The Cross-Language Influence of Phonological Processing Skills on Early Reading in Chinese-English Speaking Children

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Abstract

Empirical research shows the importance of phonological processing in children's acquisition of reading skills. However, the cross-language relationship between first language and second language is still not clearly described especially in Malaysia's multi-cultural context. This study examines the relations between phonological processing skills and early reading in children's acquisition of Chinese (L1) and English (L2) as second languages. A total of 150 Chinese-speaking children (6 - 7 years old) participated and were administered measures of early reading and phonological processing skills in both L1 and L2. Within-language and cross-language structural equation, models (SEMs) were created to explore the causal relationships between phonological processing skills and early reading in both languages. Results indicated that among the three key skills of phonological processing, rapid automatic naming was the strongest predictor of Chinese early reading. In contrast, phonological awareness strongly predicted English early reading. Only English (L2) rapid automatic naming skills contributed to Chinese (L1) early reading. The cross-language transfer of English rapid automatic naming skills on Chinese (L1) early reading was found and reported. This study contributes to the development of models and theories of bilingual acquisition. It aims to design instructional programmes by considering these critical skills' contribution in enhancing successful reading in English as a second language.

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Keywords: Cross-language; English as a Second Language; Phonological processing; Reading; Structural Equation Modelling.

INTRODUCTION

Phonological processing skills refer to the skills needed to process oral and written language using phonological information, which includes the sounds of one's language (Wagner & Torgesen, 1987). Early reading refers to the early stages of a child who begins to acquire a language in oral or written form. Over the past two decades, empirical research showed the importance of phonological processing in the acquisition of reading skills. Researchers discovered that phonological processing is closely related to children's early reading (Hanson, 2012; Lafrance & Gottardo, 2005; Spector & Moore, 2004). Wagner and Torgesen (1987) identified three main phonological processing skills that are closely related to reading performance in English monolingual children. These skills are phonological awareness, phonological memory and rapid automatic naming.

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The first key skill of phonological processing is phonological awareness. Phonological awareness is said to be the strongest predictor of early reading (Anthony & Francis, 2005; Gillon, 2004; Litt, 2010). Phonological awareness is an awareness of the sound structure of a language (Wagner & Torgesen, 1987). It is measured at different levels of grain sizes (from greatest to least): syllable, onset-rime and phonemes (Anthony & Francis, 2005). Phonological awareness skills are commonly measured by tasks such as counting, matching, deleting and blending sounds in words. The ability to detect and manipulate sound units in spoken language allows children to make connections between sounds and symbols in the reading process. Thus, it allows children to decode the phonological code represented by the symbol in print. This process is known as word decoding. Children who do not have sufficient phonological awareness will have difficulty in the coding process because they are unable to describe sounds of spoken language for smaller units of the word (Lonigan, Anthony, Phillips, Purpura, Wilson & McQueen, 2009).

The second key skill of phonological processing is phonological memory. Phonological memory is the ability to remember verbal or speech information in working memory for later use in a short period (Baddeley, 1992). Phonological memory is important in the process of decoding in early reading. It stores phonological information in working memory, such as sounds, while incorporating it for synthesis into words or sentences. This process occurs with continuous repetition in the phonological loop (Baddeley, 2009). Phonological memory is typically measured by recalling a series of verbal items in sequence within a short period. For example, remembering a string of digits or words in several minutes (Wagner, Torgesen, & Rashotte, 1994).

The third key skill of phonological processing is rapid automatic naming. Rapid automatic naming is the ability to retrieve the name of a symbol or written word quickly (Wagner & Torgesen, 1987). Rapid automatic naming can be measured by naming a set of familiar and randomly arranged objects quickly such as colours, numbers, objects and other types of stimuli. This skill relates explicitly to the phonological and orthographic information of one's language and then sounds them out (Gottardo, 2005). However, phonological memory and rapid automatic naming are considered implicit phonological processes because both of them are cognitive processes that are unconsciously involved in children's speech processes (Lafrance & Gottardo, 2005).

