.901	.879
Initial Phoneme Deletion Pretest	.903	.944
Final Phoneme Deletion Pretest	.886	.878
Concepts About Print Pretest	.710	

Effects of Phonological Intervention

The effect of the English phonological intervention was examined first, followed by the effect of the Cantonese phonological intervention. Each intervention was tested if there was learning in the language in which phonological awareness was taught, before testing for the transfer of such learning to another language. The rationale was that the learning of phonological awareness always precedes its transfer of phonological awareness. The effects of the English and Cantonese interventions were tested by repeated-measures multivariate analyses of variance (MANOVAs). In these repeated-measures MANOVAs, the intervention grouping was the independent variable and the three phonological measures of the same language at the three time points were the dependent variables. Repeated-measures MANOVAs were chosen over several analysis methods. A MANOVA was more suitable than separate ANOVAs because the former can protect against the type I errors accumulated from conducting a series of ANOVAs (Field, 2013). The repeated-measures design of MANOVA was more suitable than the analysis of covariance (ANCOVA) because the former can take advantage of using the same phonological measures for the same group of participants over three times, enhance increasing its statistical power than ANCOVA (Verma, 2015).

Three steps were involved in conducting the MANOVAs. First, the assumptions of conducting a repeated-measures MANOVA were checked. Second, the interaction effect between group and time in the MANOVA was examined. Only the interaction effect between group and time was examined because it could demonstrate that some groups improved significantly over time while others did not improve. The group effect and the time effect in MANOVA were not relevant to the analysis of the intervention effects. The group effect simply indicated the groups differed significantly regardless of the time, whereas the time effect simply suggested that all the children performed differently at different time points regardless of the grouping. Neither the group effect nor the time effect can inform whether

some groups differed significantly from other groups while other remained unchanged at the posttests. Third, when the interaction effect was found statistically significant, it is justified to proceed to the post hoc tests to compare whether the differences between the group means were significant. These results can inform whether the English training group or the Cantonese training group outperformed the control group on the phonological measures in each language.

Effects of English phonological intervention

Learning effect on English phonological awareness. To test if learning English phonological awareness has improved English phonological awareness, a repeated-measures MANOVA was carried out using the grouping as the independent variable and children's scores of the three English measures at pretest, immediate posttest, and delayed posttest as the dependent variables. Three steps were involved in the MANOVA.

First, the assumptions of using a repeated-measures MANOVA were checked. The first assumption was about multivariate normality. However, the assumption of multivariate normality can only be tested by complex methods beyond the scope of this study (see Tabachnick & Fidell, 2012a). A simpler and more practical way to check this assumption was to check the univariate normality of each dependent variable in turn because univariate normality is a necessary condition for multivariate normality (Field, 2013). Thus, the normality of each dependent variable was tested for each of the levels of the independent variable (i.e. grouping). In this analysis, the independent variable had three levels (English intervention, Cantonese intervention, print concept intervention) and there were three dependent variables (English rhyme oddity, English initial phoneme deletion, English final phoneme deletion). All the nine sets of data were assumed to be normally distributed. The normality of the nine sets of data was checked by the z-scores of skewness and kurtosis. When the absolute value of the z-score is smaller than 1.96, this indicates that the skewness

or kurtosis of the variable is not significantly different from 0 and hence indicates the normality (Field, 2013). The z-scores of skewness and kurtosis were calculated for all nine sets of data by dividing the kurtosis or skewness by its standard error. Table 29 shows the z-kurtosis and z-skewness of the English pretest measures by groups. The values of the z-skewness of the English initial phoneme deletion pretest were larger than the absolute value of 1.96 for all the three groups. The z-kurtosis of the English initial phoneme deletion pretest was also larger than |1.96| for the Cantonese training group. These results indicated that the pretest scores of the English initial phoneme deletion were not normally distributed.

Table 29 z-scores of skewness and kurtosis of the three English phonological measures

	English phonological intervention		Cantonese phonological intervention		Print concepts intervention	
	z-kurtosis	z-skewness	z-kurtosis	z-skewness	z-kurtosis	z-skewness
English rhyme oddity pretest	-0.404	-1.289	-0.495	-0.120	0.574	1.751
English initial phoneme deletion pretest	0.449	2.674	2.208	4.018	1.155	4.117
English final phoneme deletion pretest	-0.836	0.631	0.831	1.526	-0.401	1.003

Note: Values larger than |1.96| are in bold.

Although the assumption of normality was violated, simulation studies have shown that MANOVA procedures are sufficiently robust to the violation of normality when the sample size is over 20 per group (Mardia, 1971; Seo, Kanda, & Fujikoshi, 1995; Tabachnick & Fidell, 2012a). Given that the sample size of each group was over 50, MANOVA should be robust for the data in this study.

Another assumption was the homogeneity of covariance matrices. In MANOVA, the variances in each group are assumed to be equal for each dependent variable. The correlation between any two dependent variables is also assumed to be the same in all groups. This assumption was tested by Box's test of equality of covariance matrices. This statistic was significant, $F(90, 69258) = 2.537, p < .001$, suggesting the covariance matrices were not

roughly equal. Although the assumption of equal covariance matrices was violated, some multivariate test procedures in MANOVA such as Pillai-Bartlett trace are robust to this violation especially when the sample sizes are equal across the groups.

The final assumption to be checked was that there should be no sphericity in data. The scores computed between two levels of a within-subjects factor (e.g. pretest and immediate posttest) must have roughly the same variance between any two levels. This assumption is not directly relevant to MANOVA, but sphericity is assumed while solving the univariate ANOVA as a follow-up test in MANOVA. This assumption was tested by Mauchly's test of sphericity. The test showed that the statistics of all three English measures are significant ($p < .001$), suggesting that the assumption of sphericity was violated. The effect of sphericity can be adjusted by correcting the degrees of freedom associated with the F statistic, which can increase the p -value for F (Field, 2013). Although the three assumptions were violated, there were means to overcome these violations in MANOVA. Thus, MANOVA was conducted for the English measures.

The multivariate test was estimated using Pillai's trace because this method is particularly robust when the sample sizes are equal for each group (Field, 2013). Using Pillai's trace, there was a significant multivariate interaction effect between group and time on the English measures, $V = .633$, $F(12,310) = 11.976$, $p < .001$. As the assumption of sphericity was violated, the follow-up univariate analyses were corrected by Greenhouse-Geisser. In Table 30, the follow-up univariate analyses revealed that there were significant ($p < .001$) interaction effects between time and group on all three English measures.

Table 30 Follow-up univariate tests on the three English measures

Measures	Effect	Mean Square	F	df_1	df_2
English rhyme oddity	Time \times Group	14.07	22.46	3.59	285.01
English initial phoneme deletion	Time \times Group	13.02	25.30	3.17	252.35
English final phoneme deletion	Time \times Group	18.50	46.47	3.33	264.86

All significant at $p < .001$; Degrees of freedom corrected by Greenhouse-Geisser.

Because the univariate analyses did not compare the mean difference between groups, the post hoc tests were conducted to investigate the mean difference between specific groups. Because a series of post hoc comparisons would be applied to compare the means between the groups, Bonferroni pairwise comparisons were used to prevent alpha inflation at this level of the analysis. As shown in Table 31, Bonferroni pairwise comparisons revealed that the English training group significantly outperformed the control group in all three English measures ($ps < .001$). Noted that the pairwise comparisons were based on the estimated marginal means but not the actual means.

Table 31 Mean differences between the English phonological training group and the print concepts control group on the English measures

Measures	Contrast	Mean difference	95% Simultaneous confidence interval	
			Lower	Upper
English rhyme oddity	English phonological intervention vs. Print concepts intervention	1.123***	0.666	1.581
English initial phoneme deletion	English phonological intervention vs. Print concepts intervention	0.864***	0.402	1.327
English final phoneme deletion	English phonological intervention vs. Print concepts intervention	1.222***	0.862	1.582

*** $p < .001$; Based on estimated marginal means.

Given that univariate analyses have shown that the English training group outperformed the control group in all the English measures, the next step was to estimate the effect sizes for the differences between the two groups. Unlike the univariate analyses that used the estimated marginal means, the effect sizes were computed using the actual group means. The effect sizes in Cohen's d were calculated for pretest-posttest differences between the English training group and the control group in each English measure. The estimation of Cohen's d used pooled standard deviations of the two groups as follows (Carlson & Schmidt, 1999).

$$d = \frac{(M_{post,T} - M_{pre,T}) - (M_{post,C} - M_{pre,C})}{SD_{pre}}$$

where the pooled standard deviation is defined as

$$SD_{pre} = \sqrt{\frac{(n_T - 1)SD_{pre,T}^2 + (n_C - 1)SD_{pre,C}^2}{n_T + n_C - 2}}$$

Pooled standard deviations were used because the standard deviations of the English measures were different for the English training group and the control group. Simulation studies have shown that using pooled standard deviations can yield a more precise estimation of effect sizes than simply using the standard deviation of the control group (Carlson & Schmidt, 1999; Morris, 2007). Using the descriptive statistics in Table 27, the effect sizes in Cohen's *d* were computed for the pretest-posttest differences between the English training group and the control group in each English measure (Table 32). The effect sizes were all over 0.8 which were large effects (Cohen, 1988). For better visual interpretation of the differences between the two groups, the group means of each English measure are also visualised in Figure 15.

Table 32 Effect sizes of the pretest-posttest differences between the English training group and the control group in each English phonological measure

Contrast:	Cohen's <i>d</i>	
	Pretest vs. Immediate Posttest	Pretest vs. Delayed Posttest
English rhyme oddity	1.006	1.027
English initial phoneme deletion	1.346	1.316
English final phoneme deletion	1.594	1.649

In summary, the English training scored significantly higher than the control group in all three English measures. The results suggested that there was learning of English phonological awareness from the English phonological intervention. The next analysis will examine whether this learning of phonological awareness from English has transferred to Cantonese.

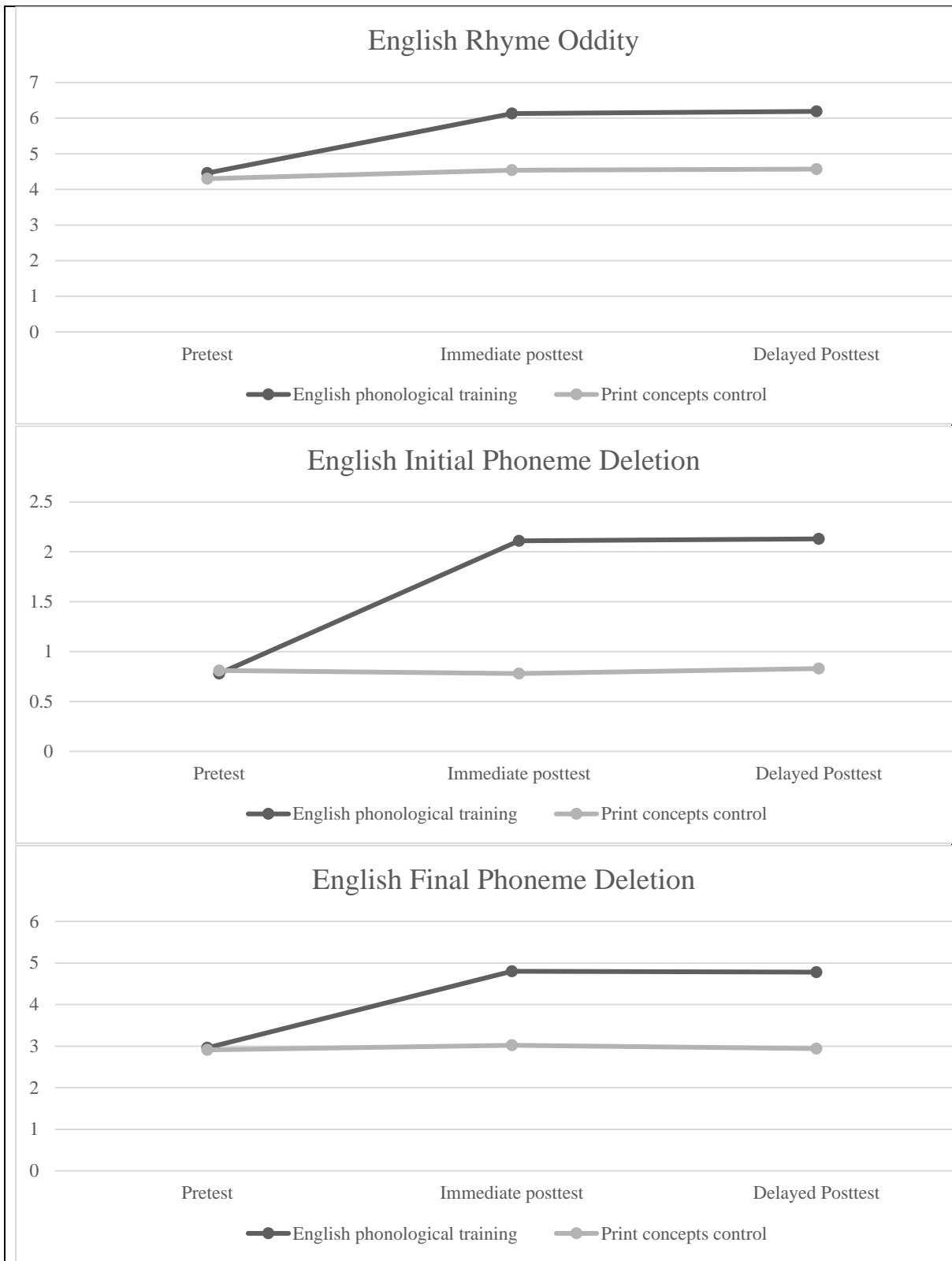


Figure 15 Means of the English measures by the English phonological training group and print concepts control group

Transfer effect on Cantonese phonological awareness. To test if the learning of phonological awareness from English phonological training has transferred to Cantonese, a similar MANOVA was carried out.

The assumption of normality was checked by examining the z-scores of skewness and kurtosis. In Table 33, the z-scores of skewness of the Cantonese initial phoneme deletion pretest and the Cantonese initial phoneme deletion pretest were larger than $|1.96|$ for all three groups. The results indicated that the assumption of normality was violated. However, the MANOVA procedures were robust to overcome the violation of normality as discussed before.

Table 33 z-scores of skewness and kurtosis of the three Cantonese phonological measures

	English phonological intervention		Cantonese phonological intervention		Print concepts intervention	
	z-kurtosis	z-skewness	z-kurtosis	z-skewness	z-kurtosis	z-skewness
Cantonese rhyme oddity pretest	-0.695	-0.575	0.117	1.782	-0.786	0.028
Cantonese initial phoneme deletion pretest	-0.163	2.723	-0.995	2.102	0.308	3.108
Cantonese final phoneme deletion pretest	9.552	7.388	1.457	4.517	1.776	4.575

Note: Values larger than $|1.96|$ are in bold.

The assumption of homogeneity of covariance matrices was checked. The Box's M statistic was significant, $F(90, 69258) = 3.399, p < .001$, suggesting the assumption of equal covariance matrices was violated. The assumption of sphericity was checked by Mauchly's test of sphericity. The test showed that the statistics of all three Cantonese measures were significant ($ps < .001$), suggesting that the assumption of sphericity was violated. Although the three assumptions were violated, there were means to tackle these violations in MANOVA procedures. Thus, MANOVA was still conducted for the Cantonese measures.

The MANOVA revealed that there was an interaction effect between group and time on the Cantonese measures, $V = .495$, $F(12,310) = 8.50$, $p < .001$, using Pillai's trace. Subsequent univariate analyses, corrected by Greenhouse-Geisser, reported that there were significant ($ps < .001$) interaction effects between time and group on all three Cantonese measures (Table 34).

Table 34 Follow-up univariate tests on the three Cantonese measures

Measures	Effect	Mean Square	<i>F</i>	<i>df</i> ₁	<i>df</i> ₂
Cantonese rhyme oddity	Time × Group	11.08	12.19	3.21	254.89
Cantonese initial phoneme deletion	Time × Group	10.10	15.95	2.68	213.10
Cantonese final phoneme deletion	Time × Group	12.16	22.59	2.78	220.81

All significant at $p < .001$; Degrees of freedom corrected by Greenhouse-Geisser.

In Table 35, the post hoc Bonferroni pairwise comparisons showed that the English training group scored significantly higher than the control group in all three Cantonese measures ($ps < .05$).

Table 35 Mean differences between the English phonological training group and the print concepts control group on the Cantonese measures

Measures	Contrast	Mean difference	95% confidence interval	
			Lower	Upper
Cantonese rhyme oddity	English phonological intervention vs. Print concepts intervention	0.691**	0.282	1.101
Cantonese initial phoneme deletion	English phonological intervention vs. Print concepts intervention	0.630*	0.143	1.116
Cantonese final phoneme deletion	English phonological intervention vs. Print concepts intervention	0.685***	0.351	1.020

*** $p < .001$; ** $p < .01$; * $p < .05$; Based on estimated marginal means.

Using the descriptive statistics in Table 27, the effect sizes (Cohen's *d*) were computed for the pretest-posttest differences between the English training group and the control group in each Cantonese measure (Table 36). The effect sizes were all over 0.8 which were large effects (Cohen, 1988), except for the difference between Cantonese initial phoneme deletion pretest and its delayed posttest ($d = 0.718$). For better visual interpretation of the differences between the two groups, the group means of each Cantonese measure are also visualised in Figure 16.

Table 36 Effect sizes of the pretest-posttest differences between the English training group and the control group in each Cantonese phonological measure

Contrast:	Cohen's <i>d</i>	
	Pretest vs. Immediate Posttest	Pretest vs. Delayed Posttest
English phonological intervention vs. Print concepts intervention	0.969	0.925
Cantonese rhyme oddity	0.812	0.718
Cantonese initial phoneme deletion	1.665	1.515
Cantonese final phoneme deletion		

In summary, the English training also scored significantly higher than the control group in all three Cantonese measures. Considering the previous MANOVA and this MANOVA, the results provided strong support for Hypothesis 3 that English phonological training led to a greater gain in Cantonese phonological awareness when compared to the control group.

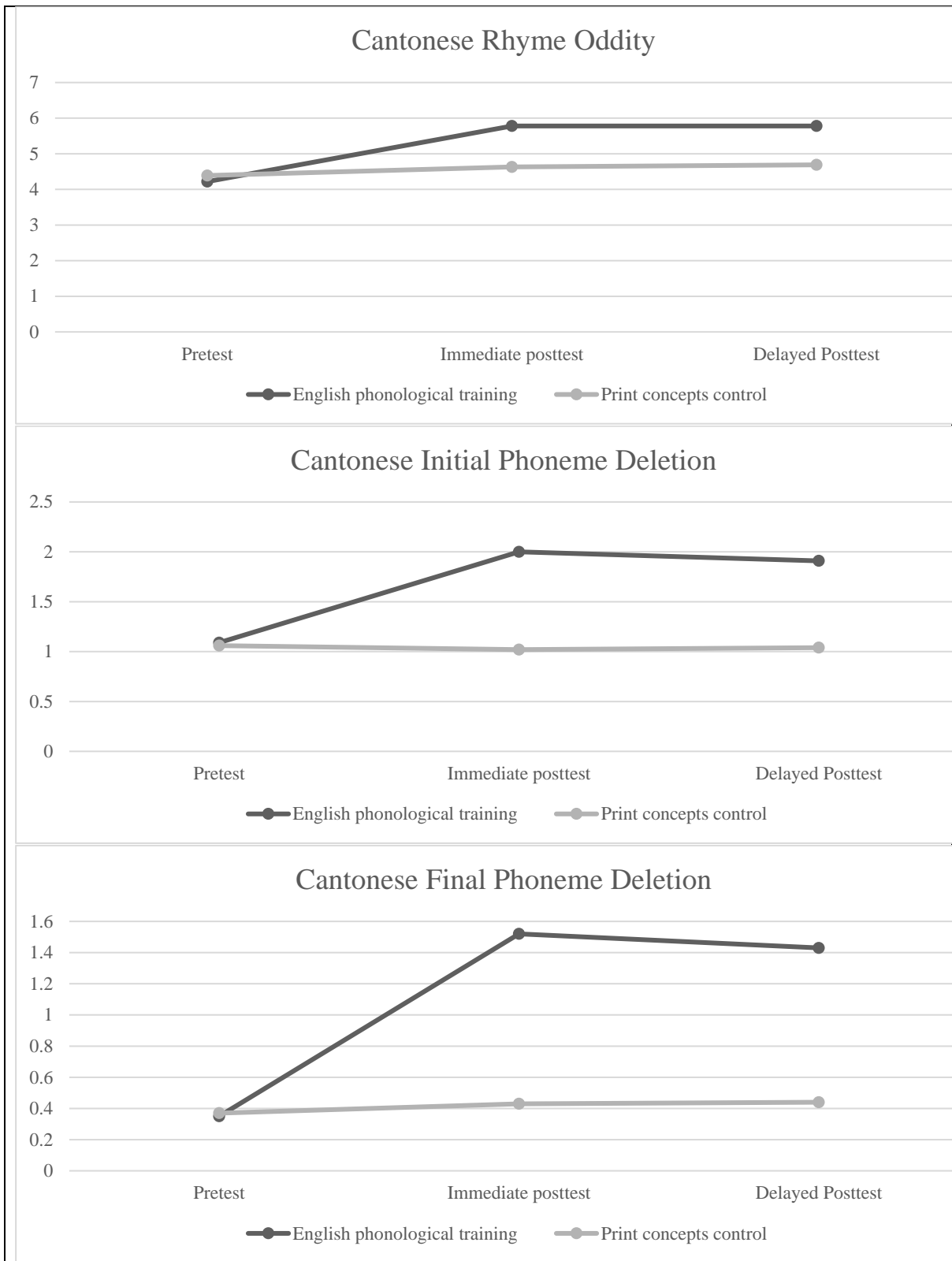


Figure 16 Means of the Cantonese measures by the English phonological training group and print concepts control group

Effects of Cantonese phonological intervention

Learning effect on Cantonese phonological awareness. To test the effect of the Cantonese phonological intervention on the Cantonese measures, the analysis was conducted using the same MANOVA used in testing the transfer effect of English phonological intervention on Cantonese measures (i.e. the second MANOVA, p.135). The analysis went through the same assumptions checking (p.135), the multivariate test (p.136), and follow-up univariate tests (Table 34, p.136). The only difference was that the post hoc Bonferroni pairwise comparisons here compared the Cantonese training group with the control group on the three Cantonese measures, as shown in Table 37 below. The post hoc Bonferroni pairwise comparisons showed that the Cantonese training group scored significantly higher than the control group in all three Cantonese measures ($ps < .01$).

