Pinyin and Chinese Children’s Phonological Awareness

by

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ABSTRACT

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This paper critically reviewed the literature on the relationships between Pinyin and Chinese bilingual and monolingual children’s phonological awareness (PA) and identified areas of research worth of further investigation. As the Chinese Phonetic Alphabet providing pronunciation of the universal Chinese characters, Pinyin facilitates children’s early reading development. What research has found in English is that PA is a reliable indicator of later reading success and meta-linguistic training improves PA. In Chinese, a non-alphabetic language, there is also evidence that PA predicts reading in Chinese, which confirms the universality of PA’s role. However, research shows the uniqueness of each language: tonal awareness is stronger indicator in Chinese while phonemic awareness is stronger indicator in English. Moreover, Pinyin, the meta-linguistic training, has been found to improve PA in Chinese and reading in Chinese and possibly facilitate the cross-language transfer of PA from Chinese to English and vice versa.
I am heartily thankful to my supervisors Becky Chen and Normand Labrie, whose guidance and support from the initial to the final level enabled me to develop a thorough understanding of the subject and eventually complete the thesis paper. In addition, I am indebted to many people in the OISE community including Katherine Rehner, Jim Cummins, Tony Lam, and Linda Pereira, for their inspiration, encouragement and assistance during my degree study. Lastly, I am most especially grateful to my father, my husband and my lovely children Jeffrey and Daniel for their great understanding and support while I have been juggling of study, work and life.
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Chapter One: Introduction

The present paper represents a critical review of the literature on the relationships between Pinyin and Chinese bilingual and monolingual children’s phonological awareness (PA) and identified areas of research worth of further investigation. Pinyin, the Chinese Phonetic Alphabet is an instrument to spell and pronounce the universal Chinese characters.

1. Rationale of the review

Pinyin, or more formally Hanyu Pinyin (汉语拼音), is currently the most commonly used romanized phonetic system for the Chinese language. Hanyu (汉语) means the Chinese language, and, Pinyin means "phonetics". The system is now used in mainland China (and Hong Kong, Macau, and Taiwan) to teach Chinese to school children and internationally to teach Chinese as a second language. It is also often used to spell Chinese names in foreign publications and can be used to enter Chinese characters on computers and cell phones.

The necessity and special role of Pinyin in Chinese children’s early literacy development come from the characteristics of the Chinese language. Chinese has a rich orthographic system. Unlike alphabetic languages such as English, the graphemes in Chinese do not map onto individual phonemes but instead onto characters, which are syllabic morphemes. In other words, a character cannot be pronounced by recourse to grapheme-phoneme correspondence rules. Chinese orthography centers on characters which may be divided into two categories: simple characters and compound characters. Only a small number of characters are simple ones that assemble strokes and cannot be divided into components. (Strokes with no association of any meaning and phonetic cues are not basic units for use in the language and strokes are merely applicable when learning to write characters or improve one’s handwriting.) More than 80 % of characters are phonetic semantic compounds that are made up of a phonetic radical and a semantic radical (Perfetti & Tan, 1999). Radicals are made of strokes like simple characters. The phonetic radical usually gives partial cues to the pronunciation of the whole character, whereas the semantic radical gives cues to its meaning. Overall, the validity of phonetic radicals in signaling whole characters’ pronunciation is less than 40% (Pollatsek, Tan & Rayner, 2000).

Due to these features of the Chinese language, at the very early stage of Chinese reading, children would have to learn characters through rote memory. In a sense, a child is able to read a Chinese
character only when he or she has been taught to do so. However, “the introduction of Pinyin may have changed the way in which the connection between speech and the writing is formed. When a child has acquired the pinyin principle, he or she is able to derive the sounds of characters through Pinyin and to match these sounds with the phonological codes that already exist in the mental lexicon. In other words, Pinyin knowledge bridges the gap between speech and writing in Chinese, and this enables children to derive the meanings of characters that are visually unfamiliar but auditorily familiar (Siok & Fletcher, 2001).” This is how Pinyin affects children’s early literacy development.

With application of Roman letters, Pinyin becomes the unique tool for children to learn to pronounce unknown characters at the early stage of literacy. Nevertheless, Chinese bilingual children who learn to read and write Chinese and English in the two different writing systems have to mentally “juggle” with Pinyin of Roman letters and Chinese characters, and English alphabet and words. Consequently, Pinyin will have a more complex role in the process of these children’s bi-literacy development. The literature reviewed in this paper has shown some evidence of this view which is also the direction for further study.