This study examines the within-language and cross-language relationship between phonological processing skills and early reading in the acquisition of Chinese (L1) and English (L2). It focuses on whether phonological processing skills predict children's early reading and if there is any cross-language effect of phonological processing skills across both languages. The research questions include: (i) Do phonological processing skills predict children's early reading in L1 and L2 respectively? (ii) Do L1 phonological processing skills predict children's early reading in L2 or vice versa?

LITERATURE REVIEW

Past research studies revealed positive relationships between early reading ability and the key skills of phonological processing. Phonological awareness has proven to be the most powerful predictor of early reading (Adams, Foorman, Lundberg, & Beeler, 1998; Anthony & Francis, 2005; Gillon, 2004; Litt, 2010 & Lonigan et al., 2009). Positive relationships between early reading and phonological memory (Alptekin & Ercetin, 2009; Gathercole & Alloway, 2007; Gathercole & Pickering, 2000); early reading and rapid automatic naming (Decker, Englund, Carboni & Brooks, 2011; Schatschneider, Carlson, Francis, Foorman, & Fletcher, 2002) also showed consistency.

2.1　Influences of L1 Phonological Processing on L2 Early Reading

Relationships between phonological processing and its relative contribution to early reading continue to be investigated in other languages. Research suggests that phonological processing is closely related to the performance of early reading in the acquisition of a second language (Endler, 2008; Eppe, 2006; Goldstein & Bunta, 2012; MacWhinney, 2012; Talebi, 2012). Furthermore, the contribution of phonological processing skills to early reading is not limited to alphabetic languages, such as English. There is empirical

evidence that phonological processing skills also contribute to non-alphabetic languages, such as Chinese (Chen, Xu, Nguyen, Hong & Wang, 2010; Chow, McBride-Chang, & Burgess, 2005, Li, Shu, McBride-Chang, Liu & Peng, 2010; Pasquarella, Chen, Gottardo & Geva, 2015; Wang, Perfettie & Liu, 2005).

For example, Chow et al. (2005) found that phonological awareness was important to Chinese early reading. Rapid automatic naming skills appeared to be important for children's word recognition with the control of visual skills. Specific phonological processing skills were transferred from Chinese to English in Hong Kong Chinese children. This suggests that some phonological processing skills are universal to children's language acquisition regardless of their orthographies. Chung and Ho (2010) found that Chinese phonological awareness and rapid automatic naming contributed significantly to the reading ability of English words. Children with low levels of phonological awareness and rapid automatic naming may have reading difficulty in both languages. Although the writing systems of Chinese and English have drastic differences, their common underlying abilities enable impacts of L1 on L2.

In a different context such as English-speaking environments in Canada, Gottardo, Chiappe, Yan, Siegel, and Gu (2006) suggested that children's L1 reading experiences might influence their phonological processes in L2. Chinese-speaking children tend to use their L1 experiences when reading English as L2. Lack of phonological awareness skills in L1 may be the source of reading difficulty in L2. These studies provided evidence of cross-linguistic transfer from L1 to L2. Keung and Ho (2009) found that Chinese and English phonological awareness and rapid automatic naming significantly contributed to Chinese word reading. This resulted from controlled Chinese and English cognitive measures on Hong Kong Grade 2 Chinese children. Chinese rhyme awareness predicted English phonemic awareness. Means, developing English phonological awareness and rapid automatic naming may also facilitate Chinese word reading development, suggesting cross-linguistic transfer from L2 to L1.

In Malaysia, cross-language influences of phonological processing skills are under-explored. Phoon, Abdullah, and Maclagan (2012) investigated the phonological development of 264 developing English-speaking Malaysian Chinese children aged 3 to 7 years. They found that English-speaking Chinese children exhibited different phonological acquisition patterns to standard English. This was due to the cross-linguistic effects of Chinese (L1) which were acquired at the same time as English (L2). The influence of their L1 appeared to accelerate or delay the phonological acquisition of L2.