Table 37 Mean differences between the Cantonese phonological training group and the print concepts control group on the Cantonese measures

Measures	Contrast	Mean difference	95% Simultaneous confidence interval	
			Lower	Upper
Cantonese rhyme oddity	Cantonese phonological intervention vs. Print concepts intervention	0.846***	0.436	1.255
Cantonese initial phoneme deletion	Cantonese phonological intervention vs. Print concepts intervention	0.759**	0.273	1.246
Cantonese final phoneme deletion	Cantonese phonological intervention vs. Print concepts intervention	0.870***	0.536	1.205

*** $p < .001$; ** $p < .01$; Based on estimated marginal means.

Using the descriptive statistics in Table 27, the effect sizes (Cohen's d) were computed for the pretest-posttest differences between the Cantonese training group and the control group in each Cantonese measure (Table 38). The effect sizes for both Cantonese initial phoneme deletion and final phoneme deletion were all over 0.8 which were large effects (Cohen, 1988). The effect sizes for the Cantonese rhyme oddity were between 0.7 to

0.8, which were medium effects (Cohen, 1988). For better visual interpretation of the differences between the two groups, the group means of each Cantonese measure are also visualised in Figure 17.

Table 38 Effect sizes of the pretest-posttest differences between the Cantonese training group and the control group in each Cantonese phonological measure

Contrast:	Cohen's <i>d</i>	
	Pretest vs. Immediate Posttest	Pretest vs. Delayed Posttest
Cantonese phonological intervention vs. Print concepts intervention	0.767	0.740
Cantonese rhyme oddity	1.033	1.060
Cantonese initial phoneme deletion	1.983	1.999

In summary, the Cantonese training scored significantly better than the control group in all three Cantonese measures. The results suggested that there was learning of Cantonese phonological awareness from the Cantonese phonological intervention. The next analysis will examine whether this learning of phonological awareness from Cantonese has transferred to English.

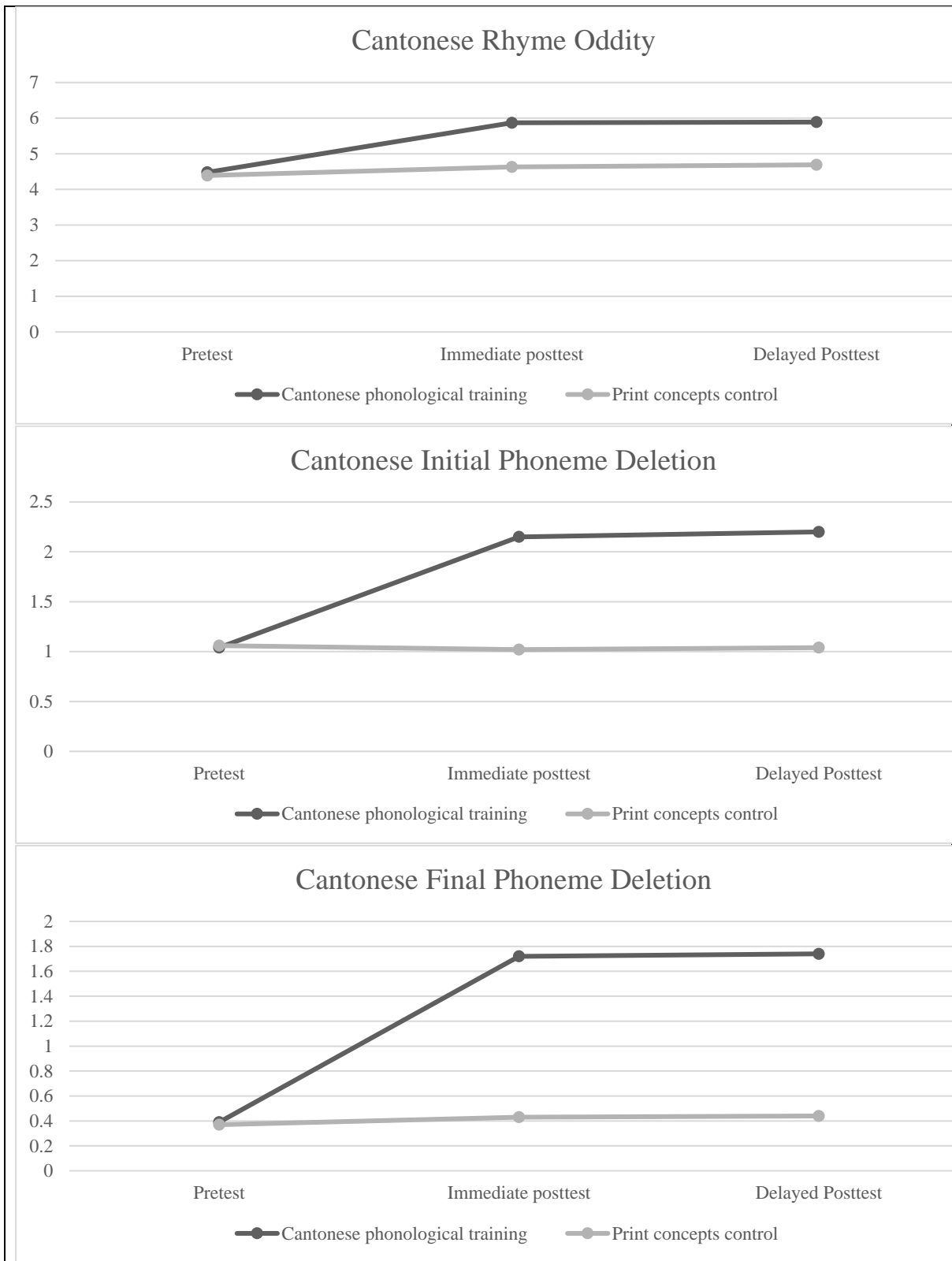


Figure 17 Means of the Cantonese measures by the Cantonese phonological training group and print concepts control group

Transfer effect on English phonological awareness. To test whether the learning from Cantonese phonological training has transferred to English phonological awareness, the same MANOVA testing the learning effect of the English phonological intervention on the English measures was used (i.e. first MANOVA, p.129). The assumptions checking (p.130-131), the multivariate test (p.131), and follow-up univariate tests (Table 30, p.131) have been reported previously. The only difference here was that the post hoc Bonferroni pairwise comparisons compared the Cantonese training group with the control group on the English measures (Table 39). In the pairwise comparisons, the Cantonese training group significantly outperformed the print concept control group in all the English measures.

Table 39 Mean differences between the Cantonese phonological training group and the print concepts control group on the English measures

Measures	Contrast	Mean difference	95% Simultaneous confidence interval	
			Lower	Upper
English rhyme oddity	Cantonese phonological intervention vs. Print concepts intervention	0.994***	0.536	1.452
English initial phoneme deletion	Cantonese phonological intervention vs. Print concepts intervention	0.827**	0.365	1.290
English final phoneme deletion	Cantonese phonological intervention vs. Print concepts intervention	1.056***	0.696	1.416

*** $p < .001$; ** $p < .01$; Based on estimated marginal means.

Using the descriptive statistics in Table 27, the effect sizes (Cohen's d) were computed for the pretest-posttest differences between the Cantonese training group and the control group in each English measure (Table 40). For better visual interpretation of the differences between the two groups, the group means of each Cantonese measure are also visualised in Figure 18.

Table 40 Effect sizes of the pretest-posttest differences between the Cantonese training group and the control group in each English phonological measure

Contrast:	Cohen's <i>d</i>	
	Pretest vs. Immediate Posttest	Pretest vs. Delayed Posttest
Cantonese phonological intervention vs. Print concepts intervention		
English rhyme oddity	0.998	1.026
English initial phoneme deletion	1.177	1.158
English final phoneme deletion	1.205	1.314

In summary, the Cantonese training also scored significantly better than the control group in all three English measures. Combining the results of the previous MANOVA and this MANOVA, the results provided the support for Hypothesis 4 that Cantonese phonological training led to a greater gain in English phonological awareness when compared to the control group.

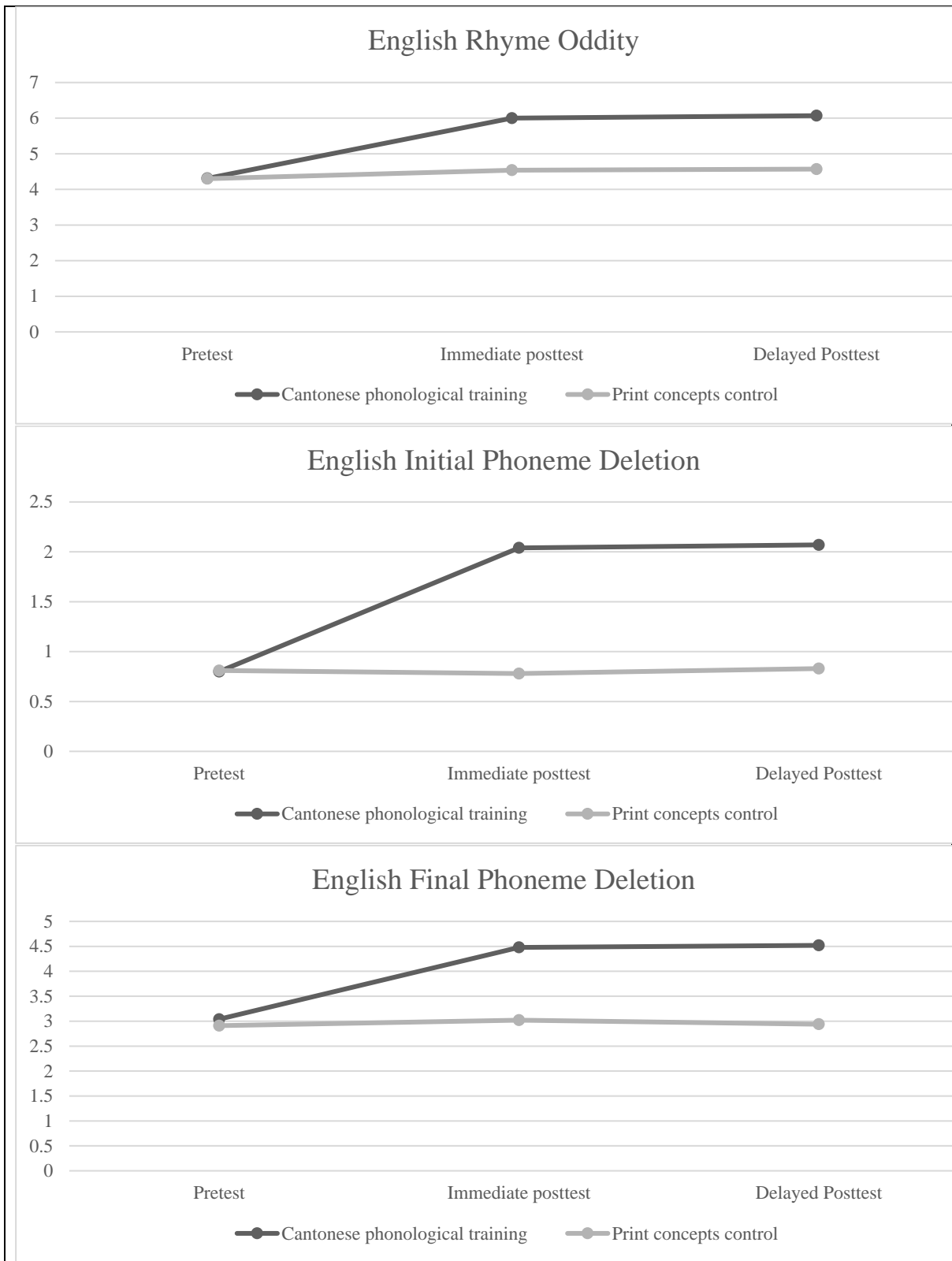


Figure 18 Means of the English measures by the Cantonese phonological training group and print concepts control group

Effect of Print Concepts Intervention

The effect of the print concepts intervention was tested by a repeated-measures ANOVA. The independent variable was the grouping and the dependent variables were the scores of the concepts about prints task at the pretest and immediate posttest. Noted that there was no delayed posttest for the concepts about prints task.

The normality of the variables was inspected by the z-scores of kurtosis and skewness, as presented in Table 41. Only the z-score of the skewness for the print concepts control group is larger than |1.96|. The print concepts scores were generally normally distributed. Sphericity was not an issue because there were only two levels of the repeated-measure variable (i.e. pretest and posttest). Because ANOVA is robust for modest violation of normality (Field, 2013), a repeated-measures ANOVA was carried out.

Table 41 z-scores of skewness and kurtosis of the print concept measure at pretest and posttest

	English phonological intervention		Cantonese phonological intervention		Print concepts intervention	
	z-kurtosis	z-skewness	z-kurtosis	z-skewness	z-kurtosis	z-skewness
Concepts about Print pre-test	-1.293	1.249	-1.072	1.837	-0.701	2.274
Concepts about Print post-test	-0.858	0.668	-0.768	1.308	-0.188	-0.542

Note: Values larger than |1.96| are in bold.

As shown in Table 42, there was a significant interaction effect between time and group, $F(2,159) = 58.122, p < .001$. As discussed previously, the time effect and the group effect were not relevant to this analysis because these two effects were not able to inform the intervention effect.

Table 42 Mean scores of print concept measures by groups

	Group				Effect			
	English phonological intervention		Cantonese phonological intervention		Print concepts intervention		Time × Group	
	M	SD	M	SD	M	SD	<i>F</i>	<i>p</i>
Pretest	17.31	2.239	17.04	2.257	16.94	2.184	58.122	<.001
Posttest	17.19	2.120	16.98	2.253	19.35	2.714		

To break down the interaction effect between time and group, all the experimental groups were contrasted. In Table 43, simple planned contrasts showed that the print concept group significantly outperformed both the English phonological training group ($p < .05$) and the Cantonese phonological training group ($p < .01$). The English training group and the Cantonese training group were not significantly different from each other ($p > .05$).

Table 43 Mean difference *t*-tests between the groups on the print concept measure

Contrast	Mean difference	95% Simultaneous confidence interval	
		Lower	Upper
Print concepts intervention vs. English phonological intervention	.898*	.064	1.732
Print concepts intervention vs. Cantonese phonological intervention	1.139**	.305	1.973
English phonological intervention vs. Cantonese phonological intervention	.241	-.781	1.263

** $p < .01$. * $p < .05$.

To conclude, the print concepts intervention was effective to improve children's print concepts. There was no effect on the English phonological training group and the Cantonese phonological training group.

Discussion

The discussion begins with a brief summary of the key findings. Each key finding will be discussed regarding why such finding was found and how such finding relates to other findings in the literature. The limitations of the study will also be discussed.

Summary of findings

In this study, children's phonological awareness in English and Cantonese were measured by rhyme oddity, initial phoneme deletion, and final phoneme deletion tasks before and after the interventions. Children's performance in most of the phoneme pretests was impressively low, except for the English final phoneme deletion pretest. The mean scores of the English and Cantonese initial phoneme deletion pretests were 0.8 and 1.06 out of 6 marks, whereas the mean score of the Cantonese final phoneme deletion pretest was 0.37 out of 6 marks. Interestingly, the mean score of the English final phoneme deletion pretest was 2.97 out of 6 marks.

After the interventions, there were improvements in the performance in the English and Cantonese phonological measures. The learning effects of the English and Cantonese phonological awareness interventions were found. Children who received English phonological training had a significantly greater gain than those who received the print concepts control in all three English phonological measures. Likewise, children who received Cantonese phonological training had a significantly greater gain than those who received the print concepts control in all the Cantonese measures.

The transfer effects of the English and Cantonese phonological interventions were also found. The English phonological training group had a significantly greater gain in all three Cantonese phonological measures than the print concepts control group. Similarly, The Cantonese phonological training group had a significantly greater gain in all three English phonological measures than the print concepts control group.

Finally, the effect of print concepts intervention serving as an active control was examined. Children who received print concept training had a significantly greater gain than those who received English or Cantonese phonological training.

Discussions of key findings

The first finding was the floor effects of the phoneme tasks at pretest. The performance of the initial phoneme deletion and final phoneme deletion tasks at pretest was impressively low. Scores for the final phoneme deletion task in Cantonese were particularly low. The performance was much better for final phoneme deletion in English and for initial phoneme deletion in Cantonese. The impressively low phonemic awareness skills in Cantonese observed in this study have been reported in the previous studies (Holm & Dodd, 1996; Huang & Hanley, 1995; McBride-Chang et al., 2004). At pretest, the initial phoneme deletion in Cantonese and in English were comparable, but the deletion of the final phoneme was considerably harder in Cantonese than in English. Previous research found that initial phonemes are easier to manipulate than final phonemes for English-speaking children (Castles et al., 2003; Puolakanaho et al., 2003; Smith, 1995; Treiman, 1991; Vandervelden & Siegel, 1995). It is likely that Cantonese-speaking children display a similar pattern and develop the awareness of initial phoneme prior to the awareness of final phoneme. This could explain why children's performance on Cantonese initial phoneme awareness is better than the Cantonese final phoneme awareness.

But there is a further striking result: the rate of correct responses in the final phoneme deletion in English was about 50%; in contrast, the rate of correct responses in the final phoneme deletion in Cantonese did not reach 10% correct. Although the attempt to understand this difference is to some extent speculative, it can be explained by the unique phonology of Cantonese. When the Cantonese plosives /p, t, k/ act as the final consonants, they become unreleased consonants that have no audible indication of the end of their

occlusion (Bauer & Benedict, 1997, p. 22). This unreleased articulation is similar to the unreleased first plosive of a plosive cluster such as the /k/ in doctor /'dɒktə(r)/. When compared to the barely audible unreleased Cantonese plosives /t, p, k/, Cantonese-speaking children might find the English final plosives /t, p, k/ particularly noticeable and hence were able to delete these English final plosives with ease.

The second key finding was the learning effect of the phonological interventions in English and Cantonese. English phonological training can improve children's English phonological awareness, whereas Cantonese phonological training can improve children's Cantonese phonological awareness. When the effects of the English phonological intervention and the Cantonese phonological intervention were put together, they established that the teaching of phonological awareness worked well in English and Cantonese. The successful training outcomes were consistent with the phonological training studies in the literature (Bus & van Ijzendoorn, 1999; Ehri et al., 2001; National Institute for Literacy, 2008), in which training phonological awareness in one language leads to significant improvements in the phonological awareness of the same language. Meta-analyses have reported that the average effect sizes of phonological awareness training using randomised control trial design ranged from $d = .73$ to $.87$ (Bus & van Ijzendoorn, 1999; Ehri et al., 2001; National Institute for Literacy, 2008). The effect sizes of the English phonological intervention in this study ranged from $d = .718$ to 1.665 , whereas the effect sizes of Cantonese phonological intervention ranged from $d = .740$ to 1.999 . The effect sizes of the phonological awareness interventions in this study were above the average value in the literature, suggesting the phonological interventions offered in this study were more effective than those offered in phonological training studies on average. The large effect sizes of the phonological interventions of this study can be attributed to the rigorous design of this study. The present study was designed with great care using high scientific standards. Children were

randomly assigned to the conditions. Pretests and two posttests were administered before and after the interventions. The training and the assessment procedures followed standardised procedures. The control group were exposed to beneficial training of the same amount of instruction as the phonological training groups. The sample size was sufficiently large. The phonological interventions were also carefully designed not to overlap the phonological assessments. The present study was conducted in school settings with all these stringent standards, further strengthening the rigour of the present study.

The third key finding was that the learning of phonological awareness in one language has transferred to another language. The learning of phonological awareness not only occurred in the language in which phonological awareness was taught, but also transferred to another language that has not been trained at all. The learning of phonological awareness from the English phonological intervention has transferred to Cantonese, which led to higher performance in the Cantonese measures in addition to the English measures. Similarly, the learning from the Cantonese phonological intervention has transferred to English, which led to higher performance in the English phonological measures along with the Cantonese measures. These transfer effects have provided strong evidence to the two hypotheses of the present study that learning phonological awareness from one language can transfer to another language. These effects of the transfer of learning were consistent with the training studies which successfully demonstrated the transfer of phonological awareness across languages (Chen et al., 2010; Rao, 2014). What differs the present study from other training studies is that the present study demonstrated the bidirectional transfer of phonological awareness between two languages at subsyllable and phoneme levels. Chen et al. (2010) only demonstrated the transfer from L2 (English) to L1 (Mandarin) at subsyllable and phoneme levels, whereas Rao (2014) demonstrated the transfer from L1 (Hindi) to L2 (English) at phoneme level. The bidirectional transfer of phonological awareness demonstrated by this

study filled the literature gap in which few studies, if any, have demonstrated the bidirectional transfer of phonological awareness from both languages.

The final key finding was that the print concepts intervention could improve children's print concepts in English. On the one hand, neither the English nor Cantonese phonological interventions had an effect on children who received the print concepts intervention. On the other hand, the print concepts intervention had no effect on children who received English or Cantonese phonological training. These results were consistent with strong evidence in the literature that phonological awareness and print concepts are two separate constructs in children's early literacy (Sénéchal & LeFevre, 2002), although both constructs are metalinguistic skills that are crucial to children's literacy development. Not only could the print concept interventions minimise the Hawthorne effect that the new experience of being research participants might lead to temporary improvements (Ehri et al., 2001; Troia, 1999), but also facilitate children's literacy development through better understanding of written text (Lomax & McGee, 1987; National Institute for Literacy, 2008; Sénéchal & LeFevre, 2002). Thus, the print concepts intervention served well as an active control for the English phonological intervention and the Cantonese phonological intervention.

Limitations

A main limitation of the study was that the same person who carried out the training also administered the posttests. This raises the issue of conscious or unconscious bias. The responses from children from the phonological awareness training groups might be treated as correct where the same response from children in the control group might be treated as incorrect. There would appear to be several ways in which bias might have been eliminated during the administration of the post-test. Some of the means have been considered. For example, an independent assessor who is blinded to the children's group membership can be

arranged to administer the tests. Alternatively, children's responses can be audio-recorded and assessed by an independent assessor. The blinded assessors could either be researchers or teachers. However, all these alternatives mentioned were turned down by the management of the kindergartens after several rounds of negotiations. It was not possible to obtain the clearance for any person other than the researcher to enter the kindergartens. The management strongly objected to the audio-recording children's performance in the tests because the tests were administered at a quiet corner of the classroom and the teaching activities would be recorded unintentionally. The teachers in the kindergartens were not able to help administer the tests because they were legally responsible for taking care of all children and were not allowed to take duties other than their legal duties. Because of the limitations of arranging independent assessors, the researcher had to be the assessor as well. To minimise the potential bias by the researcher who was also the assessor, the researcher must follow the written, standardised administration procedures for the phonological tests. Although the alternatives mentioned above are better means to minimise the bias, following the written procedures was the only feasible option to address the bias.

Another major limitation was that it was difficult to be certain that the initial phoneme deletion task was exclusively testing phoneme awareness rather than rhyme awareness. The ambiguity between a phoneme test and a rhyme test has been an issue in the literature (Treiman, 1985; Ziegler & Goswami, 2005), when a syllable begins with a single consonant phoneme. The English and Cantonese syllables in the phonological tasks all begin with a single consonant phoneme. The reason, which was explained in Study 1 (p.39), was that there are no consonant clusters in Cantonese syllables so every Cantonese syllable begins with a single phoneme. To match Cantonese syllables, the English syllables used in the English phonological tasks also begin with a single consonant phoneme. For syllables beginning with a single consonant phoneme, awareness of initial phonemes and onsets are not

distinguishable. For example in *bat* /bæt/, its initial phoneme (/b/) is a salient speech unit because it corresponds to the first segment of the onset-rime boundary of the syllable (Cisero & Royer 1995). To identify the initial phoneme, children must perceive the initial phoneme as separable from the rest of the syllable which is also the rime (/æt/). This process requires children to precisely identify the onset-rime boundary of the syllable so that the initial phoneme can be located from its given position of the syllable. Although children are not required to analyse the rime (/æt/) in detail, the implicit involvement of rime awareness is inevitable when manipulating the initial phoneme. Likewise, to detect the rime (/æt/), phonemic awareness is implicitly involved in addition to the awareness of rime, although children do not need to pay much attention to the initial phoneme (/b/).

The core issue here is to guide children to pay more attention to either the initial phoneme or the rime in a test so that the test can primarily measure the rhyme awareness or the initial phonemic awareness. In this study, phonemic awareness was measured by deletion tasks. A deletion task is an appropriate task for measuring phonemic awareness primarily. In an initial phoneme deletion task, a child is asked to identify the initial phoneme of a given syllable (e.g. *man* /mæn/), delete the initial phoneme in *mind* (e.g. /m/), and respond with the remaining syllable (e.g. /æn/). Although the correct response is the rime (e.g. /æn/), the task still primarily measures phonemic awareness. The task requires an explicit separation of the initial phoneme from the syllable. This process involves phonemic awareness because a part of the syllable is being segmented at the level of individual phonemes. Even if children respond with the rime, children do not need to process the rime any further. They only need to retrieve the rime from the verbal working memory. The involvement of awareness of rimes is kept minimal in this process.

Deletion tasks were chosen over oddity tasks to measure the awareness of initial phonemes because deletions tasks are cognitively more difficult than oddity tasks. As

explained in the design of the measures in Study 1 (p.21), deletion tasks are a kind of analysis tasks whereas oddity tasks belong to identity tasks. Research has found that analysis tasks (deletion) are more challenging than identity tasks (oddity), when the tasks were manipulating the same kind of linguistic units (Wagner et al., 1994; Yopp, 1988). Using deletion tasks over oddity tasks can avoid ceiling effects in the post-tests after children have received phonological training. Thus, in the present study, phonemic awareness was measured by deletion tasks.

There are alternatives regarding how the awareness of rimes and phonemes should be measured. One of the potential alternatives is to use oddity tasks to measure the awareness of rimes, initial phonemes, and final phonemes. The merit of using the same oddity tasks to measure phonological awareness at various linguistics units is justifiable. Because the same kind of cognitive operation is used, a uniform measurement of phonological awareness for different linguistic units can be made possible. For example, (Bradley & Bryant, 1983, 1985) used the same kind of oddity tasks to measure the awareness of initial phonemes and rimes. However, in order to measure a phenomenon, the measurement is better based on a variety of cognitive operations and units. This would help to obtain a more comprehensive description. This study aims to have a better and more comprehensive description of phonological awareness. This aim was achieved by varying the cognitive operations and the linguistic units of the phonological tasks. That is, more than one cognitive operation and linguistic unit were used in the phonological tasks. In this study, one set of operations was in the pretest and posttests (oddity and deletion) and a different set of operations was used in training (matching, grouping, substituting etc.) to minimise the possibility that the children simply learned those operations in training and showed progress in the post-tests.

To conclude, the results of this training study has provided strong evidence that the effects of phonological awareness can transfer bidirectionally between English and

Cantonese. This training study is one of the very first studies to demonstrate that phonological awareness training in one language not only improves the phonological awareness of the same language, but also transfers to another language. The findings are particularly convincing because the transfer occurred bidirectionally between two vastly different languages: English and Cantonese. These two languages have disparate sets of phonemes and are represented by disparate sets of orthography. This training study filled in the important literature gap that there were scant training studies investigating the transfer of phonological awareness, not to mention the transfer between two drastically different languages.

General Discussion

The results from Study 1 and Study 2 have provided valuable insights into the transfer of phonological awareness between English and Cantonese. In Study 1, a set of phonological awareness measures was developed to be comparable across English and Cantonese. Using the technique of Confirmatory Factor Analysis (CFA), the results showed that the phonological measures were consistent with the theoretical structure based on Guilford's (1967) model. Further investigations revealed that the English version of each measure was comparable with its Cantonese version, showing that the phonological measures fulfilled the expectation of being comparable between English and Cantonese.

Study 2 was a training study using a randomised control trial design with pretest and posttest assessments. Children were randomly assigned to receive English phonological training, Cantonese phonological training, or print concept training serving as an active control. The results showed that children's performance in phonemic awareness in English and in Cantonese were impressively low at the pretest. After the interventions, analyses revealed that the English phonological intervention significantly improved children's English phonological awareness and Cantonese phonological awareness. The Cantonese phonological intervention also significantly improved children's Cantonese phonological awareness and English phonological awareness. The findings suggested a bidirectional transfer of phonological awareness between English and Cantonese.

Theoretical implications

Combing Study 1 and Study 2, the findings have theoretical and practical implications. In the theories of learning to read, whether phonological awareness can transfer across language is relevant for developing a better understanding of the nature of phonological awareness as language-general or language-specific (Bialystok, McBride-Chang, et al., 2005; McBride-Chang & Ho, 2005). It remains unclear whether learning to

read is rooted in a universal mechanism that is based on central phonological processes (Bialystok, 2007), or is explained by specific mechanisms that vary according to the orthography and phonological representations of each language (Geva & Siegel, 2000). The language-general view considers that phonological awareness is unitary across languages (Anthony & Lonigan, 2004; Branum-Martin et al., 2006). Bilingual children's performance in both languages is largely driven by a general ability that is independent of the languages. This view has been supported by the strong associations in phonological awareness tasks between languages (Atwill et al., 2007; Cheung et al., 2010; López & Greenfield, 2004), as well as the training effects of phonological interventions across languages (Chen et al., 2010; Rao, 2014).

Alternatively, the language-specific view considers phonological awareness as a specific ability developed exclusively for reading an orthography. The view states that learning to read requires specific knowledge to represent speech units in that orthography in a unique way (McBride-Chang & Ho, 2005; Ziegler & Goswami, 2005). Thus, phonological awareness needs to be relearned with each new orthography (Bialystok, 2007). This view has been supported by the discrepancy in phonological performance in different languages for bilingual children, as well as the discrepancy in how phonological awareness in different languages explain reading differently (McBride-Chang & Ho, 2005; McBride-Chang et al., 2008). On the one hand, bilingual children speaking Cantonese and English (including Canadian Chinese, Mainland China Chinese, and Hong Kong Chinese) had better phonological awareness performance in L1 than in L2 (Bialystok, Luk, & Kwan, 2005; Luk & Bialystok, 2008; McBride-Chang et al., 2004; McBride-Chang et al., 2006). On the other hand, in bilingual children speaking Cantonese and English, phonemic awareness explains more unique variance than syllable awareness of English word recognition (McBride-Chang & Ho, 2005), whereas syllable awareness explains more unique variance of Chinese character

recognition (McBride-Chang et al., 2004). The explanation was that learning to read English requires children learning to manipulate letter sounds at phoneme level, whereas learning to read Chinese characters involves mapping speech units at syllable level to Chinese characters. The logic behind this language-specific view is that if phonological awareness is a unitary entity that is the same for all languages, there should be no discrepancy in children's performance across languages, and no discrepancy in the unique variance of reading explained by phonological awareness in different languages.

The results from Study 1 and Study 2 lend support to the language-general view that phonological awareness is a unitary phenomenon across languages. In Study 1, the phonological measures in English and in Cantonese were polished that there was no meaningful difference between the English version and the Cantonese version of the same task. In Study 2, children were randomly assigned to receive phonological training or control. The phonological training groups had greater improvements than the control group in the phonological tasks of another language. Because the phonological awareness tasks between English and Cantonese were designed with great care (Study 1) and the training study (Study 2) used randomised experimental design with pretest and posttest assessments, the only reasonable explanation for the cross-language training effects found in Study 2 is that phonological awareness is a unitary ability across language. If phonological awareness is not a language-general ability across languages, it is unlikely to explain why phonological training in one language can improve phonological awareness of another language.

There was one finding that did not seem to fit into the language-general view. That is, children's performance in English phonological awareness was better than Cantonese phonological awareness (p.49). In fact, such discrepancy can be interpreted by the language-general view. It is possible that children's underperformance in Cantonese was affected by other factors so that the Cantonese performance did not match the English performance. It is

asserted that phonological awareness is a unitary phenomenon across languages, but the level of correct performance that children show in different tasks is moderated by a series of factors. First, the cognitive operations of the phonological tasks can influence children's performance in phonological awareness (Anthony et al., 2003; Perfetti et al., 1987; Wagner et al., 1994). The effect of cognitive operations on the performance of phonological awareness tasks has been discussed in Study 1 (p. 21). For example, Wagner et al. (1994) measured children's English phonemic awareness using oddity, blending, and segmentation tasks. Children's performance in these phonemic tasks varied, even though these tasks aimed to measure the same phonemic awareness. Children's performance in the oddity, blending, and segmentation tasks were 41.3%, 18.7%, and 6.7% correct. If phonological awareness in English and Cantonese is measured by different operations, there will be a discrepancy in children's performance in phonological awareness. The difference reflects the differences in the operations used in the tasks across languages, but not the differences in phonological awareness between English and Cantonese. To minimise the influence of cognitive operations on children's phonological performance across languages, the same set of operations (i.e. oddity and deletion) was used in the English measures and the Cantonese measures in Study 1 and Study 2.

Second, the linguistic units measured in the phonological tasks can also influence children's performance in phonological awareness. This effect of units has also been discussed in Study 1 (p.23). For children learning an alphabetic orthography, children perform much better in manipulating large linguistic units than small units (Anthony et al., 2002; Anthony et al., 2003). For Cantonese-speaking children, research has found that children performed better in manipulating syllables than phonemes (Cheung et al., 2001). If the phonological tasks across languages are based on different linguistic units, there will be a discrepancy in children's phonological performance across languages. In Study 1 and Study

2, this problem was avoided by using the same set of linguistic units (rime, initial phoneme, and final phoneme) in the English and the Cantonese measures.

Third, the phonetic characteristics of the languages can influence children's performance in phonological tasks. The differences between the phonology of English and Cantonese is noteworthy. Some of the key differences were highlighted in Study 1 (p.26). For example, there is no consonant cluster in Cantonese (Bauer & Benedict, 1997) whereas consonant clusters are common in English, which constitute 49.8% of English monosyllables (De Cara & Goswami, 2002). Almost all 19 English consonants are allowed to be the final phoneme in an English syllable (Abercrombie, 1967), whereas only 6 consonants /t, p, k, m, n, ng/ are allowed to be the final phoneme in a Cantonese syllable (Bauer & Benedict, 1997). Unlike the English final consonants, the Cantonese final consonants are unreleased consonants that are barely audible. This explained why in Study 2 children's performance in English final phoneme deletion was considerably better than the performance in Cantonese final phoneme deletion because the audible English final consonants were particularly noticeable for Cantonese-speaking children. The discrepancy in performance between English final phoneme deletion and Cantonese final phoneme deletion was indeed not because awareness of final phonemes is particularly more important for English than Cantonese, but because this phonological difference between English and Cantonese sensitised Cantonese-speaking children to perform better in that task in English than Cantonese.

Fourth, young children may show response biases that affect performance in phonological tasks. This factor is particularly relevant to oddity tasks. In the pilot test of Study 1 (p.50), children had the tendency to choose the last syllable of the trio as the 'odd' syllable, and to avoid choosing the first syllable of the trio as the 'odd' syllable. If there are many trials with the 'odd' syllable being placed at the last position of the trio, children can

guess the answer of many trials correctly and hence affect the overall performance of the oddity task. To minimise the effect of children's arbitrary choice of 'odd' syllable in oddity tasks across languages, the position of the 'odd' syllable was placed evenly among the first, middle, and last position of the trio. That is, the 'odd' syllables were placed at the first position of the trio for Items 4 and 7, at the middle position for Items 2, 5, and 8, and at the last position for Items 1, 3, 6 for both the English and the Cantonese rhyme oddity tasks.

Finally, children's specific learning experiences in the home and in school can also affect their performance in phonological awareness. Research has found that English children who are exposed to nursery rhymes perform better on English phonological awareness tasks (Farver et al., 2009; López & Greenfield, 2004; Yeung, Siegel, & Chan, 2013). In Hong Kong, bilingual children are taught about phonemes in English, but not in Cantonese (Ho & Bryant, 1997b). Thus, it was not surprising to find that Cantonese-speaking Hong Kong children performed better in English than in Cantonese (p.49). The explanation was that children were more experienced in manipulating English speech units than Cantonese units and thus performed better in the English tasks than the Cantonese tasks. It was likely that it was the very first time for the Cantonese-speaking children to manipulate Cantonese phonemes. It was understandable for children to underperform in such a novel task.

Practical implications

This thesis has shown that learning of the phonetic system in English can improve Cantonese phonological awareness. There are other ways to support the learning of phonological awareness across languages. One of the examples is to learn a transparent alphabetic system like Pinyin for Mandarin. There are implications for education in ordinary schools in China and Hong Kong.

Because time and resources are limited for many developing countries like China, often educators have to choose between L1 and L2 to start phonological awareness instruction. Instruction in either language is justifiable, and educators need to consider their aims carefully for the children. There may be different perspectives with respect to this issue. On the one hand, in ordinary schools in China, it is sensible for Chinese children to begin learning phonological awareness through Pinyin, rather than learning phonological representations in English when they start school. Not only does the learning of Pinyin facilitate the development of awareness of phonemes in their first language (i.e. Chinese), but also suits the emotional needs that children are learning in their mother tongue.

On the other hand, in Hong Kong, where children are often educated in the bilingual Chinese-English environment, it is sensible to start learning phonological awareness in English rather than in Pinyin. The rationale for this choice is that the English phonetic system is closely matched to the reading and spelling of English words whereas Pinyin does not directly contribute to the reading and writing of Chinese characters. Learning phonological awareness in English can meaningfully help children to grasp the reading and spelling of English words. However, Pinyin does not offer direct clues to children to read or write Chinese characters. Thus, in such environment it will be more practical for Chinese children to start learning a phonetic system that is readily useful in the reading and spelling of the respective orthography.

The findings in Study 1 and Study 2 are a step toward providing the basis for future research. In future pedagogical studies, researchers can compare the effectiveness of the phonological interventions using different groupings or different linguistic units. For example, is one-to-one training more effective than small-group training? Can training in awareness of phonemes promote awareness of other linguistic units such as syllables and

subsyllables? The answer to these questions can maximise the outcomes of phonological training.

A limitation of both Study 1 and Study 2 is that children's reading abilities were not examined. In future research, researchers can also examine whether the effect of phonological training can transfer beyond phonological awareness. It is possible that phonological awareness training can have an effect on the reading of another orthography, based on the strong evidence in the literature that phonological awareness can promote reading development (Bus & van Ijzendoorn, 1999; Ehri et al., 2001; National Institute for Literacy, 2008). This can further unpack the role of phonological awareness plays in the processes of learning to read.

The present research is concluded by the assertion that phonological awareness is a unitary ability across language. The findings in Study 1 and Study 2 lend support to the language-general view. Some of the findings that seem to lend support to the language-specific view can be explained by a series of factors. Because the research has shown that phonological awareness is teachable and transferrable across languages, there is a need for teachers and policy makers to re-think the teaching of phonological awareness in a bilingual setting. The phonological awareness measures developed in Study 1 enable teachers and professionals to assess bilingual children's phonological awareness of English and Cantonese in parallel. The positive outcomes of the cross-language phonological training in Study 2 offer the possibility for children to use their knowledge of phonological awareness across languages. Teachers and policymakers can capitalise on the transferability of phonological awareness to help bilingual children develop phonological awareness in both languages easier and faster in today's society where diverse languages are being used every day.

List of Appendices

1. Manual for Phonological Awareness Assessment
2. Manual for Concepts About Print Assessment
3. Manual for Phonological Awareness Interventions (English and Cantonese)
4. Manual for Print Concepts Intervention
5. Ethical Approval of University of Oxford Central University Research Ethics Committee (CUREC)
6. CUREC/1A Checklist
7. Invitation letter to the head teachers
8. Information sheet for parents and parental consent form

Appendix 1

Cantonese Rhyme oddity

Step 1 (introduction):

有個新嘅找不同遊戲同你玩。我會講三個唔同嘅字，你要搵出邊個字係同其餘兩個字唔同。I say three different words. Find which word is odd word out.

Step 2 (practice items):

例如我講「車」、「遮」、「花」。「車」、「遮」、「花」邊個字聽落同其餘兩個字唔同？
「車」、「遮」、「花」，邊個特別唔同？[faa1 花] I say cece1(car) ze1(umbrella) faa1(flower), which one does not sound like the other two?

Step 3 (practice items):

咁我哋試下一組字：「蝦」、「刀」、「煲」。三個當中邊個唔同？[haa1 蝦] Let's try another set. **haa1(shrimp)** dou1(knife) bou1(pot), which one of them is very different from others?

Step 4 (assessment items):

下一組字：fo2 火 gau2 狗 so2 鎖。邊個特別唔同？Next set, fo2(fire) so2(lock) **gau2(dog)**, which one of them is particularly different from others?

a: 1st word chosen; b: 2nd word chosen; c: 3rd word chosen; n: none of above.

Score: 1 mark for each correct response. No mark for incorrect responses.

Item	Syllables	a	b	c	n	Score
Trial	ce1(car) ze1(umbrella) faa1(flower)					
Trial	haa1(shrimp) dou1(knife) bou1(pot)					
1.	fo2(fire) so2(lock) gau2(dog)					
2.	hau2(mouth) teoi2(leg) sau2(hand)					
3.	gai1(chicken) gwai1(tortoise) caa1(fork)					
4.	huk1(cry) bat1(pen) gwat1(bone)					
5.	sing1 (start) zuk1(bamboo) bing1 (ice)					
6.	luk6(six) muk6(wood) jyut6(moon)					
7.	syut3(snow) gaap3(pigeon) taap3(tower)					
8.	haai4(shoe) wan4(cloud) caai4 (firewood)					
	Total					

English Rhyme oddity

Step 1 (introduction):

Let's play a new game. I will say three words each time. You need to find out which word is the 'odd' one. That is, the one that doesn't sound like the rest of the two words.

Step 2 (practice items):

For example, I say men dad bad. You need to find out which one of the three words is the odd one. sail nail boot. Which one is the odd one? [boot]

Step 3 (practice items):

Let's try another group: sock hay tray. Which one is the odd one? [sock]

Step 4 (assessment items):

Next group: cat hat bell. Which one is the odd one?

a: 1st word chosen; b: 2nd word chosen; c: 3rd word chosen; n: none of above.

Score: 1 mark for each correct response. No mark for incorrect responses.