2.2   Differences between Phonological and Orthographic in Chinese and English

Chinese writing is classified as a logographic system and considered morphemic or morpho-syllabic (Perfetti & Liu, 2006). A single Chinese character can be a word and can also join with other characters to form a multi-character word. A character can provide orthographic information (writing), syllables (mentions) and morphology (meaning) (Li et al., 2010). Syllable is a basic unit of pronunciation in Chinese, and each syllable is divided into two parts: onset-rime, such as / mei3 / divided into / m / (onset) and / ei3 / (rime). It is more consistent and reliable when syllables and rhymes are used to sound out Chinese words or characters. Hence, larger grain size is favoured in Chinese reading (Chung & Ho, 2010; Ziegler & Goswami, 2005).

English is an alphabetic system that uses letters to represent sounds in speech. An alphabetic language consists of 26 letters that can make up 44 sounds or phonemes. Phonemes are small units of sounds in speech and are consistent with small grain-sized units of phonemes. English has strong letter-sound correspondence and is represented at phonemic level. Balota, Cortese, Sergent-Marshall, Spieler and Yap (2004) described the onset and rime structure in English syllables. A single syllable consists of onset and rime. The rime consists of a nucleus and a coda. Nucleus represented by the vowel, coda represented by the final consonant, and the onset is represented by the initial consonant. In other words, a syllable represented by alphabetic orthography. For example, the word "*sit*" / sɪt / consists of three letters "s", "i" and "t", where "s″ represents sound / s /, "i" sound / ɪ / and "t ″ / t /.

METHODOLOGY

3.1 Participants

150 Chinese-speaking children participated in this study, aged between six and seven years old, and all enrolled in Grade One. They were randomly chosen from six National-type Chinese primary schools in Selangor, Malaysia. The participants included 85 boys and 65 girls. Seventy-eight were from urban schools, and 72 were from rural schools. The children spoke Mandarin at home from a young age. They were exposed to written forms of Chinese and English languages since four or five years old in kindergarten. The medium of instruction in the primary schools is Chinese.

3.2 Measures

3.2.1 Early Reading

Chinese and English word reading. The reading items were chosen from Grade One Chinese and English textbooks for national schools (Curriculum Development Centre, Ministry of Education). The English words in vocabulary lists were categorised based on their syllable and phonic structure. Fifty words were chosen based on the resultant categories that emerged. The Chinese words were selected based on the complexity of the characters. The words were arranged in order of increasing complexity.

Chinese and English text reading. The text reading sentences were chosen from Grade One Chinese and English language textbooks in accordance with the curriculum for national schools (Curriculum Development Centre, Ministry of Education). Sentences were chosen based on the complexity of the words in the sentences. Two or three paragraphs were selected from front, middle and back chapters of the books.

3.2.2 Phonological Processing

Phonological awareness. The children were administered the adapted phonological awareness subtests of the Comprehensive Test of Phonological Processing (CTOPP-2) (Wagner, Torgesen, Rashotte, & Pearson, 2013), which was suitable to the context of the participants. The phonological awareness contained three subtests: deleting, blending and segmentation of sounds. Each task consisted of four practice trials and ten experimental trials. The maximum score for this task was 10.

Chinese phonological awareness. Sound deletion task: children were asked to delete either the onset or rime unit of a syllable. For example, given syllable /ba1/, the children were asked to delete onset /b/ sound. The answer in this case is /a1/; or syllable /mei3/ delete rime /ei3/ sound, answer is /m/. Sound blending task: the children were asked to combine onset and rime unit of a syllable. For example, onset /c/ and rime /ai4/ were sounded out separately. Children were then asked to combine these two sounds to produce a syllable /cai4/. Sound segmentation task: the children were asked to detect the onset and rime sound and then sound them out separately. For example, syllable /hua1/ segmented it into /h/ and /ua1/ (Chow et al., 2005; Li et al., 2010).