Item	Real-words	a	b	c	n	Score
Trial	sail nail boot					
Trial	bell cat hat					
1.	hay day see					
2.	peg cot leg					
3.	fish dish book					
4.	cup fan man					
5.	hen car pen					
6.	bun sun tap					
7.	paw boat goat					
8.	wall dog ball					
	Total					

Cantonese initial phoneme deletion task

Step 1 (introduction):

今次我哋玩返上次奇怪字嘅遊戲。今次遊戲會再難啲啲，會更好玩。同上次唔同。上次啲字係有幾個音加埋一齊。今次我哋玩啲字得返一個音，例如 baa1 爸。

玩法同上次一樣。我講一個字，你跟住我講個字，但你玩嘢，專登講漏最前個音。

因為今次個字得返一個音，你今次要講漏前面個啲啲音。

Step 2 (practice items):

例如我講摸 /mɔ2/，你淨係講鵝 /o2/，冇咗最前面嘅啲啲音/mɔ2/嘅 m 音。

我哋試多次：baa1 爸 [aa1 鴉]。

Step 3 (practice items):

例如我講米 /mai5/，你淨係講蟻 /ai5/，冇咗最前面嘅啲啲音/mai5/嘅 m 音。

我哋試多次：米 /mai5/。

Step 3 (assessment items):

下一個字：媽 /ma1/ 但唔使講最前面嘅啲啲音。

c: correct response; p: partially correct; i: incorrect response

Item	Real characters	c	p	i	Note
Trial	摸 /mo2/ (touch) => 鵝 /o2/ (goose)				(shared nasal m) CV
Trial	米 /mai5/ (rice) => 蟻 /ai5/ (ant)				(shared nasal m) CV
1.	抹 /maat3/ (wipe) => 壓 /aat3/ (press)				(shared nasal m) CVC
2.	麵 /min6/ (noodles) => /in6/ (n/a)				(shared nasal m) CVC
3.	手 /sau2/ (hand) => 嘔 /au2/ (vomit)				(shared fricative s) CV
4.	縮 /suk1/ (shrink) => 屋 /uk1/ (house)				(shared fricative s) CVC
5.	火 /fo2/ (fire) => 鵝 /o2/ (goose)				(shared fricative f) CV
6.	花 /faa1/ (flower) => 鴉 /aa1/ (crow)				(shared fricative f) CV
	Total				

English initial phoneme deletion task

Step 1 (introduction):

We will play the strange word game again. This time it will be more difficult so that you can have more fun.

Unlike last time, we had words made up of several sounds. This time we will play with words with one sound like 'tea'.

This time I will say a sound. Then you repeat without the first bit of the sound.

Step 2 (practice items):

For example, I say my /maɪ/, you just need to say 'i' /aɪ/, without m sound. Let's try again:
my /maɪ/.

Step 3 (practice items):

One more example. I say May /meɪ/. You say 'A' /eɪ/. You miss the first bit of m sound of 'May'.

Let's try again: May /meɪ/.

Step 4 (assessment items):

Next sound: say man /mæn/ without /m/. ['Ann' /æn/]

c: correct response; p: partially correct; i: incorrect response

Item	Real words	c	p	i	Notes
Trial	my /maɪ/ => 'I' /aɪ/				(shared nasal m) CV
Trial	May /meɪ/ => 'A' /eɪ/				(shared nasal m) CV
1.	man /mæn/ => 'Ann' /æn/				(shared nasal m) CVC
2.	mat /mæt/ => 'at' /æt/				(shared nasal m) CVC
3.	see /si:/ => 'E' /i:/				(shared fricative s) CV
4.	sit /sɪt/ => 'it' /ɪt/				(shared fricative s) CVC
5.	four /fɔ:(r)/ => /ɔ:(r)/				(shared fricative f) CV
6.	far /fɑ:(r)/ => /ɑ:(r)/				(shared fricative f) CV
	Total				

Cantonese final phoneme deletion task

Step 1 (introduction):

玩法同上次一樣。我講一個字，你跟住我講個個字，但你玩嘢，專登講漏最後個啲啲音。

Step 2 (practice items):

例如我講 tsaam1 參，你淨係講 tsaal 叉，冇咗 tsaam1 tsaam1 tsaam1 最後面嘅啲啲 m 音。我哋試多次：tsaam1 參 [tsaal 叉]。

Step 3 (assessment items):

下一個字：sam1 三 但唔使講最後面嘅啲啲。

c: correct response; p: partially correct; i: incorrect response

Item	Real characters	c	p	i	word read out
Trial	參 /caam1/ (participate) => 叉 /caa1/ (fork)				(shared nasal m) CVC
Trial	三 /saam1/ (three) => 沙 /saa1/ (sand)				(shared nasal m) CVC
1.	尖 /zim1/ (pointy) => 芝 /zi1/ (cheese)				(shared nasal n) CVC
2.	山 /saan1/ (mountain) => 沙 /saa1/ (sand)				(shared nasal n) CVC
3.	釘 /deng1/ (spike) => 爹 /de1/ (grandpa)				(shared nasal ŋ) CVC
4.	闊 /fut3/ (wide) => 富 /fu3/ (rich)				(shared plosive p) CVC
5.	葉 /jip6/ (leaves) => 二 /ji6/ (two)				(shared plosive t) CVC
6.	畫 /waak6/ (draw) => 話 /waa6/ (speak)				(shared plosive k) CVC
	Total				

English final phoneme deletion task

Step 1 (introduction):

Like last time, I will say a sound. Then you repeat without the **last** bit of the sound.

Step 2 (practice items):

For example, I say hide /haɪd /, but you say hide /haɪd / without d. So what will you say?

[high /haɪ/]

That is, I say hide /haɪd/, you just need to say high /haɪ/ without the last sound d at the end.

Let's try again: hide /haɪd/ [high /haɪ/]

Step 3 (assessment items):

Next sound : say need /ni:d/ without the last bit of the sound. [knee /ni:/].

c: correct response; p: partially correct; i: incorrect response

Item	Real words	c	p	i	word read out
Trial	hide /haɪd / => high /haɪ/				(exclusive plosive) CVC
Trial	need /ni:d/ => knee /ni:/				(exclusive plosive) CVC
1.	team /ti:m/ => tee /ti:/				(exclusive plosive g) CVC
2.	bean /bi:n/ => bee /bi:/				(exclusive fricative f) CVC
3.	song /sɔ:ŋ/ => saw /sɔ:/				(exclusive affricate tʃ) CVC
4.	beef /bi:f/ => bee /bi:/				(shared plosive k) CVC
5.	bowl /bəʊl/ => bow /bəʊ/				(shared nasal n) CVC
6.	pour /pɔ:r/ => paw /pɔ:/				(shared nasal ŋ) CVC
	Total				

Appendix 2

Manual for Concepts About Print Assessment

Administration Instructions for <i>Sand, Stones, Follow Me, Moon and No Shoes</i>	
Say to the child: <i>'I'm going to read you this story but I want you to help me.'</i>	
COVER	
Item 1	Test: For orientation of book. Pass the book to the child, holding it vertically by outside edge, spine towards the child. Say: <i>'Show me the front of this book.'</i> Score: 1 point for the correct response.
PAGES 2/3	
Item 2	Test: Concept that print, not picture, carries the message. Say: <i>'I'll read this story. You help me. Show me where to start reading. Where do I begin to read?'</i> Read the text on page 2. Score: 1 point for print. 0 for picture.
PAGES 4/5	
Item 3	Test: For directional rules. Say: <i>'Show me where to start.'</i> Score: 1 point for top left.
Item 4	Test: Moves left to right on any line. Say: <i>'Which way do I go?'</i> Score: 1 point for left to right.
Item 5	Test: Return sweep. Say: <i>'Where do I go after that?'</i> Score: 1 point for return sweep to left, or for moving down the page. (Score items 3–5 if all movements are demonstrated in one response.)
Item 6	Test: Word-by-word pointing. Say: <i>'Point to it while I read it.'</i> Read the text on page 4 slowly but fluently. Score: 1 point for exact matching.
PAGE 6	
Item 7	Test: Concept of first and last. Read the text on page 6. The child must NOT continue word-by-word pointing. Say: <i>'Show me the first part of the story.'</i> <i>'Show me the last part.'</i> Score: 1 point if BOTH are correct in any sense, that is, applied to the whole text or to a line, or to a word, or to a letter.
PAGE 7	
Item 8	Test: Inversion of picture. Say: (slowly and deliberately) <i>'Show me the bottom of the picture.'</i> (Do NOT mention upside-down.) Score: 1 point for verbal explanation, OR for pointing to top of page, OR for turning the book around and pointing appropriately.
PAGES 8/9	
Item 9	Test: Response to inverted print. Say: <i>'Where do I begin?'</i> <i>'Which way do I go?'</i> <i>'Where do I go after that?'</i> Read the text on page 8 now. Score: 1 point for beginning with 'The' (<i>Sand</i>), or 'I' (<i>Stones</i>), or 'I' (<i>Moon</i>), or 'Leaves' (<i>Shoes</i>), and moving right to left across the lower and then the upper line. OR 1 point for turning the book around and moving left to right in the conventional manner.
PAGES 10/11	
Item 10	Test: Line sequence. Say: <i>'What's wrong with this?'</i> Read immediately the bottom line first, then the top line. Do NOT point. Score: 1 point for comment on line order.
PAGES 12/13	
Item 11	Test: A left page is read before a right page. Say: <i>'Where do I start reading?'</i> Score: 1 point for indicating the left page.
Item 12	Test: Word sequence. Say: <i>'What's wrong on this page?'</i> (Point to page number 12 , NOT the text.) Read the text on page 12 slowly as if it were correctly printed. Score: 1 point for comment on either error.
Item 13	Test: Letter order. (Changes to first or last letters.) Say: <i>'What's wrong on this page?'</i> (Point to page number 13 , NOT the text.) Read the text on page 13 slowly as if it were correctly printed. Score: 1 point for any ONE re-ordering of letters that is noticed and explained.

PAGES 14/15

- Item 14** Test: Re-ordering of letters within a word.
Say: 'What's wrong with the WRITING on this page?'

Read the text on page 14 slowly as if it were correctly printed.

Score: 1 point for ONE error noticed.

- Item 15** Test: Meaning of a question mark.
Say: 'What's this for?' (Point to or trace the question mark with a finger or pencil.)

Score: 1 point for explanation of function or name.

PAGES 16/17

Test: Punctuation.

Read the text on page 16.

Say: 'What's this for?'

- Item 16** Point to or trace with a pencil, the full stop (period).

Score: 1 point.

- Item 17** Point to or trace with a pencil, the comma.

Score: 1 point.

- Item 18** Point to or trace with a pencil, the quotation marks.

Score: 1 point.

- Item 19** Test: Capital and lower case letters.

Say: 'Find a little letter like this.'

Sand: Point to capital T and demonstrate by pointing to an upper case T and a lower case t if the child does not succeed.

Stones: As above for S and s.

Moon: As above for P and p.

Shoes: As above for W and w.

Say: 'Find a little letter like this.'

Sand: Point to capital M, H in turn.

Stones: Point to capital T, B in turn.

Moon: Point to capital M, I in turn.

Shoes: Point to capital M, I in turn.

Score: **Sand:** 1 point if BOTH m and h are located.

Stones: 1 point if BOTH t and b are located.

Moon: 1 point if BOTH m and i are located.

Shoes: 1 point if BOTH m and i are located.

PAGES 18/19

- Item 20** Test: Words that contain the same letters in a different order.

Read the text on page 18.

Say: 'Show me "was".'

'Show me "no".'

Score: 1 point for BOTH correct.

PAGE 20

Have two pieces of light card (13 cm x 5 cm) that the child can hold and slide easily over the line of text to block out words and letters. To start, lay the cards on the page but leave all print exposed. Open the cards out between each question asked.

- Item 21** Test: Letter concepts.

Say: 'This story says:

Sand: "The waves splashed in the hole".

Stones: "The stone rolled down the hill".

Moon: "The moon followed me home".

Shoes: "My shoes were by the river".

I want you to push the cards across the story like this until all you can see is (deliberately with stress) **JUST ONE LETTER.**' (Demonstrate the movement of the cards but do not do the exercise.)

Speak deliberately. Stress the item.

Say: 'Now show me two letters.'

Score: 1 point if BOTH are correct.

- Item 22** Test: Word concept.

Say: 'Show me just one word.'

'Now show me two words.'

Score: 1 point if BOTH are correct.

- Item 23** Test: First and last letter concepts.

Say: 'Show me the first letter of a word.'

'Show me the last letter of a word.'

Score: 1 point if BOTH are correct.

- Item 24** Test: Capital letter concepts.

Say: 'Show me a capital letter.'

Score: 1 point if correct.

See page 45 for quick reference to scoring standards for this task.

Concepts About Print Score Sheet

ID		GROUP	DATE	SCORE
PAGE	SCORE	ITEM	COMMENT	
Cover		1. Front of book		
2/3		2. Print contains message		
4/5		3. Where to start		
4/5		4. Which way to go		
4/5		5. Return sweep to left		
4/5		6. Word-by-word matching		
6		7. First and last concept		
7		8. Bottom of picture		
8/9		9. Begins 'The' (Sand) Begins T (Stones) Begins T (Moon) Begins 'Leaves' (Shoes) bottom line, then top, OR turns book		
10/11		10. Line order altered		
12/13		11. Left page before right		
12/13		12. One change in word order		
12/13		13. One change in letter order		
14/15		14. One change in letter order		
14/15		15. Meaning of a question mark		
16/17		16. Meaning of full stop (period)		
16/17		17. Meaning of comma		
16/17		18. Meaning of quotation marks		
16/17		19. Locate: m h (Sand), t b (Stones); m i (Moon); m i (Shoes)		
18/19		20. Reversible words 'was', 'no'		
20		21. One letter: two letters		
20		22. One word: two words		
20		23. First and last letter of word		
20		24. Capital letter		

Appendix 3

Phonological Awareness Training

Syllable awareness training

The training of syllable awareness comprises three components. The pace of going through these components depends on children's individual ability. More able children can progress more complex training faster or even skip the training, depending on the child's performance throughout the training.

1. Syllable size comparison (English)

Duration

5 minutes

Objective

Student will be able to differentiate syllables of various size

Materials

Picture of words of mono-syllabic, bi-syllabic, and tri-syllabic words

Lead in

Some words sound very short. Some words sound quite long. Today we are going to find out which words sound shorter and which words sound longer.

Presentation/ Instruction

Some words sound very short. Like egg (clap hand), boy (clap), mum (clap). They just have one bit of the sound. Some other words sound longer, like teacher (clap clap), window (clap clap). They all have two bits of sound. Some words sound quite long because they have three bits of sound, like banana (clap clap clap), elephant (clap clap clap).

Practice

Let's listen to a pair of words. Tell me which word sounds longer to you.

Item no.	1	2	3	4	5	6	7	8	9	10
Items	leg	<u>sofa</u>	panda	tea	<u>jacket</u>	door	cow	ferry	<u>computer</u>	car
	<u>finger</u>	bed	<u>butterfly</u>	<u>hamburger</u>	hat	<u>window</u>	<u>tiger</u>	<u>bicycle</u>	book	<u>taxi</u>

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Ask the child to pay attention to the differences in the pair. Leg, finger. One of them has more bits of sound. <input type="checkbox"/> Use clapping as a tool Ask the child to tap out the number of syllables.

	<input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use simpler questions, e.g. use open-ended questions instead of open-ended questions <i>Leg, finger. Does 'finger' sound shorter than 'leg'?</i> <input type="checkbox"/> Lower the demand of response, accept simpler responses <i>Leg, finger. Which one sounds longer? Answer me 'one' if the first word is longer, 'two' if the second word is longer.</i>

Progression

Stopping rules	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	<p>After the child answered the final item, a checking question is asked. The question checks if the child understood the concepts of syllable size.</p> <p><i>e.g. [Scored 5 consecutive passes at 8th item] Why is 'bicycle' longer than 'ferry'? How do you know? You can clap to show me how you get the answer.</i></p> <p>This helps to decide which training the child should progress to, as follows:</p> <ol style="list-style-type: none"> 1. Five consecutive passes + passed the checking question ⇒ Go to Sub-syllabic (rimes) training directly 2. Five consecutive passes + failed the checking question ⇒ Proceed to Syllable size ordering 3. No five consecutive passes ⇒ Proceed to Syllable size ordering

1. Syllable size comparison (Chinese)

Duration

5 minutes

Objective

Student will be able to differentiate syllables of various size

Materials

Picture of words of mono-syllabic, bi-syllabic, and tri-syllabic words

Lead in

有啲字聽落好短，而又有啲字聽落好長。今日我哋去搵下有啲咩字聽落好短，或是聽落好長。
 (Some words sound very short. Some words sound quite long. Today we are going to find out which words sound shorter and which words sound longer.)

Presentation/ Instruction

有啲字聽落好短，就好似蛋(clap), 人(clap), 車(clap)等等。呢啲字都只有一粒音。有啲字聽落長少，好似老師(clap clap), 課室(clap clap)。呢啲字都有兩粒音。而仲有啲字聽落好長，因為佢哋有三粒音，就好似朱古力(clap clap clap), 大笨象(clap clap clap) 等等。

(Some words sound very short. Like egg (clap hand), man(clap), car (clap). They just have one bit of the sound. Some other words sound longer, like teacher (clap clap), classroom (clap clap). They all have two

bits of sound. Some words sound quite long because they have three bits of sound, like chocolate (clap clap clap), elephant (clap clap clap).

Practice

Instructions

我哋一齊留心聽住一對一對嘅字。話我知邊個字先係聽落去短啲。你到時要答我「一」定係「二」。「一」即係指第一字，「二」係第個字。

(Let's listen to a pair of words. Tell me which word sounds longer to you. Answer me 'one' for the first word being longer, 'two' for the second word being longer.)

The pairs of words for Practice 1

1	2	3	4	5	6	7	8	9	10
腳	沙發	貓	茶	冷衫	窗	牛	船	電腦	車
手指	床	蝴蝶	漢堡包	帽	門口	老虎	單車	書	的士
Translation									
<i>leg</i>	<i>sofa</i>	<i>cat</i>	<i>tea</i>	<i>jacket</i>	<i>window</i>	<i>cow</i>	<i>ferry</i>	<i>computer</i>	<i>car</i>
<i>finger</i>	<i>bed</i>	<i>butterfly</i>	<i>hamburger</i>	<i>hat</i>	<i>door</i>	<i>tiger</i>	<i>bicycle</i>	<i>book</i>	<i>taxi</i>

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Ask the child to pay attention to the differences in the pair. Leg, finger. One of them has more bits of sound. <input type="checkbox"/> Use clapping as a tool Ask the child to tap out the number of syllables. <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use simpler questions, e.g. use open-ended questions instead of open-ended questions <i>Leg, finger. Does 'finger sound shorter than 'leg'?</i> <input type="checkbox"/> Lower the demand of response, accept simpler responses <i>Leg, finger. Which one sounds longer? Answer me 'one' if the first word is longer, 'two' if the second word is longer.</i>

Progression

Stopping rules	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	After the child answered the final item, a checking question is asked. The question checks if the child understood the concepts of syllable size. <i>e.g. [Scored 5 consecutive passes at 8th item] Why is 'bicycle' longer than 'ferry'? How do you know? You can clap to show me how you get the answer.</i> This helps to decide which training the child should progress to, as follows:

	<p>4. Five consecutive passes + passed the checking question ⇒ Go to Sub-syllabic (rimes) training directly</p> <p>5. Five consecutive passes + failed the checking question ⇒ Proceed to Syllable size ordering</p> <p>6. No five consecutive passes ⇒ Proceed to Syllable size ordering</p>
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2. Syllable size ordering (English)

Duration

5 minutes

Objective

Student will be able to arrange syllables according to their size

Materials

Picture of words of mono-syllabic, bi-syllabic, and tri-syllabic words

Lead in

This time we will do something different. We will put pictures in the order of the bits of sound, but not the actual size.

Presentation/ Instruction

There are three pictures. Put these pictures in the order of bits of sound. You should start with the one with fewest bits of sound.

The trios of words for syllable size ordering

Item no.	1	2	3	4	5	6
Items	ball	fish	dog	bus	milk	chair
	Lego	dolphin	monkey	lorry	chicken	toilet
	computer	octopus	elephant	bicycle	banana	microwave

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Ask the child to compare a pair of words, instead of a trio, to make noticing the difference in syllables easier. <i>So monkey is put before dog. Monkey, dog. Monkey dog. Which one sounds like having more bits of sound?</i> <input type="checkbox"/> Use clapping as a tool Ask the child to tap out the number of syllables. <i>How many bits of sound for bicycle? Let's tap out the bits.</i>

	<input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again e.g. Which one has the fewest bits of sound? Ball, Lego, or computer?

Progression

Stopping rules	Two consecutive trios in correct order. The probability of getting all two consecutive trios correct is 0.028, which is statistically significant.
Progression rules	<p>After the child answered the final item, a checking question is asked. The question checks if the child understood the concepts of syllable size. <i>So 'monkey' is put after 'dog'. Why is 'monkey' longer than 'dog'? You can clap to show me how you get the answer.</i></p> <p>This helps to decide which training the child should progress to, as follows:</p> <ol style="list-style-type: none"> Two consecutive passes + passed the checking question ⇒ Go to Sub-syllabic (rimes) training directly Two consecutive passes + failed the checking question ⇒ Proceed to Syllable size grouping No two consecutive passes ⇒ Proceed to Syllable size grouping

2. Syllable size ordering (Chinese) (牛牛排隊)

Duration

5 minutes

Objective

Student will be able to arrange syllables according to their size

Materials

Picture of words of mono-syllabic, bi-syllabic, and tri-syllabic words

Lead in

今次我哋做啲唔同嘅嘢。我哋要幫牛牛將一啲圖畫重新排好，但要根呢啲圖畫有幾多粒音去排，唔係根佢哋嘅大細。

(This time we will do something different. We will put pictures in the order of the bits of sound, but not the actual size.)

Presentation/ Instruction

呢度有三幅圖畫。宜家將呢三幅圖畫由最少粒音開始排起，最尾係最多粒音。

(There are three pictures. Put these pictures in the order of bits of sound. You should start with the one with fewest bits of sound.)

The trios of words for syllable size ordering

Item no.	1	2	3	4	5	6
Items	波	魚	狗	船	雞	櫈

	電腦	海豚	馬騮	貨車	牛奶	廁所
	顏色筆	八爪魚	大笨象	電單車	車厘子	微波爐
	Translation					
	<i>ball</i>	<i>fish</i>	<i>dog</i>	<i>ship</i>	<i>chicken</i>	<i>chair</i>
	<i>computer</i>	<i>dolphin</i>	<i>monkey</i>	<i>lorry</i>	<i>milk</i>	<i>toilet</i>
	<i>colour pen</i>	<i>octopus</i>	<i>elephant</i>	<i>motorbike</i>	<i>cherry</i>	<i>microwave</i>

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Ask the child to compare a pair of words, instead of a trio, to make noticing the difference in syllables easier. <i>So monkey is put before dog. Monkey, dog. Monkey dog. Which one sounds like having more bits of sound?</i> <input type="checkbox"/> Use clapping as a tool Ask the child to tap out the number of syllables. <i>How many bits of sound for bicycle? Let's tap out the bits.</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again e.g. Which one has the fewest bits of sound? Ball, Lego, or computer?

Progression

Stopping rules	Two consecutive trios in correct order. The probability of getting all two consecutive trios correct is 0.028, which is statistically significant.
Progression rules	<p>After the child answered the final item, a checking question is asked. The question checks if the child understood the concepts of syllable size. <i>So 'monkey' is put after 'dog'. Why is 'monkey' longer than 'dog'? You can clap to show me how you get the answer.</i></p> <p>This helps to decide which training the child should progress to, as follows:</p> <ol style="list-style-type: none"> Two consecutive passes + passed the checking question ⇒ Go to Sub-syllabic (rimes) training directly Two consecutive passes + failed the checking question ⇒ Proceed to Syllable size grouping No two consecutive passes ⇒ Proceed to Syllable size grouping

3. Syllable size grouping (English)

Duration

5 minutes

Objective

Student will be able to identify the number of syllables in a word

Materials

- Picture of words of mono-syllabic, bi-syllabic, and tri-syllabic words
- Cards with number 1, 2, and 3

Lead in

This time we will do something more. I want to group words by their bits of sound.

Presentation/ Instruction

I will give you some pictures. Please group them according to the according to how many bits of sound in that word.

No. of syllables	1	2	3
Items	dog	monkey	butterfly
	sheep	rabbit	elephant
	duck	tiger	kangaroo
	pig	giraffe	octopus

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put kangaroo for two bits of sound. We have tiger for the two bits of sound. Kangaroo, tiger, kangaroo, tiger, can you hear the difference?</i> <input type="checkbox"/> Use clapping as a tool Ask the child to tap out the number of syllables. <i>How many bits of sound for kangaroo? Let's tap out the bits.</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again

Progression

Stopping rule	Three consecutive items in correct grouping. The probability of getting three consecutive correctly matched is at least 0.048, which is statistically significant.
Progression rules	Any performance ⇒ Go to Sub-syllabic (rimes) training directly

3. Syllable size grouping (Chinese) (動物返屋企)

Duration

5 minutes

Objective

Student will be able to identify the number of syllables in a word

Materials

- Picture of words of mono-syllabic, bi-syllabic, and tri-syllabic words
- Cards with number 1, 2, and 3

Lead in

This time we will do something more. I want to group words by their bits of sound.

Presentation/ Instruction

我會俾啲圖畫你。你要幫牛牛將啲動物放入唔同的屋企。得一粒音嘅動物放落數字 1 嘅屋企。得兩粒音嘅放落數字 2 嘅屋企。得三粒音嘅放落數字 3 嘅屋企

[I will give you some pictures. Please group them according to the according to how many bits of sound in that word. Put animals with one bit of sound to home number 1. Put those with two bits of sound to home number 2. And put animals with three bits of sound to home number three.]

No. of syllables	1	2	3
Items	狗 gau2	蝴蝶 wu4 dip6	長頸鹿 coeng4 geng2 luk6
	兔 tou3	馬騮 maa5 lau4	大笨象 daai6 ban6 zoeng6
	鴨 aap3	老虎 lou5 fu2	八爪魚 baat3 zaau2 jyu4
	豬 zyu1	袋鼠 doi6 syu2	貓頭鷹 maau1 tau4 jing1
	Translation		
	<i>dog</i>	<i>butterfly</i>	<i>giraffe</i>
	<i>rabbit</i>	<i>monkey</i>	<i>elephant</i>
	<i>duck</i>	<i>tiger</i>	<i>octopus</i>
	<i>pig</i>	<i>kangaroo</i>	<i>owl</i>

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put kangaroo for two bits of sound. We have tiger for the two bits of sound. Kangaroo, tiger, kangaroo, tiger, can you hear the difference?</i> <input type="checkbox"/> Use clapping as a tool Ask the child to tap out the number of syllables.

	<input type="checkbox"/> <i>How many bits of sound for kangaroo? Let's tap out the bits.</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again

Progression

Stopping rule	Three consecutive items in correct grouping. The probability of getting three consecutive correctly matched is at least 0.048, which is statistically significant.
Progression rules	Any performance ⇒ Go to Sub-syllabic (rimes) training directly

Sub-syllable (rime) awareness training

Sub-syllables include onsets and rimes. However, there are no consonant clusters in Cantonese. The onsets of Cantonese syllables are single phonemes. Therefore, for a comparable training, only rimes will be included in sub-syllable training whereas onsets will be included in the upcoming phoneme training.

1. Rhyme comparison (English)

Objective

Student will be able to compare and identify rhyming words.

Materials

Picture of words of rhyming words and distractors

Lead in

Today we are going to find out some words that nearly sound the same. For example, words like 'fat' [picture], 'cat' [picture], and hat [picture] nearly sound the same.

Presentation/ Instruction

Today we are feeding some cows. However, these cows are magic cows. They don't feed on grass. They feed on things that sound like their names. For example, look, book, cook sound almost the same. When this cow, named 'look', it feeds on book, and cook. These words have the same ending bits of sound. Listen carefully. Look [stressed], book [stressed], cook [stressed]. They have the same endings bits ending. Listen again, Look [stressed], book [stressed], cook [stressed].

Now you have three things to choose. The cow only eats one of them. If you pick the wrong one, the cows will get angry and eat you.

So this cow is called 'Fat. What does he feed on?

Items to eat:

car	<u>cat</u>	pen
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Practice

Now you had something to eat. But your friends are so hungry. So what do your monster friends eat?

Monster			
1. Moon	<u>spoon</u>	man	pen
2. Pan	pie	<u>can</u>	cat
3. Frog	tie	fire	<u>dog</u>
4. Tail	tea	rain	<u>snail</u>
5. Sun	sweet	<u>bun</u>	ball
6. Bee	<u>key</u>	bread	hair

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put bee and bread together. Does bee sounds like bread? Bee, bread, bee, bread. Do you think they sound almost the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again Bee, bread. Bee, bread. Do they sound almost the same? Yes or No?

Progression

Stopping rule	Three consecutive passes. The probability of getting all three consecutive passes is 0.037, which is statistically significant.
Progression rules	Three consecutive passes ⇒ Go to Phoneme training directly < three consecutive passes ⇒ Go to Rhyme grouping

1. Rhyme comparison (Chinese)(餵牛牛)

Objective

Student will be able to compare and identify rhyming words.

Materials

Picture of words of rhyming words and distractors

Lead in

今日我哋會睇下有啲字聽落好似。例如星 *sing1*、冰 *bing1*、鷹 *jing1*

(Today we are going to find out some words that nearly sound the same. For example, words like 'star' [picture], 'ice' [picture], and 'eagle' [picture] nearly sound the same.)

Presentation/ Instruction

有啲字聽落去好似一樣，因為呢啲字個音最尾嗰啲部份都係一樣。留心聽住，星 *sing1*[stressed]，冰 *bing1*[stressed]。佢哋個音最尾嗰啲部份都係一樣。聽多次，星 *sing1*[stressed]，冰 *bing1*[stressed]。

(Some words sound almost the same because they have the same ending bits of sound. Listen carefully. star [stressed], ice [stressed]. They have the same endings bits ending. Listen again, cat [stressed], hat [stressed].)

有嘅怪獸淨係食同佢個名好似嘅嘢。例如雲 (*wan4*) 先生/小姐淨係食塵 (*can4*)。貓 (*maau1*) 先生/小姐淨係食包 (*baau1*)。咁你宜家係星 (*sing1*) 先生/小姐，你會食咩?

(Some monsters only eat things that sound like his name. So Mr. Paddy likes to eat lots of candy. Mr. Head likes to eat bread. So you're Mr./Ms. Star [give a picture of star to the child]. You're so hungry. What will you eat? Remember your name is Star. [Read out the items to be eaten by the child one by one])

Items to eat:

沙 saa1	鷹 <u>jing1</u>	火 fo2
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Practice

你宜家就食餓。但你哋怪獸朋友好肚餓。咁你哋怪獸朋友會食啲咩? (Now you had something to eat. But your friends are so hungry. So what do your monster friends eat?)

Monster			
1. 雞 gai1	龜 <u>gwai1</u>	菇 gu1	火 fo2
2. 電 din6	豆 dau6	面 <u>min6</u>	包 baau1
3. 狗 gau2	帽 mou6	頸 <u>geng2</u>	手 sau2
4. 果 gwo2	牛 ngau4	鼓 gu2	火 <u>fo2</u>
5. 蛋 daan6	豆 dau6	飯 <u>faan6</u>	簿 bou6
6. 雀 zoek3	腳 <u>goek3</u>	箭 zin3	魚 jyu4

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put din6 and din6 together. Does din6 sounds like din6? Din6, din6, din6, din6. Do you think they sound almost the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again Din6, din6. Din6, din6. Do they sound almost the same? Yes or No?

Progression

Stopping rule	Three consecutive passes. The probability of getting all three consecutive passes is 0.037, which is statistically significant.
Progression rules	Three consecutive passes ⇒ Go to Phoneme training directly < three consecutive passes ⇒ Go to Rhyme grouping

2. Rhyme grouping (English)

Objective

Student will be able to differentiate rhyming words from other words

Materials

Picture of sets of words of rhyming words

Lead in

Today we are going to find out some words that nearly sound the same. For example, words like 'fat' [picture], 'cat' [picture], and hat [picture] nearly sound the same. Another example is dog [picture], frog [picture], and log [picture].

[Pictures of rhyming words are presented while reading out the sentences composed of these rhyming words]

A fat cat with a hat.

A dog and a frog sit on a log.

Look! A cook eats a book.

Presentation/ Instruction

These words sound almost the same because they have the same bits of sound at the end. Put those pictures with the same ending bits of sound side by side.

cat	fat	cook	look
-----	-----	------	------

Practice

[Put the pictures of 'cat', 'dog', and 'look' in a row and give other pictures to the child]

These pictures [point to the remaining pictures] belong to three groups: 'cat', 'dog', and 'look' [point to 'cat', 'dog', and 'look']. Put these pictures [point to the remaining pictures] under these three pictures [point to 'cat', 'dog', and 'look'] if they sound almost the same.

fat	dog	look
cat	frog	cook
hat	log	book

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put 'cat' and 'cook' together. Does 'cat' sound like 'cook'? 'cat', 'cook', 'cat', 'cook'.</i> <i>Do you think they sound almost the same?</i> <input type="checkbox"/> More clearly enunciated

No response	<input type="checkbox"/> Give simpler instructions again <i>When the pictures sound similar to each other, put them together. For example, if 'cat' sounds like 'log', then put them together and under 'fat'. If 'cat' and 'log' do not sound like each other, then find another pictures that sound almost the same.</i>
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Progression

Stopping rule	Four consecutive items placed correctly. The probability of getting all four consecutive passes is 0.022, which is statistically significant.
Progression rules	Four consecutive items correct ⇒ Go to Phoneme training directly < Four consecutive items correct ⇒ Go to Phoneme training directly

2. Rhyme grouping (Chinese)(牛牛去買餸)

Objective

Student will be able to differentiate rhyming words from other words

Materials

Picture of sets of words of rhyming words

Lead in

頭 tau[picture]、樓 lau4[picture]、手 sau2[picture]，佢哋都聽落好似一樣咁。另一個例子係坐 zo6[picture]、果 gwo2[picture]、歌 go1[picture]。

(Today we are going to find out some words that nearly sound the same. For example, words like 'fat' [picture], 'cat' [picture], and hat [picture] nearly sound the same. Another example is dog [picture], frog [picture], and log [picture].)

Presentation/ Instruction

牛牛宜家去幫三個朋友買嘢食。但佢呢三個朋友一齊玩牛牛，無明要食啲咩，係唱咗首歌俾牛牛，要佢估下大家想食啲咩。

牛牛請你幫下佢手，去估下要買啲咩嘢食俾牛牛嘅朋友。

[邊唱邊展示圖畫]

[Little Cow is going to buy something for his friends to eat. However, his friends do not tell him what to buy. Instead, each one of them sing a song to him. Little Cow has to guess what his friends want from the songs.]

[Pictures of rhyming words are presented while reading out the sentences composed of these rhyming words] (Rhyming words underlined)

肥仔個頭 tau4，大過五層樓 lau4，肥仔隻牛 ngau4，細過荷蘭豆 dau2

排排包 baau1，食貓 貓 maau1，坐埋一齊食膠 gaau1。

攞尿豬 zyu1，煲冬廚 cyu1，煮唔熟，賴亞書 syu1。

Practice

有啲字聽落好似。呢到有係三組唔同嘅音[放好頭、坐、蝦的圖片]，不如我哋幫牛牛將呢啲聽落似嘅字放上去。

[These pictures belong to three groups. Those, which sound similar, will be in one group.]

頭 tau4	包 baau1	豬 zyu1
樓 lau4	貓 maau1	廚 cyu1
牛 ngau4	膠 gaau1	書 syu1
Translation		
<i>head</i>	<i>sit</i>	<i>shrimp</i>
<i>building</i>	<i>fruit</i>	<i>melon</i>
<i>hand</i>	<i>song</i>	<i>mom</i>

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put 'lau4' and 'go1' together. Does 'lau4' sound like 'go1'? 'lau4', 'go1', 'lau4', 'go1'. Do you think they sound almost the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Give simpler instructions again <i>When the pictures sound similar to each other, put them together. For example, if 'cat' sounds like 'log', then put them together and under 'fat'. If 'cat' and 'log' do not sound like each other, then find another pictures that sound almost the same.</i>

Progression

Stopping rule	Four consecutive items placed correctly. The probability of getting all four consecutive passes is 0.022, which is statistically significant.
Progression rules	Four consecutive items correct ⇒ Go to Phoneme training directly < Four consecutive items correct ⇒ Go to Phoneme training directly

3. Rhyme filling (English)

Objective

Student will be able to select rhyming words to form a poem.

Materials

Picture of sets of words rhyming words and distractors.

Lead in

Let's make a funny poem today. I will give you the first sentence. Let's finish the rest of the poem together.

Presentation/ Instruction

Trial poem: **I had a little chat, with a little cat, who's very fat, wearing a little hat.**

Let me say the two sentences: *I had a little chat [picture of chat], with a little cat [picture of a cat]. Chat, cat, chat, cat. Do they sound alike?*

Practice

Now let's finish the rest of the poem. *I have a little chat, with a little cat, who is very... what? You can pick one from three pictures [fat, skinny, strong].*

I have a little chat, with a little cat, who is very fat? Does it feel good?

I have a little chat, with a little cat, who is very skinny?

I have a little chat, with a little cat, who is very strong?

Which one you feel is the best?

Fat	Hat
Skinny	Tie
strong	dress

Let's make more poems.

Poem 1: **Summer is fun, with a big hot sun. I have a water gun, you'd better run.**

Sun	Water gun	Run
Moon	Bicycle	Jump
Star	computer	Sleep

Poem 2: **Here's an old man, living in an old van. He is selling an old pan, to buy a new fan.**

Van	Pan	Fan
Truck	Fork	Book
Taxi	Cup	Fish

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put 'cat' and 'skinny' together. Does 'cat' sound like 'skinny'? 'cat', 'skinny', 'cat', 'skinny'. Do you think they sound almost the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Give simpler instructions again <i>When the pictures sound similar to each other, put them together. For example, if 'cat' sounds like 'hat', then put them together to form a poem.</i>

Progression

Stopping rule	Three consecutive items placed correctly. The probability of getting all three consecutive passes is 0.037, which is statistically significant.
Progression rules	Four consecutive items correct ⇒ Go to Phoneme training directly < Four consecutive items correct ⇒ Go to Phoneme training directly

3. Rhyme filling (Chinese) (牛牛作童謠)

Objective

Student will be able to select rhyming words to form a poem.

Materials

Picture of sets of words rhyming words and distractors.

Lead in

今日我哋一齊作呢好好笑嘅詩歌。

[Let's make a funny poem today. I will give you the first sentence. Let's finish the rest of the poem together.]

Presentation/ Instruction

Trial poem: 飛天大老鼠，頭頂生番薯，對眼似金魚，嚇親小公主。

我作頭兩句。飛天大老鼠 syu2 [picture]，頭頂生番薯 syu2 [picture]。鼠 syu2、薯 syu2，鼠 syu2、薯 syu2，聽落似唔似?

[Let me say the two sentences: A flying rat [picture of rat], growing a sweet potato [picture of a sweet potato] on his head. Syu2, syu2, syu2, syu2. Do they sound alike?]

Practice

我哋宜家作晒成首詩歌。你可以由三張圖片當中揀一張。

飛天大老鼠 syu2，頭頂生番薯 syu2，對眼似金魚 jyu2? 聽落順唔順?

飛天大老鼠，頭頂生番薯，對眼似斑馬?

飛天大老鼠，頭頂生番薯，對眼似烏龜?

[Now let's finish the rest of the poem. I have a little chat, with a little cat, who is very... what? You can pick one from three pictures].

金魚	公主
斑馬	醫生
烏龜	警察

Let's make more poems.

Poem 1: 天上大麻鷹 jing1，地上大猩猩 sing1，邊個大眼睛 zing1? 贏咗食刨冰 bing1。

猩猩	眼睛	刨冰
大熊	鼻子	水果
河馬	嘴巴	蛋糕

Poem 2: 小公雞 gai1，扮烏龜 gwai1，上樓梯 tai1，戴頭盔 kwai1

烏龜	樓梯	頭盔
熊貓	山坡	頸巾
小貓	輪船	手錶

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you put 'syu2' and 'jyu2' together. Does 'syu2' sound like 'jyu2'? 'syu2', 'jyu2', 'syu2', 'jyu2'. Do you think they sound almost the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Give simpler instructions again <i>When the pictures sound similar to each other, put them together. For example, if 'syu2' sounds like 'jyu2', then put them together to form a poem.</i>

Progression

Stopping rule	Three consecutive items placed correctly. The probability of getting all three consecutive passes is 0.037, which is statistically significant.
Progression rules	Four consecutive items correct \Rightarrow Go to Phoneme training directly < Four consecutive items correct \Rightarrow Go to Phoneme training directly

Phoneme awareness training

1. Onset recognition (English)

Objective

Children will be able to be aware of the onsets of syllables, based on their understanding of rimes.

Materials

Sets of four rhyming pictures that match the written word endings on card (cat, hat, fat, bat)

Lead in

Last time we worked on the last bits of the sound. This time we will pay attention to the first bit of the sound.

Presentation/ Instruction

Recalling we have fat, cat, hat, mat [show the set of pictures with the rime 'at']. They sound almost the same. This time we listen to these words very carefully. There is only a small difference across these words. It is the first bit of the sound.

Practice 1

*Is this pair of words the **same**? Yes or No.*

Pair of words	Same?	Pair of words	Same?
1. fat cat	N	2. book cook	N
3. pan pan	Y	4. sock sock	Y
5. ball tall	N	6. sun bun	N
7. nail nail	Y	8. sing king	N
9. tea bee	N	10. cake make	N

Practice 2

After the child answered the final item (or the previous item with difference if the final item has identical pair), ask the child about how he/she deduces the answer.

How do you tell why 'cake' and 'make' are not the same?

Prompt the child to pay attention to the onset

You might pay attention to the first bit of the sound of these two words. 'Cake' and 'make' start with different bit of sound.

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair.

	<p><i>So you think 'sing' and 'king' is the same? Does 'sing' sounds like 'king'? 'Sing', 'king', 'sing', 'king'. Do you think they sound the same?</i></p> <p><input type="checkbox"/> More clearly enunciated</p>
No response	<p><input type="checkbox"/> Use shorter and simpler questions again</p> <p><i>'Sing', 'king'. Are they the same? Yes or no?</i></p>

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Five consecutive passes ⇒ Go to Onset (k,b) pairing < Five consecutive passes ⇒ Go to Onset (k,b) pairing

1. Onset recognition (Chinese)

Objective

Children will be able to be aware of the onsets of syllables, based on their understanding of rimes.

Materials

Sets of four rhyming pictures that match the written word endings on card (頭 *tau4*、樓 *lau4*、手 *sau4*)

Lead in

上一次我哋留意每粒音最後啲啲部份。今次我哋留意番每粒音最前啲部份。

(Last time we worked on the last bits of the sound. This time we will pay attention to the first bit of the sound.)

Presentation/ Instruction

記唔記得上次我哋留心聽過頭 *tau4*、樓 *lau4*、手 *sau4* [pictures of these words]。呢啲字都聽落真係好似。今次我哋特別留心呢啲字嘅最前嘅啲部份。最前呢啲啲部份係呢三個字之間嘅分別。

(Recalling we have fat, cat, hat, mat [show the set of pictures with the rime 'at']. They sound almost the same. This time we listen to these words very carefully. There is only a small difference across these words. It is the first bit of the sound.)