English phonological awareness. Sound deletion task: children were asked to delete an onset-rime or phonemic unit of a syllable. For example, children were given task such as "say /pat/ without /p/ at onset-rime level or phonemic level, or "say /book/ without /k/ sound. Sound blending task: the children were asked to combine an onset-rime or phonemic unit of a syllable to produce a word. For example, combine phonemes /c/, /a/ and /p/ to sound out syllable /cap/. Sound segmentation task: the children were asked to detect the onset-rime or phonemic sound and then sound them out separately. For example, "tell me the first sound, middle sound and the last sound of /map/". The response will be /m/, /a/ and /p/ (Wagner et al., 2013).

Chinese and English phonological memory. Phonological memory was measured by a span digit test and non-word repetition test. This task involved ten series of digit strings and ten non-word combinations.

The number of digits was added from four to eight digits gradually. Digits 1 to 9 were randomly selected and not repeated. Researchers read a series of digits or non-word combinations slowly but loudly. Children were asked to repeat the number or non-word afterwards. For example, the examiner mentioned a digit string such as 5-3-1-4, and the child had to repeat it in the same order of 5-3-1-4. The number of digits or non-word were added from four digits/non-word to eight digits/non-word gradually. The test was terminated if the child was unable to or incorrectly answered three items.

Chinese and English rapid automatic naming. Digit-naming and letter-naming tasks were administered to measure children's speed of digits and letter naming. Six digits or letters familiar to the children were chosen and repeated. These were arranged randomly in a 9 x 4 array which consisted of four rows of nine digits each. The child was asked to name from left to right the digits or letters presented to them at the fastest speed possible in Chinese and English respectively. Response times were recorded. A faster time indicated a higher score.

3.3   Data Analysis

Descriptive analysis was conducted to calculate means and standard deviation for all the tests in both languages (see Table 1). Prior to the primary analysis, steps such as coding data, treating missing data and checking normality were conducted (Hair, Black, Babin, & Anderson, 2010). Once these steps were complete, partial least square (PLS) path modelling Smart PLS 3.0 software was used to test the theoretical model (Ringle, Wende & Becker, 2015). Measurement model properties were assessed to ascertain the validity and reliability of the relations between indicator and latent construct. Structural model analysis was conducted to evaluate significances of path coefficients for the research model (Hair, Hult, Ringle & Sarstedt, 2014).

FINDINGS

Table 1 presents the means and standard deviation of the measures. 2-sample-t test results showed that bar phonological awareness, children's Chinese (L1) early reading performance, phonological memory and rapid automatic naming skills were significantly greater than their English (L2) ($p < .001$). For phonological awareness abilities, 2-sample-t test results revealed no significant differences in sound deletion and sound blending skills between Chinese and English ($p > .05$).

Table 1. Means and Standard Deviation of the Measures (Raw Scores).

Task	Chinese (L1)		English (L2)	
	M	**SD**	**M**	**SD**
Early Reading (max=100%)				
Word Reading	74.25	25.38	59.92	34.27
Text Reading	83.48	25.13	72.43	32.85
Phonological Awareness (max=10 marks)				
Sound Deletion	4.49	3.42	4.93	3.88
Sound Blending	5.57	3.94	5.44	3.35
Sound Segmentation	3.51	7.74	5.88	3.43
Phonological Memory (max=10marks)				
Digit Span Task	8.06	1.65	6.05	2.16
Rapid Automatic Naming (time=second)				
Digit-naming	22.00	5.97	33.32	11.35
Letter-naming	-	-	24	8.54

Note: *n* = 150

4.1   Assessment of Measurement Model

To assess the measurement model, internal consistency reliability, individual item reliability, convergent and discriminant validity were ascertained. Individual item reliability was assessed by analysing the outer loadings of each construct's measure. Items with loadings of at least .708 or above indicated that the items used obtained significant reliability (Hair et al., 2014). The outer loading for all items in this study ranged from .752 to 1.00, which indicated that the tasks used to measure the constructs had enough reliability.

For internal consistency reliability, composite reliability coefficient values were checked. Based on the rule of thumb, the composite reliability should be at least .70 or above (Hair et al., 2014). Table 2 shows the composite reliability coefficients of each latent construct ranging from .814 to 1.00 for adequate internal consistency reliability. Convergence validity of the measures was ascertained by examining Average Variance Extracted (AVE). The AVE of the latent constructs ranged from .688 to 1.00 in which the above rule of thumb's minimum value was .50.