Practice 1

聽落係唔係一樣? 係定唔係。(Is this pair of words the **same**? Yes or No.)

Pair of words	Same?	Pair of words	Same?
1. 頭 <i>tau4</i> 樓 <i>lau4</i>	N	2. 瓜 <i>gwaa1</i> 媽 <i>maa1</i>	N
3. 鼓 <i>gu2</i> 鼓 <i>gu2</i>	Y	4. 頸 <i>geng2</i> 頸 <i>geng2</i>	Y
5. 雞 <i>gai1</i> 龜 <i>gwai1</i>	N	6. 歌 <i>go1</i> 坐 <i>zo6</i>	N
7. 簿 <i>bou6</i> 簿 <i>bou6</i>	Y	8. 雀 <i>zoek3</i> 腳 <i>goek3</i>	N
9. 狗 <i>gau2</i> 手 <i>sau2</i>	N	10. 電 <i>din6</i> 面 <i>min6</i>	N

Practice 2

After the child answered the final item (or the previous item with difference if the final item has identical pair), ask the child about how he/she deduces the answer.

你點知電 *din6* 同面 *min6* 係唔同? (How do you tell why 'cake' and 'make' are not the same?)

Prompt the child to pay attention to the onset

你可以留意番每粒音最前面嗰啲啲部份。電 *din6* 同面 *min6* 係有最前面嗰啲啲係唔同
(You might pay attention to the first bit of the sound of these two words. 'Cake' and 'make' start with different bits of sound.)

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>So you think 'sing' and 'king' is the same? Does 'sing' sounds like 'king'? 'Sing', 'king', 'sing', 'king'. Do you think they sound the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again <i>'Sing', 'king'. Are they the same? Yes or no?</i>

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Five consecutive passes ⇒ Go to Onset (k,b) pairing < Five consecutive passes ⇒ Go to Onset (k,b) pairing

2. Onset (k,b) pairing (English)

Objective

Children will be able to recognize syllables with the same onsets (/k/ & /b/)

Materials

- Pictures of words sharing the same onsets (/k/ & /b/)
- Letter c and b

Lead in

Last time, we grouped words by the ending bits of the sound. Like we group fat, cat, hat, mat. This time will group words by their first bit of sound. Like cat, can, cake, cook. They are all with the first bit /k/ at the beginning.

Presentation/ Instruction

Pay attention to the first bit of the sound. Cat [stressed], can [stressed], cake [stressed], and cook [stressed]. They all have the /k/ [stressed] as the first bit of the sound. Usually, these words starting with /k/ sound have the letter c at the beginning [give the letter c to the child].

Let's change the first bit of sound to /b/. What happen when we have book, big, bake, and bin? These words they all start with /b/ sound. Usually, these words start with the letter b [give the letter b to the child].

Practice

Let's group words in the new way. Group the pictures by the first bit of the sound. We have words of /c/ and /b/. Put the pictures under the letter c or b.

Items/ onsets	1	2	3	4	5	6	7	8	9	10
c	Car /kɑ:/	Cup /kʌp/	Cake /keɪk /	Cat /kæt /	Cow /kaʊ/	Key /ki:/	Cook /kʊk/	Can /kæn/	Cold /kəʊld/	Cap /kæp/
b	Bee /bi:/	Bag /bæg/	Bus /bʌs/	Ball /bɔ:l/	Bird /bɜ:d/	Bed /bed/	Bun /bʌn/	Bin /bɪn/	Bell /bel/	Bear /beə/

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>Do you think bus and cup have the same first bit of sound? Bus, cup. Bus, cup. Pay attention to the first bit of sound.</i> <i>The first bit of sound for bus is /b/. The first bit of sound for cup is /c/. Are they the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again 'Bus', 'cup'. Same first bit of sound? Yes or no?

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Three consecutive passes ⇒ Onset (d,g) pairing < Three consecutive passes ⇒ Onset (d,g) pairing

2. Onset (Chinese) (牛牛失散了)

Objective

Children will be able to recognize syllables with the same onsets (/k/ & /b/)

Materials

- Pictures of words sharing the same onsets (/k/ & /b/)
- Letter k and b

Lead in

上次我哋試過用每粒音最尾嗰啲部份嚟排好啲字。今次我哋用每粒音最前嗰啲部份嚟排字。好似咁 kaat1、琴 kam4、咳 kat1 咁，呢啲字都有個/k/ 音。

(Last time, we grouped words by the ending bits of the sound. Like we group fat, cat, hat, mat. This time will group words by their first bit of sound. Like card, piano, cough. They are all with the first bit /k/ at the beginning.)

Presentation/ Instruction

留心咁 kaat1[stressed]、琴 kam4[stressed]、咳 kat1[stressed]。每粒音最前嗰啲部份係/k/ 音。而 /k/ 音通常可以用英文字母 k 嚟代表。

(Pay attention to the first bit of the sound. Card[stressed], piano[stressed], cough[stressed]. They all have the /k/[stressed] as the first bit of the sound. Usually, these words starting with /k/ sound have the letter c at the beginning [give the letter c to the child].)

我哋轉做/b/ 音。/b/ 音通常用英文字母 b 嚟代表，例子有包 baau1、爸 baa1、bak1。都有/b/ 音喺最前。

Let's change the first bit of sound to /b/. What happen when we have bun, dad, and north? These words they all start with /b/ sound. Usually, these words start with the letter b [give the letter b to the child].

Practice

我哋有一班小牛牛失散咗。有啲牛牛 BB 係/k/ 農場，有啲就係/b/ 農場。我哋幫啲牛牛 BB 返屋企。

Let's group words in the new way. Group the pictures by the first bit of the sound. We have words of /c/ and /b/. Put the pictures under the letter c or b.

Items/ onsets	1	2	3	4	5	6	7	8	9	10
k	咁 kaat1	咳 kat1	企 kei2	拳 kyun4	琴 kam4	橋 kiu4	吸 kap1	扣 kau3	旗 kei4	騎 ke4
b	餅 beng2	包 baau1	杯 bui1	病 beng6	鼻 bei6	百 baak3	白 baak6	冰 bing1	簿 bou6	八 baat3

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child

Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>Do you think kaat1 and baat3 have the same first bit of sound? Kaat1, baat3. kaat1, baat3. Pay attention to the first bit of sound.</i> <i>The first bit of sound for kaat1 is /k/. The first bit of sound for baat3 is /b/. Are they the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again 'kaat1', 'baat3'. Same first bit of sound? Yes or no?

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Three consecutive passes ⇒ Onset (d,g) pairing < Three consecutive passes ⇒ Go to Onset (d,g) pairing

3. Onset (d,g) pairing (English)

Objective

Children will be able to recognize syllables with the same onsets (/d/ & /g/)

Materials

- Pictures of words sharing the same onsets (/d/ & /g/)
- Letter d and g

Lead in

Last time, we worked on the /k/ and /b/ sound for the first bit of sound. This time we work on more first bits of sound, which are /d/ and /g/.

Presentation/ Instruction

Pay attention to the first bit of the sound. Dad [stressed], dog [stressed], door [stressed], and dot [stressed]. They all have the /d/ [stressed] as the first bit of the sound. Usually, these words starting with /d/ sound have the letter d at the beginning [give the letter d to the child].

Let's change the first bit of sound to /g/. What happen when we have girl, glass, gift, and green? These words they all start with /g/ sound. Usually, these words start with the letter g [give the letter g to the child].

Practice

Let's group words in the new way. Group the pictures by the first bit of the sound. We have words of /d/ and /g/. Put the pictures under the letter d or g.

Items/ onsets	1	2	3	4	5	6	7	8	9	10
d	Dad	Dog	door	Dot	Duck	dance	Dish	Desk	Doll	Deer

g	Girl	Glass	Gift	Ghost	Gun	Grapes	Green	Glue	Giant	Gold
----------	------	-------	------	-------	-----	--------	-------	------	-------	------

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>Do you think Day and Gate have the same first bit of sound? Day, Gate. Day, Gate. Pay attention to the first bit of sound.</i> <i>The first bit of sound for Day is /d/. The first bit of sound for Gate is /g/. Are they the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again 'Day', 'gate'. Same first bit of sound? Yes or no?

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Five consecutive passes ⇒ Onset substitution < Five consecutive passes ⇒ Onset substitution

3. Onset (d,g) pairing (Chinese)

Objective

Children will be able to recognize syllables with the same onsets (/d/ & /g/)

Materials

- Pictures of words sharing the same onsets (/d/ & /g/)
- Letter d and g

Lead in

Last time, we worked on the /k/ and /b/ sound for the first bit of sound. This time we work on more first bits of sound, which are /d/ and /g/.

Presentation/ Instruction

Pay attention to the first bit of the sound. 打 daa2 [stressed], 大 daai6 [stressed], 蛋 daan6 [stressed], and 豆 dau6 [stressed]. They all have the /d/ [stressed] as the first bit of the sound. Usually, these words starting with /d/ sound have the letter d at the beginning [give the letter d to the child].

Let's change the first bit of sound to /g/. What happen when we have 頸 geng2, 雞 gai1, 金 gam1, and 狗 gau2? These words they all start with /g/ sound. Usually, these words start with the letter g [give the letter g to the child].

Practice

Let's group words in the new way. Group the pictures by the first bit of the sound. We have words of /d/ and /g/. Put the pictures under the letter d or g.

Items/ onsets	1	2	3	4	5	6	7	8	9	10
d	打 daa2	大 daai6	蛋 daan6	豆 dau6	釘 deng1	燈 dang1	刀 dou1	凍 dung3	碟 dip6	袋 doi6
g	頸 geng2	雞 gai1	金 gam1	九 gau2	龜 gwai1	角 gok3	鏡 geng3	鼓 gu2	劍 gim3	高 gou1

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>Do you think 豆 dau6 and 九 gau2 have the same first bit of sound? 豆 dau6, 九 gau2. 豆 dau6, 九 gau2. Pay attention to the first bit of sound.</i> <i>The first bit of sound for 豆 dau6 is /d/. The first bit of sound for 九 gau2 is /g/. Are they the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again ‘豆 dau6, ‘九 gau2’. Same first bit of sound? Yes or no?

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Five consecutive passes ⇒ Onset substitution < Five consecutive passes ⇒ Onset substitution

4. Onset substitution (English)

Objective

Children will be able to swap onset (initial phoneme) from syllables.

Materials

- Birthday hat
- Hand puppet
- Letter k, b, d, g

Lead in

Today is the birthday of Little Cow. Let's sing a birthday song to him. [Happy birthday to you...]

Presentation/ Instruction

Little Cow thinks the original birthday song is very boring. Shall we sing a funny birthday song? Let me show you a funny one with every sound starting with /b/.

Bappy Birthbay Boo Boo

Bappy Birthbay Boo Boo

Bappy Birthbay boo boo boo

Bappy Birthbay Boo Boo

Practice

This time your turn to sing a funny song. I will sing the first few lines with you.

Kappy Kirthkay koo koo

More examples:

Dappy Dirthday doo doo

Gappy Girthgay goo goo

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>You said Kappy birthday koo koo. Do you think you change every bit of sound to /k/ so that every bit of sound starts with /k/?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again <i>Kappy birthday koo koo. All starts with /k/? Yes or no?</i>

Progression

Stopping rule	Should go through all four version of birthday songs.
Progression rules	Five consecutive passes ⇒ Onset and final phonemes identification < Five consecutive passes ⇒ Onset and final phonemes identification

4. Onset substitution (Chinese)(變種生日歌)

Objective

Children will be able to swap onset (initial phoneme) from syllables.

Materials

- Birthday hat
- Hand puppet
- Letter k, b, d, g

Lead in

牛牛今日生日。我哋唱首生日歌俾佢。

[Today is the birthday of Little Cow. Let's sing a birthday song to him. [Happy birthday to you...]]

Presentation/ Instruction

牛牛覺得生日歌有啲悶。不如我哋唱首好笑嘅生日歌俾佢? 例如我唱一首每個字都係/b/開頭嘅生日歌。

Little Cow thinks the original birthday song is very boring. Shall we sing a funny birthday song? Let me show you a funny one with every sound starting with /b/.

buk1 bei5 bang1 bat6 baai3 bok6

buk1 bei5 bang1 bat6 baai3 bok6

buk1 bei5 bang1 bat6 baai3 bok6 bok6

buk1 bei5 bang1 bat6 baai3 bok6

Practice

今次我哋唱多幾首。

[This time your turn to sing a funny song. I will sing the first few lines with you.]

kuk1 kei5 kang1 kat6 kaai3 kok6

More examples:

duk1 dei5 dang1 dat6 daai3 dok6

guk1 gei5 gang1 gat6 gaai3 gok6

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>You said buk1 nei5. Do you think you change every bit of sound to /b/ so that every bit of sound starts with /b/?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again <i>buk1 bei5 bang1 bat6 baai3 bok6. All starts with /k/? Yes or no?</i>

Progression

Stopping rule	Should go through all four version of birthday songs.
Progression rules	Five consecutive passes ⇒ Onset and final phonemes identification < Five consecutive passes ⇒ Onset and final phonemes identification

5. Onset and final phonemes identification (English)

Objective

Children will be able to differentiate initial phonemes and final phonemes.

Materials

- Train engine and 2 carriages
- Hand puppet
- Letter d, g
- Pictures of words starting with and ending with /d/ and /g/

Lead in

Little Cow needs to put different goods on the train.

Presentation/ Instruction

There is one rule about how to put these goods on the train. For example, these pictures all have /d/. Some of them start with /d/, others end with /d/. Little Cow will sit in the middle carriage.

Practice

Put dog in the train engine (first carriage). Put bed in the last carriage.

<i>Initial D</i>	<i>Final D</i>
<i>Dog</i>	<i>Bed</i>
<i>Dance</i>	<i>Card</i>
<i>Door</i>	<i>Cold</i>
<i>Dot</i>	<i>Old</i>
<i>Duck</i>	<i>Wind</i>

Similar practice with words starting with and ending with /g/.

<i>Initial G</i>	<i>Final G</i>
<i>Girl</i>	<i>Bag</i>
<i>Glass</i>	<i>Big</i>
<i>Green</i>	<i>Dog</i>
<i>Gun</i>	<i>Frog</i>
<i>Ghost</i>	<i>Leg</i>

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>You put 'bed' in the first carriage. Do you think 'bed' starts with /d/. or it ends with /d/. Listen again, 'bed'. Where is the /d/?</i> <input type="checkbox"/> More clearly enunciated

No response	<input type="checkbox"/> Use shorter and simpler questions again <i>Bed. /d/ in the front or at the back? Yes or no?</i>
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Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Five consecutive passes ⇒ Go to Vowel identification < Five consecutive passes ⇒ Go to Vowel identification

5. Onset and final phonemes identification (Chinese)(牛牛火車頭火車尾)

Objective

Children will be able to differentiate initial phonemes and final phonemes.

Materials

- Train engine and 2 carriages
- Hand puppet
- Letter m, k
- Pictures of words starting with and ending with /m/ and /k/

Lead in

今日牛牛要做火車司機。佢要搬啲貨上火車。

[Little Cow needs to put different goods on the train.]

Presentation/ Instruction

呢度有啲圖片。所有字都有/m/音。/m/音喺頭嘅字就搬上火車頭，/m/音喺尾嘅字就搬上火車尾。

[There is one rule about how to put these goods on the train. For example, these pictures all have /m/. Some of them start with /m/, others end with /m/. Little Cow will sit in the middle carriage.]

Practice

將媽 *maa1* 搬上火車頭，將金 *gam1* 搬上火車尾。

[Put 媽 *maa1* in the train engine (first carriage). Put 金 *gam1* in the last carriage.]

Initial m	Final m
媽 <i>maa1</i>	金 <i>gam1</i>
貓 <i>maau1</i>	劍 <i>gim3</i>
襪 <i>mat6</i>	三 <i>saam1</i>
麵 <i>min6</i>	琴 <i>kam4</i>
帽 <i>mou6</i>	尖 <i>zim1</i>

Similar practice with words starting with and ending with /k/.

Initial k	Final k
咳 kat1	角 gok3
企 kei2	屋 uk1
拳 kyun4	石 sek6
琴 kam4	百 baak3
橋 kiu4	黑 hak1

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>You put 金 gam1 in the first carriage. Do you think 金 gam1 starts with /m/. or it ends with /m/. Listen again, 金 gam1. Where is the /m/?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again <i>金 gam1. /m/ in the front or at the back? Yes or no?</i>

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Five consecutive passes ⇒ Go to Vowel identification < Five consecutive passes ⇒ Go to Vowel identification

6. Vowel identification (English)

Objective

Children will be able to recognize the vowels within a CVC syllable

Materials

- Letters/symbols for the vowel sounds /a/, /i/, /e/, /o/.
- Pictures of CVC words.
- Pictures of monsters with mouths (or puppets or boxes with faces on).

Lead in

Let me introduce two monster friends to you. Hag /hæg/ and Hig /hɪg/. Hag, Hag. Hag, Hag. Oh, it is so difficult to remember their names. Let me help you. In Hag's name, the middle bit is the /æ/ [stressed] sound. /æ/.....sounds like the letter a. So this letter a [letter 'a' card] is for Hag.

How about Hig? The middle bit is the /ɪ/ sound. /ɪ/..... sounds like 'in', 'in' starts with letter i. So this letter i [letter 'i' card] for Hig.

Presentation/ Instruction

Oh, Hag and Hig told me they are very hungry. I need you to feed them. However, they are very fussy and they only eat things that have the same sound in the middle as their names. For example, Hag only eats bag [picture] and bat [picture]. Hig only eats something like chips [picture] and wings [picture]

Practice 1

I have something that you can feed them. Don't feed the wrong thing to the monsters, otherwise they will be angry and eat you!

Items to feed Hag and Hig:

	Item/ Vowel	1	2	3	4	5	6	7	8	9	10
Hag	a /æ/	can	cat	fan	ham	hat	jam	man	map	lamb	sand
Hig	i /ɪ/	bin	pig	dish	fish	ring	king	milk	chip	kid	pin

Practice 2

There are more monsters to feed! This is Heg and this is Hog. For Heg, the middle bit is /e/, /e/..... sounds like egg... then e for egg. I will use letter e for Heg. For Hog, the middle bit is /ɒ/, /ɒ/..... sounds like on. O for on. So I use letter O for Hog. I have another bag for you to feed Heg and Hog.

Items for feed Heg and Hog:

	Item/ Vowel	1	2	3	4	5	6	7	8	9	10
Heg	e /e/	bed	desk	head	leg	pen	ten	bell	chess	belt	wet
Hog	o /ɒ/	dog	box	doll	fox	log	rock	lock	bomb	mop	sock

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child

Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>Do you think fan and fish can feed Hag? Fan, fish. Fan, fish. Pay attention to the middle bit of sound.</i> <i>The middle bit of sound fan is /æ/. The middle bit of sound for fish is /ɪ/. Are they the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again 'Fan', 'fish'. Same middle bit of sound? Yes or no?

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	Five consecutive passes in Practice 1 ⇒ Go to Final Phoneme identification < Five consecutive passes in Practice 1 ⇒ Go to Practice 2 Five consecutive passes in Practice 2 ⇒ Go to Final Phoneme identification < Five consecutive passes in Practice 1 ⇒ Go to Final Phoneme identification

6 .Vowel identification (Chinese)

Objective

Children will be able to recognize the vowels within a CVC syllable

Materials

- Letters/symbols for the vowel sounds /a/, /i/, /e/, /o/.
- Pictures of CVC words.
- Pictures of monsters with mouths (or puppets or boxes with faces on).

Lead in

今日我要介紹兩個怪獸俾你識。一個叫 Hag /hæg/, 其一個叫 Hig /hɪg/. Hag, Hag. Hag, Hag。好難記嘅名。不如我幫你。喺 Hag 嘅名, 中間嗰啲音係 /æ/ [stressed]。/æ/..... 聽落似英文字母 a, 所以用英文字母 a 嚟代表 Hag.

(Let me introduce two monster friends to you. Hag /hæg/ and Hig /hɪg/. Hag, Hag. Hag, Hag. Oh, it is so difficult to remember their names. Let me help you. In Hag's name, the middle bit is the /a:/ [stressed] sound. /a:/.....sounds like the letter a [letter 'a' card] is for Hag.)

咁 Hig 呢? 佢嘅中間嗰啲音叫做 /ɪ/ [stressed]。/ɪ/.....聽落似英文子 in, i for in, 所以用英文字母 i 嚟代表 Hig.

(How about Hig? The middle bit is the /ɪ/ sound. /ɪ/..... sounds like 'in', 'in' starts with letter i. So this letter i [letter 'i' card] for Hig.)

Presentation/ Instruction

Hag 同 Hig 話我知佢哋好肚餓。我需要你哋餵佢哋。但係佢哋好麻醉，只係食啲名中間有一樣音嘅嘢食。例如 Hag 只會食咗 kaat1 [picture] 同埋賊 caak6 [picture]。而 Hig 只會食點 dim2 [picture] 同埋電 din6 [picture]。

Oh, Hag and Hig told me they are very hungry. I need you to feed them. However, they are very fussy and they only eat things that have the same sound in the middle as their names. For example, Hag only eats bag [picture] and bat [picture]. Hig only eats something like chips [picture] and wings [picture]

Practice 1

我有一啲嘢你可以用嚟餵怪獸。千祈唔好俾錯，唔係啲怪會食番你轉頭。

I have something that you can feed them. Don't feed the wrong thing to the monsters, otherwise they will be angry and eat you!