Discriminant validity was ascertained by comparing correlations among the latent constructs with square roots of AVE (Fornell & Larker, 1981). To achieve adequate discriminant validity, square root of AVE should be greater than the correlations among latent constructs. As indicated in Table 3, the correlations of the latent constructs were higher than all correlations among other latent constructs, suggesting adequate discriminant validity.

Table 2. Internal Consistency Reliability and Convergent Validity.

Latent Construct	Cronbach's Alpha	Composite Reliability	AVE
Chinese Early Reading	.947	.974	.949
Chinese Phonological Awareness	.848	.903	.767
Chinese Phonological Memory	1.00	1.00	1.00
Chinese Rapid Automatic Naming	1.00	1.00	1.00
English Early Reading	.953	.977	.955
English Phonological Awareness	.897	.935	.829
English Phonological Memory	.773	.898	.814
English Rapid Automatic Naming	.571	.814	.688

Table 3. Validity Discrimination (Correlations among Latent Construct).

Latent Construct	1	2	3	4	5	6	7	8
1.Chinese Early Reading	**.974**	.390	.459	.482	.676	.451	.461	.509
2.Chinese Phonological Awareness		**.876**	.363	.299	.660	.877	.387	.451
3.Chinese Phonological Memory			**.907**	.321	.439	.424	.873	.388
4.Chinese Rapid Automatic Naming				**1.000**	.393	.302	.296	.430
5.English Early Reading					**.977**	.756	.492	.671
6.English Phonological Awareness						**.910**	.451	.513
7.English Phonological Memory							**.902**	.462
8.English Rapid Automatic Naming								**.830**

4.2   Path Analysis of Cross-language Model

Two SEM models were created using Smart PLS 3.0 to explore the causal relationships between phonological processing skills and early reading in both languages. Figure 1 shows the within-language structural equation model of Chinese and Malay. Figure 2 shows the cross-language structural equation model between Chinese and Malay. As depicted in Figure 1 and 2, numbers shown near the arrows are the value of β, path coefficient between the latent constructs.

Within-language relationships. The causal relationships between phonological processing skills and early reading explored within-language first. In Chinese (L1), all three phonological processing skills were significant predictors of early reading. Rapid automatic naming was the strongest predictor among the three skills ($\beta = .334$, $p < .001$), followed by phonological memory ($\beta = .284$, $p < .001$) and phonological awareness ($\beta = .188$, $p < .01$).

In English (L2), phonological awareness was the strongest predictor of early reading ($\beta = .535$, $p < .001$), followed by rapid automatic naming ($\beta = .356$, $p < .001$). However, phonological memory was found not to be a predictor of early reading ($\beta = .087$, $p > .05$). In comparison to the *R*-squared values of early reading (shown in Figure 1), Chinese early reading with phonological processing skills only explained 36.5% of the total variance. On the other hand, English phonological processing skills better explained the total variance in English early reading, which was 68.6%.
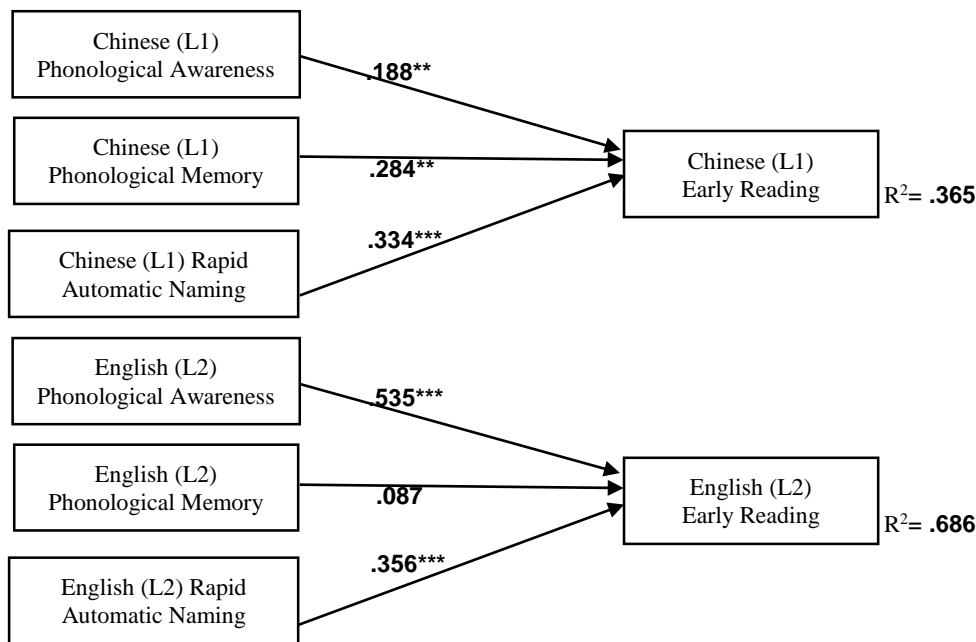