Items to feed Hag and Hig:

	Item/ Vowel	1	2	3	4	5	6	7	8	9	10
Hag	a /ɑ:/ (aa)	三 saam1	蛋 daan6	飯 faan6	眼 ngaan5	炭 taan3	鏟 caan2	橙 caang4	八 baat3	髮 faat3	賊 caak6
Hig	i /ɪ/ (i)	劍 gim3	尖 zim1	煙 jin1	麵 min6	天 tin1	冰 bing1	鷹 jing1	碟 dip6	葉 jip6	繩 sing4

Practice 2

有更多嘅怪獸等你去餵! 下次係 Heg 同 Hog。Heg 中間嗰啲部份係 /e/。/e/.....聽落去好似英文 egg, e for egg, 我會用英文字母 e 嚟代表 /e/。Hog 中間嗰啲部份係 /ɔ:/, /ɔ:/.....聽去似 o, 所以用英文字母 o 嚟代表 /ɔ:/。

(There are more monsters to feed! This is Heg and this is Hog. For Heg, the middle bit is /e/, /e/..... sounds like egg... then e for egg. I will use letter e for Heg. For Hog, the middle bit is /ɔ:/, /ɔ:/..... sounds like on. O for on. So I use letter O for Hog. I have another bag for you to feed Heg and Hog.)

Items for feed Heg and Hog:

	Item/ Vowel	1	2	3	4	5	6	7	8	9	10
Heg	e /e/ (e)	餅 beng2	病 beng6	釘 deng1	頸 geng2	鏡 geng3	井 zeng2	夾 gep6	石 sek6	尺 cek3	蓆 zek6
Hog	o /ɔ:/ (o)	床 cong4	糖 tong4	角 gok3	駱 lok3	鱷 ngok6	鑊 wok6	汗 hon6	方 fong1	芒 mong4	湯 tong1

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair.

	<p><i>Do you think cek3 and cong4 can feed Heg? cek3, cong4. cek3, cong4. Pay attention to the middle bit of sound.</i></p> <p><i>The middle bit of sound cek3 is /e/. The middle bit of sound for cong4 is /o/. Are they the same?</i></p> <p><input type="checkbox"/> More clearly enunciated</p>
No response	<p><input type="checkbox"/> Use shorter and simpler questions again 'cek3', 'cong4'. Same middle bit of sound? Yes or no?</p>

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	<p>Five consecutive passes in Practice 1 ⇒ Go to Final Phoneme identification</p> <p>< Five consecutive passes in Practice 1 ⇒ Go to Practice 2</p> <p>Five consecutive passes in Practice 2 ⇒ Go to Final Phoneme identification</p> <p>< Five consecutive passes in Practice 1 ⇒ Go to Final Phoneme identification</p>

7. Final Phoneme identification (English)

Objective

Children will be able to recognize the final phonemes of CVC syllables

Materials

- Pictures of CVC and CV words

Lead in

Today we'll talk about the final bit of the sound. We talked about the last bits of sound last time, but this time we are talking about the final bit of the sound which is very subtle to notice. For example, 'bay' and 'bake'. There is /k/ final bit of sound in bake whereas there is nothing left in 'bay'.

Presentation/ Instruction

Another example, listen very carefully. Bee, beef. Bee, beef. For 'beef', the last bit of 'beef' has a /f/ sound. For bee, the last bit of sound is /i:/.

Practice

Which one has the final consonant?

Item no.	1	2	3	4	5	6	7	8	9	10
Items	fee	tie	buy	beak	lie	team	see	bee	toy	two
	feet	tide	bye	bee	lie	tea	seal	beak	toy	two
Same?	N	N	Y	N	Y	N	N	N	Y	Y
final consonant	t	d	n/a	k	n/a	m	l	k	n/a	n/a

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>Do you think fee and feet are the same? fee, feet. fee, feet. Pay attention to the last bit of sound.</i> <i>The last bit of sound fee is /i:/. The last bit of sound for feet is /t/. Are they the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again <i>'Fee', 'feet'. Same last bit of sound? Yes or no?</i>

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	A checking question is asked at the final item. The child is asked to check if he/ she noticed the final consonant. Five consecutive passes in Practice + correct check question ⇒ End of training Five consecutive passes in Practice + incorrect check question ⇒ continue the remaining training < Five consecutive passes in Practice + correct check question ⇒ End of training < Five consecutive passes in Practice + incorrect check question ⇒ repeat the training

7. Final Phoneme identification (Chinese)

Objective

Children will be able to recognize the final phonemes of CVC syllables

Materials

- Pictures of CVC and CV words

Lead in

今日我哋會講每粒音最尾嗰啲嘅部份。上次我哋學過啲音最後嗰一堆音一樣，所以啲字聽落好似。今次我哋要留意嘅係最後嗰一堆音當中最尾嘅啲音。佢好細，所以好容易聽漏。例如沙 *saa1* 同三 *saam1*。個三 *saam1* 字最尾嗰啲嘅有個/m/音，反而沙 *saa1* 就無。

(Today we'll talk about the final bit of the sound. We talked about the last bits of sound last time, but this time we are talking about the final bit of the sound which is very subtle to notice. For example, 'sand' *saa1* and 'three' *saam1*. There is /m/ final bit of sound in 'three' *saam1* whereas there is nothing left in 'sand' *saa1*.)

Presentation/ Instruction

仲有多個例子。歌 go1，乾 gon1。乾 gon1 最後嗰啲啲音有個 /n/ 音，反而歌 go1 就無。歌 go1 最後一個音係 /ɔ:/

Another example, listen very carefully. Song, dry. Song, dry. For 'dry', the last bit of 'dry' has a /n/ sound. For song, the last bit of sound is /ɔ:/.

Practice

Which one has the final consonant?

Item no.	1	2	3	4	5	6	7	8	9	10
Items	蛙 waa1	瓜 gwaa1	花 faa1	八 baat3	lie	釘 deng1	兒 ji4	匙 si4	toy	two
	彎 waan1	關 gwaan1	花 faa1	伯 baa3	lie	爹 de1	鹽 jim4	繩 sing4	toy	two
Same?	N	N	Y	N	Y	N	N	N	Y	Y
final consonant	n	n	n/a	t	n/a	ng	m	ng	n/a	n/a

Feedback for various responses

Response	Feedback
Correct	<input type="checkbox"/> Praise the child
Incorrect	<input type="checkbox"/> Compare and contrast Form a minimal pair comprising the incorrect and correct response and ask the child to pay attention to the differences in the pair. <i>Do you think waa1 and waan1 are the same? waa1, waan1. waa1, waan1. Pay attention to the last bit of sound.</i> <i>The last bit of sound waa1is /aa/. The last bit of sound for waan1is /n/. Are they the same?</i> <input type="checkbox"/> More clearly enunciated
No response	<input type="checkbox"/> Use shorter and simpler questions again Waa1, waan1. Same last bit of sound? Yes or no?

Progression

Stopping rule	Five consecutive passes. The probability of getting all five consecutive passes is 0.031, which is statistically significant.
Progression rules	A checking question is asked at the final item. The child is asked to check if he/ she noticed the final consonant. Five consecutive passes in Practice + correct check question ⇒ End of training Five consecutive passes in Practice + incorrect check question ⇒ continue the remaining training < Five consecutive passes in Practice + correct check question ⇒ End of training < Five consecutive passes in Practice + incorrect check question ⇒ repeat the training

Appendix 4

Print Concepts Intervention Items

Training items for English books ‘Happy Birthday Litte Cow’ and ‘A Hungry Litte Cow ‘

Note: E1 = ‘Happy Birthday Litte Cow’; E2 = ‘A Hungry Litte Cow’

Item no.	Page no.	Item	Explanation
1	Front cover	Where is the name of the book?	It is written on the top of the page, and in larger letters.
2		How many words in the title?	We can count the words...there are 4 words. [E1][E2]
3		Looking at the picture, what could the title be?	The picture shows a baby cow having his birthday party [E1]/ thinking about food [E2], so possible book should be about birthday [E1]/ food [E2].
4		Where is the author’s name?	It is written below the title and in smaller letters.
5	2-5	Where do we start reading?	At the top, left- hand-side.
6		Which direction do we read in?	Left to right.
7		Where do we go next?	Left-hand-side of the next line below.
8	6-7	Is there something wrong with this page? (normal print, inverted picture)	The picture is upside down, but the print is the right way around, so we can read the book this way.
9	8-9	Is there something wrong with this page? (inverted print, normal picture)	The picture is the right way around, but the writing is upside down, so we need to turn the book the other way around.
10	10-11	Is there something wrong with any lines in this page? (wrong line sequence)	We should read from the line which begins with a capital letter. The last line should end with a full stop.
11		What does this symbol mean? (Full stop)	It means we have reached the end of a sentence.
12	12-13	Where do we start reading? (both pages with text)	Left to right. There are page numbers at the bottom of the pages.
13		Is there something wrong with any of the words on this page? (wrong word sequence)	These two words are written in wrong order.
14		Is there something wrong with any of the words on this page? (wrong letter sequence)	The letters of this word are in wrong order.
15	14-15	What does this symbol mean? (Question mark)	It means that this sentence is a question.
16		Is there something wrong with any of the words on this page? (multiple words in wrong letter sequence)	The letters of some of the words are in wrong order.

17	16-17	What does this symbol mean? (Comma)	It means there is a slight pause in a sentence.
18		What does this symbol mean? (Quotation marks, in the speech bubble)	Quotation marks are placed around a word, sentence, etc. to show that it is what somebody said
19		Can you show me the lower-case letter of T/M/H?	Letters are written in capital or lower-case.
20	18-19	Can you show me the word 'no'/'saw'? (mirror-image words)	The letters of some of the words are in reverse order.
21	20	Can you show me one complete sentence?	We know it is a complete sentence because it ends with a full stop.
22		Can you show me one word?	We know it is a whole word because is a space between it and the next word.
23		Can you show me one letter	That is a letter. Words are made up of many letters.
24		Can you show me a Capital letter?	In a new sentence, the first word always starts with a capital letter. Names start with a Capital letter too.

Training items for Chinese books ‘Hide-and-seek with Little Cow’ and ‘Where's Little Cow's cakes?’

Note: C1 = ‘Hide-and-seek with Little Cow’; C2 = ‘Where's Little Cow's cakes?’

Item no.	Page no.	Item	Explanation
1	Front cover	Where is the name of the book?	It is written on the top of the page, and in larger characters.
2		How many Chinese characters in the title?	We can count the words...there are 5 [C1]/ 8 [C2] words.
3		Looking at the picture, what could the title be?	The picture shows a baby cow playing with his friends [C1]/ thinking about cakes [C2], so possible book should be about game [C1]/ food [C2].
4		Where is the author’s name?	It is written below the title and in smaller characters.
5	2-5	Where do we start reading?	At the top, left- hand-side.
6		Which direction do we read in?	Left to right.
7		Where do we go next?	Left-hand-side of the next line below.
8	6-7	Is there something wrong with this page? (normal print, inverted picture)	The picture is upside down, but the print is the right way around, so we can read the book this way.
9	8-9	Is there something wrong with this page? (inverted print, normal picture)	The picture is the right way around, but the writing is upside down, so we need to turn the book the other way around.
10	10-11	Is there something wrong with any lines in this page? (wrong line sequence)	We should read from the line which begins without punctuation. The last line should end with a full stop.
11		What does this symbol mean? (Full stop)	It means we have reached the end of a sentence.
12	12-13	Where do we start reading? (both pages with text)	Left to right. There are page numbers at the bottom of the pages.
13		Is there something wrong with any of the words on this page? (wrong word sequence)	These two words are written in wrong order.
14		Is there something wrong with any of the words on this page? (wrong radical sequence)	The radicles of this word are in wrong order.
15	14-15	What does this symbol mean? (Question mark)	It means that this sentence is a question.
16		Is there something wrong with any of the words on this page? (multiple words in wrong radical sequence)	The radicles of some of the words are in wrong order.
17	16-17	What does this symbol mean? (Comma)	It means there is a slight pause in a sentence.

18		What does this symbol mean? (Quotation marks, in the speech bubble)	Quotation marks are placed around a word, sentence, etc. to show that it is what somebody said
19		Is the first Chinese character in a sentence larger than the rest of them? (No)	Chinese characters are the same, no matter where they are placed. Chinese characters are NOT written in capital or lower-case.
20	18-19	Is there something wrong with any of the words on this page? (mirror-image)	The radicals of some of the words are in reverse order.
21	20	Can you show me one complete sentence?	We know it is a complete sentence because it ends with a full stop.
22		Can you show me one word?	We know it is a whole word because there is a space between it and the next word.
23		Can you show me one radical	That is a radical. Words are made up of many radicals.
24		Can you show me a left/top radical?	Radicals usually are in pairs (left-right or top-bottom).

A Hungry Little Cow

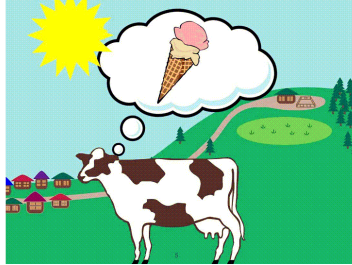


Brad Chan

I am a magic cow
and I love
to eat.



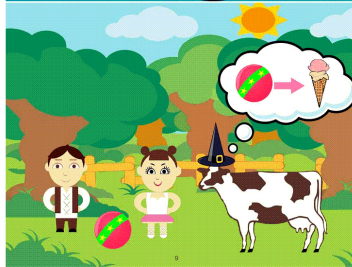
In summer,
I love to eat ice cream.



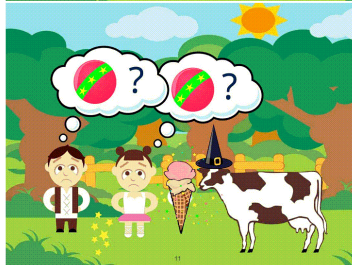
I can find a ball
and turn it into
an ice cream.



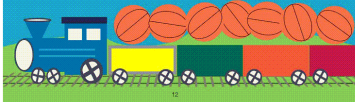
A boy and a girl are
playing with a ball.
This ball can be
my ice cream.



into an ice cream.
I turned the ball



Then I saw train a
of full balls.



I saw eth balls
adn I wondered.
Could I turn these blals
into iec cream?



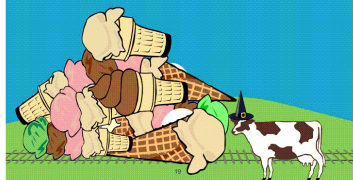
Shall I hvae an
iec cream
with a chryry?
Or wtih a chocolate bar?



Then I called,
"There is too much
ice cream!"



All ice cream fell
on the ground.
All I saw was a hill of
ice cream.
And oh, no ice cream.



I turned balls into ice cream.

Happy Birthday Little Cow

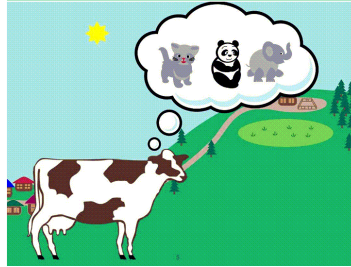


Brad Chan

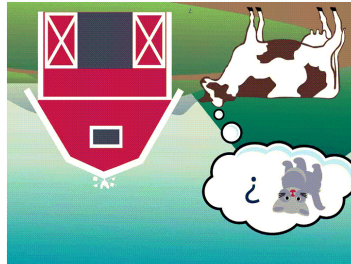
Today is Little Cow's birthday.
He is very happy.



He wants to have a birthday party with friends.



Little Cow went to Little Cat's home.
No one was there.

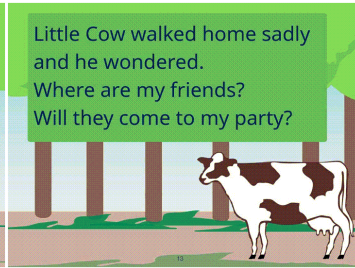
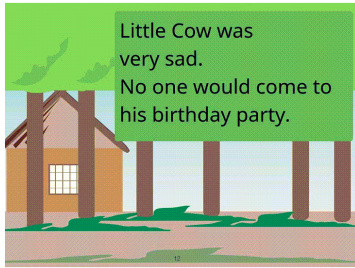


Little Cow went to Little Panda's home.
No one was there.

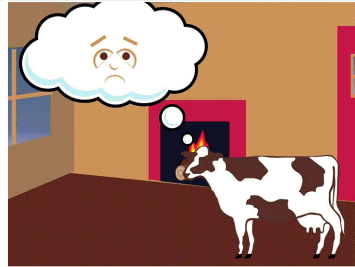


Little Cow went to Little Elephant's home.
No one was there.





Did they forget my birthday?
Or they do not like me?



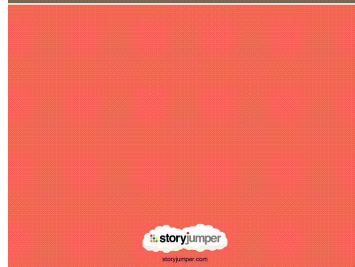
"Surprise!" shouted the friends.
"Happy Birthday," they said.



I was so shocked.
All I saw was a big, chocolate cake.
And oh, no sad birthday.



I had a surprise birthday party.



牛牛捉迷藏



麵包哥哥

有一天，
我跟朋友
一起到公園玩耍。



今天天氣很好，
我們可以踢足球。



我的朋友不想踢足球，
因為我會把
足球變成雪糕。



「好！」大家都說：
我們玩捉迷藏。



我由十數到一：「十，
九，八，七，六，五，
四，三，二，一」。
我負責捉人，



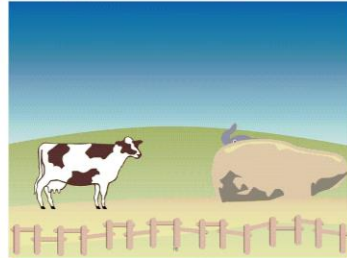


我開始找去
其他小朋友。



我在想，
小朋友跑得快。
他們躲在哪裡？

為什麼石頭有長長的鼻？
這是小象的鼻嗎？



我說：「小貓你在屋後。」
「被你發現了。」小貓說。



我看到你在屋後。

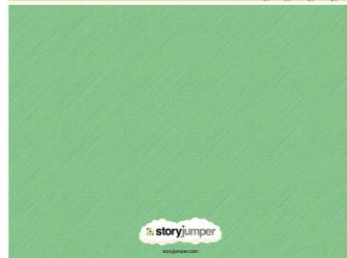
被你發現了。

我看見熊貓
在樹上睡着了，
忘記自己正在玩捉迷藏。



Zzzz

熊貓在樹上睡着了。



storyjumper

牛牛的蛋糕在哪裡？



Brad Chan

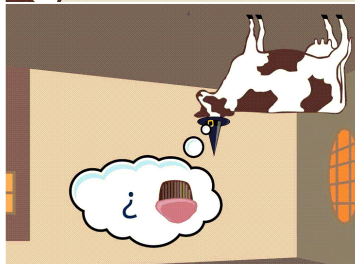
牛牛很喜歡
食蛋糕。
他每朝要吃
三個蛋糕。



有一天，牛牛發現
有一件蛋糕不見了。
我的蛋糕在哪裡？



牛牛在家裡
也找不到蛋糕。
我的蛋糕在哪裡？



牛牛去找其他小動物，
問他們有沒有
見過他的蛋糕。



沒有見過蛋糕。
小貓剛起床，





我的蛋糕
丟了哪兒？
我應該找警察
去捉小偷嗎？

14



我說：「我的蛋糕被偷了。」
「你的蛋糕
可能在你的帽子裡。」
警察叔叔說。

16



我拿走我的帽子，
我看到的是
那個軟軟的、香香的蛋糕。
噢，沒有小偷了。

18



誰偷走了我的蛋糕？

20



storyjumper
www.jumper.com

Appendix 5

TITLE: A teaching programme to improve children's awareness of sounds of English and Chinese

PRINCIPAL RESEARCHER: Yu Wing Chan (Supervisors: Terezinha Nunes & Maria Evangelou)

The above application has been considered on behalf of the Departmental Research Ethics Committee (DREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to DREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly, approval has been granted.

Please note that CUREC approval does not guarantee access to participants, and it is your responsibility to check whether countries or contexts in which you plan to conduct your research might impose additional requirements.

If your research involves participants whose ability to give free and informed consent is in question (this includes those under 18 and vulnerable adults), then it is advisable to read the following NSPCC professional reporting requirements for cases of suspected abuse <http://www.nspcc.org.uk/globalassets/documents/information-service/factsheet-child-abuse-reporting-requirements-professionals.pdf>

Should there be any subsequent changes to the project which raise ethical issues not covered in the original application you should submit details to research.office@education.ox.ac.uk for consideration.

Good luck with your research study.

Yours sincerely,

Heath Rose

Associate Professor of Applied Linguistics

Department of Education

Appendix 6

The University of Oxford places a high value on the knowledge, expertise, and integrity of its members and their ability to conduct research to high standards of scholarship and ethics. The research ethics clearance procedures have been established to ensure that the University is meeting its obligations as a responsible institution.

They start from the presumption that all members of the University will take their responsibilities and obligations seriously and will ensure that their research on human subjects is conducted according to the established principles and good practice in their fields and in accordance, where appropriate, with legal requirements. Since the requirements of research ethics review will vary from field to field and from project to project, the University accepts that different guidelines and procedures will be appropriate.

- Please check the [CUREC flowchart and NHS flowchart](#) first to see if you need ethics approval.
- Please complete this form using a word processor and email it, together with your [supporting documents](#), to your [Departmental Research Ethics Committee \(DREC\)](#) (if applicable). If you don't have a DREC please email this form to ethics@socsci.ox.ac.uk using your official **ox.ac.uk email address**. **Only emailed applications will be accepted.**

WHAT THIS CHECKLIST IS DESIGNED FOR

This **CUREC 1A checklist** is designed largely for research that falls within the Divisions of Social Sciences and Humanities where ethical issues are relatively few and straightforward. Interviews, field work and oral history are also included in the CUREC process.

The **full CUREC 2 application** is only required where certain project characteristics (e.g. type of participants, or procedures) result in a more complex set of ethical issues. It is expected that only in a limited number of cases will it be necessary for researchers to complete a CUREC 2 application. The checklist below will direct you to a CUREC 2 application if needed.