Figure 1. The within-language structural equation model, showing path coefficients significant at
**p < .01; ***p < .001

Table 4. Path Coefficients of Cross-Language Structural Equation Model

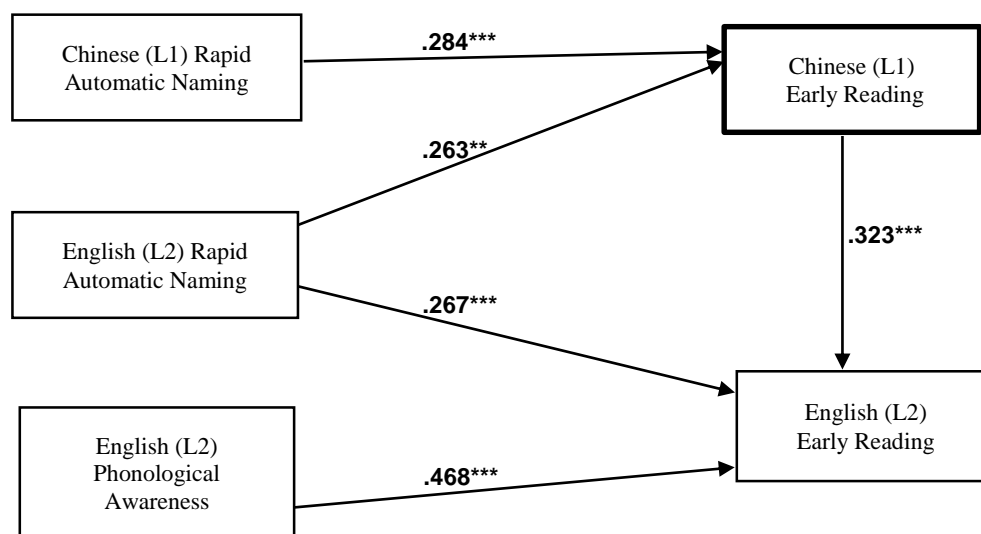| Relation		Direct Effect, β	p value
Chinese Early Reading	→English Early Reading	.323***	< .001
Chinese Phonological Awareness	→ Chinese Early Reading	-.047	.691
Chinese Phonological Memory	→ Chinese Early Reading	.163	.073
Chinese Rapid Automatic Naming	→ Chinese Early Reading	.284***	< .001
English Phonological Awareness	→ English Early Reading	.468***	< .001
English Phonological Memory	→ English Early Reading	.037	.455
English Rapid Automatic Naming	→ English Early Reading	.267***	< .001
Chinese Phonological Awareness	→ English Early Reading	.003	.969
Chinese Phonological Memory	→ English Early Reading	-.031	.586
Chinese Rapid Automatic Naming	→ English Early Reading	.014	.747
English Phonological Awareness	→ Chinese Early Reading	.188	.115
English Phonological Memory	→ Chinese Early Reading	.070	.471
English Rapid Automatic Naming	→ Chinese Early Reading	.263**	.008

Figure 2. The cross-language structural equation model, showing path coefficients significant at
**p < .01; ***p < .001

Cross-language relationships. Table 4 presents the path coefficients of the cross-language structural model. Results indicated that all three Chinese phonological processing skills (phonological awareness, phonological memory and rapid automatic naming) did not predict English early reading (β = -0.03, p > .05; β = -0.031, p > .05; β = 0.14, p > .05). Chinese phonological awareness and phonological memory were found to be significant and positively predicted Chinese early reading in the within-language structural equation model (Figure 1). Though this was not the case in the cross-language structural equation model (Figure 2). Another important finding was that English rapid automatic naming was found to significantly predict Chinese early reading (β = .263, p < .01). And Chinese early reading was found to significantly predict English early reading (β = .323, p > .001) in Figure 2.

DISCUSSION

Results revealed the interdependent relationship between phonological processing skills and early reading in children's acquisition of Chinese (L1) and English (L2) as second languages. In respect of first research question -- do phonological processing skills predict children's early reading in L1 and L2 respectively? -- the within-language structural equation model revealed that phonological processing skills explained unique variances in both Chinese and English early reading. However, both languages consist of drastically different structures in orthography and phonological systems. In respect of the second research question -- do L1 phonological processing skills predict children's early reading in L2 or vice versa? -- the cross-language structural equation model showed significant effects across L1 and L2 to posit the cross-language influences in both languages.

5.1   Within-language Relationships

Chinese phonological processing and early reading.   The within-language model (Figure 1) revealed that all phonological processing skills have positive and significant effects on Chinese early reading. Phonological awareness, phonological memory and rapid automatic naming were predictors of Chinese early reading (L1). These findings were consistent with the empirical studies of Chow et al. (2005) and Li et al. (2010).

Among the three key skills, rapid automatic naming is the most critical predictor for Chinese early reading. There are many reasons that rapid automatic naming is considered a cognitive skill important to Chinese recognition of words. The Chinese writing system is logographic. To read in Chinese, one needs to obtain sufficient visual graphical analysis skills (Zhou, McBride-Chang & Wong, 2014). This is because Chinese orthography consists of three stages: stroke, radical and character. Stroke is the most basic unit of character. Each character consists of several basic "strokes" (examples: 一, 丿, 丶, 丨). The number of strokes measures the complexity of a character. The greater the number of strokes, the more difficult it is to learn. Many characters are different with just one or two strokes, for example, 大(big), 太(too), 犬(dog), 夭(dead), 夫(husband). At a glance, the form of these characters is much the same. Therefore, it is expected that visual graphical analysis skills involved in rapid automatic naming tasks are important in character recognition of Chinese reading (Chen et al., 2010). The task of rapid automatic naming involves a lot of visual graphical analysis skills on the writing system that represents semantic information. Chinese characters are usually taught with memorisation or "look-and-say" instructions. Therefore, children need visual graphical analysis skills that involve rapid automatic naming skills in the process of recognition of Chinese characters.

English phonological processing and early reading. For English, the within-language model (Figure 1) revealed that only two phonological processing skills -- phonological awareness and rapid automatic naming -- have positive and significant effects on English early reading. Phonological memory not found to contribute to English early reading. These findings are in line with Gillon (2004), Litt (2010), Lonigan et al. (2009) and Nelson, Lindstrom, Lindstrom and Denis (2012). These studies proposed that children who are inept in phonological awareness and rapid automatic naming skills are likely to be at high risk of having difficulties in early reading. The findings indicate that phonological memory does not show significant relationships to reading, but that does not mean that phonological memory skill is an unimportant contributor to reading. It may indirectly contribute through its impact on phonological awareness.

Children proficient in phonological awareness and rapid automatic naming are said to be proficient in English early reading. Phonological awareness is the best predictor of English early reading ability. English is consistent with strong letter-sound correspondence and small grain size units of phonemes. Balota et al. (2004) described the onset and rime structure in English syllables. A single syllable consists of onset and rime. The rime consists of a nucleus and a coda. The nucleus represented by the vowel, the coda is represented by the final consonant, and the onset represented by the initial consonant. Syllables in English are represented by alphabetic orthography; thus phonological awareness is crucial for early reading.