WHAT THIS CHECKLIST WILL NOT ASSESS

This checklist does not cover research governance, satisfactory methodology, or compliance with the requirements of publishers when administering their tests or questionnaires. As principal researcher, it is your responsibility to ensure that requirements in these areas are met.

CUREC does not review studies classed as **audit** (see [Glossary](#) and [Decision Flowchart for CUREC](#) on our website).

Further information on the University's research ethics procedures are available from the CUREC website: www.admin.ox.ac.uk/curec.

SECTION A: Filter for CUREC2 application

This section determines whether your study raises more complex issues which require the completion of a full application for ethical review, known as the CUREC 2 application.

(Please mark 'X' in the Yes/No column as appropriate to indicate your response.)

<p>1. Are research participants classed as people whose ability to give free and informed consent is in question? (This may include those under 18 (though see "competent youths" in FAQ C12), prisoners, or adults "at risk".) Your attention is drawn to the University's Safeguarding Code of Practice and its implications for researchers involving children or adults at risk, including the need for the work to be risk assessed and for researchers to undertake related training.</p> <p>(Note: If any of your participants are aged 16 or under, please answer 'Yes' here and also answer question 4 below.)</p>	<p style="text-align: center;">Yes X</p>	<p style="text-align: center;">No</p>
<p>2. By taking part in the research, will participants be at serious risk of criminal prosecution (e.g. by providing information on drug abuse or child abuse)?</p>	<p style="text-align: center;">Yes</p>	<p style="text-align: center;">No X</p>
<p>3. Does the research involve the deception of participants?</p>	<p style="text-align: center;">Yes</p>	<p style="text-align: center;">No X</p>

If you have answered 'No' to all of the questions above please go to **Section B**. If you have answered 'Yes' to any question above continue to question 4 below.

4. Is your project covered by a CUREC approved procedure (formerly known as "CUREC Protocols")?	Yes X	No
---	--------------	----

If yes, please give research procedure number(s): 25

If you answered 'Yes' to ANY of questions 1-3, and answered 'No' to question 4, please stop completing this checklist and do not submit it for ethical review. Instead, please complete the [CUREC 2 application form](#) from the CUREC website. Then submit the CUREC 2 form for ethical review.

If you answered 'Yes' to ANY of questions 1-3, and answered 'Yes' to question 4, please go on to **Section B**.

SECTION B: Contact details and project description (NB: must be typed not handwritten)

Contact details:

1. Principal researcher /supervisor (title and name) (if student research):	Professor Terezinha Nunes Dr Maria Evangelou
2. Name of student (if student research):	Yu Wing Chan
3. Degree programme, e.g. DPhil, BA, MPhil, BSc, MSc (if student research):	DPhil Education
4. Department or Institute name:	Department of Education
5. Address for correspondence (if different from 4 above):	
6. University e-mail (not private email) and telephone contact:	[REDACTED]@education.ox.ac.uk [REDACTED]
7. Name and status of others taking part in the project, e.g. third year undergraduate; postdoctoral research assistant:	Probationer Research Student (PRS) DPhil Education

SECTION B continued	
Project description:	
8. Title of research project:	A teaching programme to improve children’s awareness of sounds of English and Chinese
9. List of location(s) where project will be conducted:	Kindergartens in Hong Kong
10. If your research involves overseas travel or fieldwork, by the time the research starts, will you have completed and returned a travel risk assessment form? (This has to be approved by your department before you travel. If you are travelling overseas, you are strongly advised to take out University travel insurance .)	Yes X No N/A
11. Anticipated duration of research project overall:	months or 3 years (maximum 5)
12. Anticipated start and end dates of the research project involving human participants:	From: (06/06/16) To: (30/06/19) Please note that you will need ethics approval before you start your research. CUREC1As may take up to 30 days to process.
13. Title and very brief and simple lay description of research (about 150 words), plus description (about 200 words) of the nature of participants.	
a) Title and brief lay description of research (150 words). When describing the research, please include your methodology, how you are applying professional guidelines, and the use to which results/data will be put. Please also declare any conflicts of interest here.	
Title: A teaching programme to improve children’s awareness of sounds of English and Chinese	

Description: The study aims to teach bilingual kindergarteners about phonological awareness - the ability to manipulate units of sound - in one language and analyse whether there is an improvement in the language of training as well as in the other language. Children will be randomly assigned to three experimental conditions, namely English phonological training, Chinese phonological training, and concepts of print (the control group). In each condition, a 15-minute weekly training will be provided individually for six weeks. Specifically, children in the English and Chinese phonological training groups will learn to work with syllables, rhymes, and phonemes through games. Children in the control group will learn how print works in English and Chinese through shared-reading storybooks with the experimenter. Measures of phonological awareness in English and Chinese and of concepts of print will be used at pre- and post-test. The pre- and post-test will be divided in two sessions, in order to avoid tiring the children. A language background questionnaire will be given to parents to find out how English and Chinese are used at home and school. Training in all three conditions is child-friendly in which games and storybooks are used.

Children's work in the training, which involves no handwriting, will be photographed. There will not be an identification of the children who produced the work on the photographed materials. Photos will be safely stored and will not include the children's faces.

b) Description of participants and [obtaining informed consent](#) (200 words). When describing participants, please include

- criteria for inclusion/exclusion
- method of recruitment
- processes for consent to participate

Please ensure you attach as separate documents (if applicable, in English translation):

- your recruitment and advertisement material e.g. a poster or brief invitation letter/ email
- information for participants to read (or hear) before they agree to take part e.g. [written participant information sheets](#) or (only if applicable) [oral information scripts](#)
- a document to record informed consent. Templates for [written consent forms](#) and/or [oral consent scripts](#) (in case of an oral consent process) are available from the CUREC website
- a guide to interview questions (this may be a list of questions to be asked, or a preliminary scope of questions), or a sample of other instruments (such as a sample questionnaire)
- (if relevant) debriefing document after participants have taken part

All the participants, aged five, are in their third and final year of kindergarten. These children are native speakers of Cantonese. They started to learn Chinese (Cantonese) and English concurrently at the age of three in the first year of kindergarten. Thus, these children will have received approximately two years of English instruction before the study.

Criteria for inclusion/exclusion

Children should speak Cantonese natively and learn English as their second language starting from age three. Children with reading or speech difficulties are not included to avoid intervening clinical treatment.

Method of recruitment

Invitation letters will be sent to head teachers of kindergartens through person contacts. If the head teacher agrees to participation, consent letters will be sent to parents by the head teachers.

Processes for consent to participate

All children at the appropriate age will be invited. Consent forms (in opt-out forms) and information packs will be given to the parents through class teachers. According to protocol 25, this is appropriate as the children will be carrying out learning activities that are part of what they do in kindergarten, no sensitive information will be collected, and the files will be entirely anonymised once the data collection is completed. Parents will be given approximately 7-10 days to reply. If the parents refuse to let their children participate in the study, they will sign and return the opt-out form to the class teachers. The class teachers then compile a list of consented children by withdrawing children with learning difficulties and those whose parents denied consent.

14. What are the ethical issues connected with your research and what steps have you taken to address them? Please do not answer 'none'. The committee needs to see evidence that you have identified potential ethical issues with respect to your research and have taken steps to address them. These issues could relate to:

- your own physical and psychological safety as a researcher (please see the [University's](#) and [Social Science Division's Safety in Fieldwork](#) guidance
- participant burdens and/or risks, and

- data protection/ confidentiality.

For more guidance on ethical issues, please see www.admin.ox.ac.uk/curec/resources/.

Potential costs or harm for children

Attending individual training may occupy their regular learning time at school. Participating in individual assessments may also cause stress for the child.

Solution: Negotiate with the teachers to see which time slots are less disruptive. The training or assessments can be also conducted during recess, lunchtime or after school. To minimize the unnecessary stress, children will be reminded that the results of the assessments will not contribute to their school results. The assessments will be administered in a stress-free, quiet setting at school. Guidelines from British Educational Research Association and British Psychological Society were applied; for example, children in control group are treated with a beneficial intervention.

Privacy

The sample does not include children with learning difficulties. This may require an access to children's status of learning difficulties, a sensitive information, in order to discount them from the sample.

Solution: School teachers distribute consent forms to students; the researcher will not have access to information about learning difficulties.

Confidentiality and anonymity

The results of the training and assessments may be known to people other than the researcher and such information may be misinterpreted.

Solution: All the participating children will only be identified by a participation number. The results of the assessments will only be known to the researcher and his supervisors at University of Oxford. A summary of research will be given to the head teachers and the parents upon request. Paper data will be stored in locked filing cabinets and electronic data will be stored in a password protected file.

Informed consent from children

Children are not able to understand fully the study in order to make an informed decision about their participation.

Solution: Written informed consent will be sought from both the child's parents and the head teacher acting on behalf of them. The children will be invited verbally before the assessments and they can withdraw from the study at any time they want.

Section B continued		
15. Will you obtain informed consent according to CUREC guidelines and good practice in your discipline before participation?	Yes X	No
If you have marked 'No', please give a brief explanation and justification for this decision here:		
16. Will your research involve discussing sensitive issues? This could be information relating to race or ethnic origin, political opinions, religious beliefs, physical/mental health, trade union membership, sexual life or criminal activities.	Yes	No X
If you have marked 'Yes', please make sure that you have included some supporting information (as directed in question 13 of this section) showing the range of questions covering these issues.		
17. Will you ensure that personal data collected directly from participants or via a third party is held and processed in accordance with the provisions of the Data Protection Act ?	Yes X	No
18. How will you ensure that any personal or sensitive data are captured, transferred and stored securely? In particular if data are to be captured electronically, please consult with your local IT department and, with respect to University IT security policies, please comment on how you will capture such data in the first instance, how you will transfer them over networks or via portable media and how and where data will be stored. For more information please see the University's web pages on research data management: http://researchdata.ox.ac.uk/university-of-oxford-policy-on-the-management-of-research-data-and-records/		

All data collected, in forms of test scores, photographs of children’s work, and parents questionnaires, will be kept confidential and stored securely in a locked drawer. These materials are all identified by participation numbers only. The researcher will input or scan these materials into computer files and store the data securely in a password-protected USB drive. All data in the computer files are coded anonymously by participation numbers. The access to the data, either in forms of hard copy or soft copy, is only limited to the researcher, his supervisors and authorized examiners at the University of Oxford. Results will be analysed as group data and not for a particular child. A brief summary of research findings will be made available to schools and parents upon request. All data, in form of hard copy or soft copy, will be destroyed upon the completion of the DPhil, except for the database coded anonymously for future research.

SECTION C: Methods and procedures to be used

Method used: Please ensure you have addressed any potential ethical issues related to these methods in Section 14 and in your Participant Information Sheet	Please mark ‘X’
1. Analysis of existing records	
2. Snowball sampling (recruiting through contacts of existing participants)	
3. Use of casual or local workers e.g. interpreters	
4. Participant observation	
5. Covert observation	
6. Observation of specific organisational practices	
7. Participant completes questionnaire in hard copy	X
8. Participant completes online questionnaire or other online task	
9. Using social media	
10. Participant performs paper and pencil task	
11. Participant performs verbal or aural task (e.g. for linguistic study)	X
12. Focus group	
13. Interview	
14. Audio recording of participant (you will generally need specific consent from participants for this)	
15. Video recording of participant (you will generally need specific consent from participants for this)	

16. Photography of participant (you will generally need specific consent from participants for this)	
17. Others (please specify):	X
Photographs of participants' work, e.g. how plastic letters were arranged to form words (with no handwriting)	

SECTION D: Professional guidelines and training		
<p>In this section, please mark 'X' against at least one of the following professional guidelines you aim to adhere to.</p> <p>You should use the principles listed in your chosen guideline(s) in conducting your own research.</p> <p>Note: this is not an exhaustive list.</p>		Please mark 'X'
Research specialism/ methodology	Association and guidance document	
Anthropology	<u>Association of Social Anthropologists of the UK and Commonwealth</u>	
Criminology	<u>British Society of Criminology: Code of Ethics for Researchers in the Field of Criminology</u>	
Education	<u>British Educational Research Association Ethical Guidelines for Educational Research</u>	X
Geography	<u>Association of American Geographers Statement on Professional Ethics</u> <u>Royal Geographical Society: Research Ethics and Code of Practice</u>	
History	<u>Oral History Society of the UK Ethical Guidelines</u>	
Internet-based Research	<u>British Psychological Society: Conducting Research on the Internet</u> <u>Association of Internet Researchers Ethics Guide</u> Also see our <u>Best Practice Guidance on internet-based research</u>	

Law (Socio-Legal)	Socio-Legal Studies Association: Statement of Principles of Ethical Research	
Management	Academy of Management’s Professional Code of Ethics	
Political Science	American Political Science Association (APSA) Guide to Professional Ethics in Political Science	
Politics	Political Studies Association. Guidelines for Good Professional Conduct	
Psychology	British Psychological Society Code of Ethics and Conduct British Psychological Society: Conducting Research on the Internet Also see “Internet-based Research” guidance above	X
Social Research	Social Research Association: Ethical Guidelines	
Sociology	The British Sociological Association: Statement of Ethical Practice	
Visual Research	ESRC National Centre for Research Methods Review Paper: Visual Ethics: Ethical Issues in Visual Research	
Other professional guidelines. Please specify the other guidelines used here:		

Please indicate what training in research ethics the researchers involved with this study have received, e.g. the title of the course and date completed (online training available at www.admin.ox.ac.uk/curec/training).

If no formal training has been undertaken, please indicate any discussions of research methodology between researchers and supervisors here.

Received a Health and Safety Training in Department of Education on 25th January 2016 by Martin Akhurst. Received training in ethical procedures as an MSc student and a PRS student in the department.

SECTION E: Signatures

- ‘Electronic signatures’ sent as email confirmations from a University of Oxford email address can be accepted. Separate emails should come from each of the relevant signatories as outlined below, indicating acceptance of the relevant responsibilities.
- If you have obtained handwritten (wet-ink) signatures, please scan them and the rest of the checklist pages to create a single PDF document and email through.

Please ensure this checklist is signed by:

For staff research:	For student research:
1. Principal researcher	1. Principal researcher (project supervisor)
2. Head of Department (or nominee)	2. Head of Department (or nominee)
	3. Student researcher

1. Principal researcher signature/supervisor signature (if student research)

I understand my responsibilities as [principal researcher](#) as outlined in the CUREC glossary and guidance on the CUREC website.

I declare that the answers above accurately describe the research as presently designed, and that a new checklist will be submitted should the research design change in a way which would alter any of the above responses so as to require completion of CUREC 2 (involving full scrutiny by an IDREC). I will inform the relevant IDREC if I cease to be the principal researcher on this project and supply the name and contact details of my successor if appropriate.

Signature: 

Print name (block capitals): Terezinha

Date: ...24 May 2016...

Nunes

2. Departmental endorsement signature

I have read the research project application named above. On the basis of the information available to me, I:

- (i) consider the principal researcher to be aware of her/his ethical responsibilities in regard to this research;
- (ii) consider that any ethical issues raised have been satisfactorily resolved or are covered by relevant professional guidelines and/or CUREC approved procedures, and that it is appropriate for the research to proceed (noting the principal researcher’s obligation to report should the design of the research change in a way which would alter any of the above responses so as to require completion of a CUREC 2 full application);
- (iii) am satisfied that: the proposed project design and scientific methodology is sound; the project has been/will be subject to appropriate [peer review](#); and is likely to contribute to existing knowledge and/or to the education and training of the researcher(s) and that it is in the [public interest](#).

Signed by Head of Department or nominee (example nominees for student research include the Director of Graduate Studies/ Director of Undergraduate Studies):

Signature:

Print name (block capitals):

Date:

3. Student signature (if student research)

I understand the questions and answers that have been entered above describing the research, and I will ensure that my practice in this research complies with these answers, subject to any modifications made by the principal researcher properly authorised by the CUREC system.

Signed by student: [redacted]

Date: ...24 May 2016.....

Print name (block capitals):Yu Wing Chan.....

SECTION F: SUBMITTING THE COMPLETED CHECKLIST	Please
	mark 'X'
1. Check you have completed all sections (A-E)	X
2. Ensure your application is signed by you, your supervisor (if student) and department	
3. Please attach all supporting documents (see section B, question 13b for details). If the appropriate supporting documentation is not included with your application, you will then be asked to provide this separately. This may well delay the ethical review process, and thus the start of your research.	X
4. Ensure you have declared conflicts of interest (if any) in Section B, question 13.	X
5. If your department has a Departmental Research Ethics Committee (DREC) , submit this checklist and supporting information to the appropriate departmental officer.	NA
6. If your department does not have a DREC, submit the checklist and supporting information to the SSH IDREC (email ethics@socsci.ox.ac.uk).	
7. Applications must be sent by email from your official ox.ac.uk email account. Please do not send applications by post.	

Appendix 7

Letter to head teachers

UNIVERSITY OF OXFORD

DEPARTMENT OF EDUCATION

15 Norham Gardens, Oxford OX2 6PY

Tel: +44(0)1865 274024 Fax: +44(0)1865 274027

general.enquiries@education.ox.ac.uk www.education.ox.ac.uk



01 July 2019

Dear _____,

I am writing to invite your school to participate in a research project about a teaching programme to promote pre-school children's awareness of sounds in English and in Chinese. Research has shown that children who are aware of sounds progress more quickly in literacy, when they start learning to read. By participating in this research, your school will contribute to the understanding of bilingual children's literacy development and the children will benefit from the new pedagogy inspired by the advancements in bilingual research. The study will be part of my work for the doctoral degree in Education at the University of Oxford, which is being supervised by Professor Terezinha Nunes and Dr. Maria Evangelou.

The commitment from the school would be to allow me to carry out six 15-minute sessions, once a week, with your K3 students. The children will participate in 10 sessions altogether, over a period of two weeks, because there is an assessment before the teaching programme and an assessment after it has been completed, which is used to evaluate the teaching programme. During the teaching, I will guide them to play with units of sound such as syllables, rhymes and phonemes, and they will also become familiar with some letters.

The University of Oxford Ethics Committee has approved this project. I am a registered teacher in Hong Kong and have been cleared by the Sexual Conviction Record Check. Prior to the research, written consent forms will be obtained from parents or guardians. Children and parents have the right to withdraw at any time without any consequence. Your school and the children would remain anonymous in all research reports. The data collected would be kept strictly confidential, available only to my supervisor and myself, and will be used only for my doctoral work and academic publications.

If you need any information, please do not hesitate to contact me at [REDACTED] or via email ([REDACTED]). I have also enclosed a reply slip for your convenience if you are happy for your school to take part. Thank you very much for your time. I look forward to receiving your favourable reply.

Yours sincerely,

Yu Wing Chan (Brad)

Reply Slip

I agree to the procedures set out above to facilitate Yu Wing Chan to conduct the research in my school.

Signed by:

Date:

[Name of Principal]

Principal

[School name]

Appendix 8

Parent's consent form

UNIVERSITY OF OXFORD

DEPARTMENT OF EDUCATION

15 Norham Gardens, Oxford OX2 6PY

Direct dialling: (+852) [REDACTED] | (+44) [REDACTED]

Email: [REDACTED]@education.ox.ac.uk



Project title: A teaching programme to improve children's awareness of sounds of English and Chinese

If you would like your child to participate in this research project, you do not need to do anything.

If you do not wish your child to participate, you can opt out by returning this form to the class teacher.

I DO NOT give permission for my child to take part in the study titled "A teaching programme to improve children's awareness of the sounds of English and Chinese".

Child's name (block capitals).....

Parent/guardian name (block capitals)

Parent/Guardian signature:Date:

UNIVERSITY OF OXFORD
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15 Norham Gardens, Oxford OX2 6PY
Tel: +44(0)1865 274024 Fax: +44(0)1865 274027
general.enquiries@education.ox.ac.uk www.education.ox.ac.uk



Dear Parent/ Guardian,

Your child's school has agreed to take part in a project investigating the effectiveness of a teaching programme designed to improve children's awareness of the sounds of English and Chinese. I am writing to ask for your permission for your child's participation. The project will be part of my doctoral studies in the University of Oxford and is supervised by Professor Terezinha Nunes and Dr Maria Evangelou. Your child will also be asked whether he/she wants to participate. Participation is completely voluntary and can be stopped at any time without giving any reasons and without any consequence.

The aim of this project is to evaluate whether a teaching programme implemented in Chinese leads to gains both in Chinese and English and whether the opposite is also true, that is, whether the teaching implemented in English leads to gains both in English and Chinese. Research shows that children's awareness of sounds of a language leads to faster progress when they start learning to read. The novelty of this project is that the children participating are bilingual and the project will help clarify how learning in one language helps them in the other language that they already know. This is not an evaluation of your child or of the school.

If you agree to allow your child's participation, your child will work with me on language games designed to improve children's awareness of sounds in the language. This will involve a total of ten sessions, 15 minutes each, once a week for two weeks. Children enjoy playing these word games and are expected to benefit from them by learning about the sounds of English and Chinese languages. It would be extremely helpful if you answer the questionnaire about the languages that your child uses at home and returned it to your child's teacher.

All results will be kept confidential. The assessments will be kept anonymous; the children will be identified by a number only. Results will be analysed as a group and not for any individual child. The results will be kept in a password protected computer file. At the end of the project, a summary of the findings will be given to the school.

If you are happy for your child to take part in this project, you do not have to do anything. You only need to sign the opt-out form if you do not wish your child to participate. If you have any questions you would like to ask before deciding, please do not hesitate to contact me by email [REDACTED] or by phone [REDACTED]. If have any concerns about this project, you can contact my primary supervisor, Professor Terezinha Nunes, by email: [REDACTED].

Your participation would be much appreciated. Thank you.

Yours faithfully,

Yu Chan

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