5.1   Cross-language Relationships

This study investigates the cross-language relationship of phonological processing skills in Chinese and English early reading. Based on the cross-language structural model displayed in Table 4, all Chinese phonological processing skills did not predict English early reading. On the other hand, English rapid automatic naming has positive and significant effects on Chinese early reading. This means that English rapid automatic naming contributes to Chinese early reading acquisition. Notably, transfer of rapid automatic naming skills occurs from English to Chinese (Chen et al., 2010; Chung & Ho, 2010; Pasquarella, Chen, Lam, Luo & Ramirez, 2011). This transfer is likely due to rapid automatic naming skills, which are common processing skills that contribute to both Chinese and English reading. This transfer suggests that rapid automatic naming skills may be shared and help to learn both languages. Cummins (2005) indicated that children develop common underlying proficiency (CUP) which is a general form of skills or knowledge that can be transferred from one language to another.

Chinese phonological awareness skills are not associated with English early reading, whereas English phonological awareness strongly predicts English reading. Due to the nature of alphabetic script, English is consistent orthography because of its strong letter and sound correspondence at phonemic level (Ziegler & Goswami, 2005). Therefore, phonological awareness of smaller units of phoneme strongly predicts early reading, especially word decoding in English. Chinese is an inconsistent language because of its morpho-syllabic script. This syllabic script is also phonological, but not phonemic because it indicates larger units than phonemes. In Chinese script, a single symbol or character is used to represent both a syllable and a word. Syllables and rimes are more salient in Chinese words. Thus, phonological awareness contributes the least to Chinese reading when compared with phonological memory and rapid automatic naming. McBride-Chang et al. (2008) mentioned that phoneme awareness is less critical for Chinese reading because the phoneme is not explicitly represented in Chinese words. Furthermore, Chung and Ho (2010) suggested that lacking phonological awareness is not related to Chinese reading problems. Lacking phonological awareness skills at phonemic level is strongly associated with English reading impairment.

Goodrich, Lonigan and Farver (2013) explained that the transfer of phonological awareness is likely dependent on both language-independent and language-specific processes. Phonological awareness skills may involve universal underlying proficiency that is language independent. These skills can be transferred to any language that receives adequate exposure and motivation. On the other hand, the transfer of phonological awareness skills is partially language dependent (Cummins, 2005). However, in this study, there was no transfer observed in phonological awareness from Chinese (L1) to English (L2), or vice versa. This finding is most likely due to language-specific processes influencing a more significant portion of the transfer and as a result of the drastic script differences between both languages.

CONCLUSION AND RECOMMENDATION

This study provides evidence for a reciprocal relationship between Chinese and English early reading abilities. Results indicate that children with lower performance in phonological processing skills have more difficulties in both their first (Chinese) and second language's (English) early reading. Also, Chinese early reading contributes significantly to English early reading. This suggests that L1 is a strong predictor of the cause of reading difficulties in L2. Hence, children who encounter reading difficulties in Chinese may show similar problems in English.

This study further explains that phonological awareness may contribute less to Chinese reading difficulty, but is closely related to English reading difficulty. Phonological awareness competency is the strongest predictor for Chinese-English children who struggle in English language acquisition. Rapid automatic naming is an essential cognitive skill involved in phonological processing that is common in both Chinese and English reading acquisition. Although there is evidence suggesting that Chinese early reading contributes a significant effect on English early reading, there is no cross-language transfer from Chinese phonological processing skills to English early reading in this study. However, this transfer was observed from English phonological processing skills to Chinese early reading (L2 to L1). It is argued that this is

likely due to the influences of the linguistic characteristics and proficiency levels of both languages. Furthermore, this study contributes to the development of models and theories of bilingual acquisition. This can help to design instructional programmes by considering phonological processing skills as their prior contribution to the success of early reading.

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