Pinyin has been found out in the studies in the recent decade to be highly correlated to PA. PA is the conscious sensitivity to the sound structure of language. It includes the ability to distinguish units of speech such as syllables and phonemes. The ability to segment and blend phonemes is critical for the development of reading fluency and spelling. PA has, therefore, been the focus of much research on children’s cognitive and language development. Evidence from alphabetic languages shows a strong relationship between PA and reading success. However, many researchers in the past ten years have raised questions regarding phonological awareness of nonalphabetic languages: Is the importance of phonological awareness in learning to read universal across languages? Specifically, is there a similar relationship between phonological awareness and reading in a non-alphabetic language where the speech-writing mapping is less consistent and if so, what is the nature of phonological awareness for a non-alphabetic language? (Siok & Fletcher, 2001) So far, research on these issues has generated mixed evidence.

In addition to the issue about PA in different writing systems, what remains in debate is whether or not the development of PA relates language experience such as training on alphabet and spelling, and orthography. Learning Pinyin is a typical language training experience for Chinese children to acquire Chinese characters—the first step to literacy in Chinese. Thus the
investigation of the relationship between Pinyin and Chinese children’s PA has shed some light not only on whether or not Chinese PA relates to Chinese reading but also more importantly on whether or not PA relates language training experience from the perspective of a non-alphabetical language.

2. Research questions

Overall, the present paper identified the developments of research in the past twenty years on the following questions: What are the relationships among pinyin, Chinese PA and Chinese reading? What is the relationship between pinyin and English PA? What is the relationship between Chinese PA and English PA in the same group of Chinese children? The paper offers an interdisciplinary review of the literature which draws on theories from educational psychology and second language education. Specifically I looked into the studies on possible correlations among the key factors. Does Pinyin correlate with PA in Chinese? Does Pinyin correlate with Chinese reading? Does Pinyin correlate with PA in English? Does Chinese PA correlate to English PA?

In the past twenty years, there has been ample literature on PA and reading in English, Chinese monolingual children’s PA development, the effects of Pinyin on Chinese monolingual children’s PA, and cross-language transfer of PA between alphabetic writing systems. However, there has been very few research conducted on the relationship between Pinyin and the development of PA among Chinese bilingual children. This review shows that it is worth of further investigation in the future on the relationships of Pinyin and the development of PA in Chinese and English, and, the relationships of Pinyin and reading in Chinese and English in Chinese bilingual children.

3. Methodology

Before conducting the analytical review, I have searched the research literature relevant to Pinyin and PA in ERIC and China Knowledge Resource Integrated Database (CNKI) using key words such as Pinyin, Chinese Phonetic Alphabet, phonological awareness, reading, Chinese children and cross-language transfer. The majority of the literature was journal articles written in either English or Chinese published in the past twenty years. About 300 potentially related articles and references in several review papers were further screened. Among them, close to 100 articles were reviewed and recorded in an annotated bibliography. This paper directly quoted and referred
to 52 relevant studies on Pinyin and Chinese children’s PA, which are listed in the reference section of this paper with an asterisk. These studies had to meet the following criteria:

- Studies had to appear in a refereed journal.
- Studies had to employ correctional or experimental or quasi-experimental design.
- Studies had to test at least one of the hypotheses that Chinese PA improves Chinese reading, or Chinese PA correlates English PA, or Pinyin improves Chinese PA and reading.

In order to have a thorough understanding of issues about Pinyin and as well a critical analysis of studies on Pinyin, we have to define and illustrate what Pinyin is first. An overview of both Chinese phonology and other perspectives of Chinese language provide a background of Pinyin’s rationales and functions. So does a historical review of Pinyin’s origin. The following chapter is to focus on these questions.
Chapter Two: Pinyin

1. What is Pinyin?

Pinyin is the Romanized phonetic transcription of the Chinese language. It was first developed by a government committee in the People's Republic of China (PRC), and approved by the Chinese government in 1958. Pinyin employs 26 Roman letters in all as its phonetic symbols but as a matter of fact only 25 letters are generally used since the letter “v” is not used in transcribing any words from Chinese but used as transliteration of words from other languages.

Pinyin system reflects the characteristics of the Chinese language. The basic phonetic unit in Chinese is a syllable. One syllable represents phonetically the pronunciation of one Chinese character. The segmental structure of a syllable in Chinese begins with an initial, followed by a final with a tone. Initials are initial consonants, while finals are all possible combinations of a medial (semivowel coming before the vowel), a nucleus vowel, and a coda (final vowel or consonant). Unlike in European languages, initials (声母) and finals (韵母) — and not consonants and vowels — are the fundamental elements in Pinyin (and most other phonetic systems used to describe the Chinese language).

There are 21 initials in Pinyin. The following table (translated and adapted from the corresponding table in Chinese in Lin & Wang (2004)’s *Phonetics*), which includes each and every initial, is arranged in rows that designate manner of articulation, meaning how the initial or consonant is produced, and columns that designate place of articulation, meaning where in the vocal tract the initial or consonant is produced. Each cell in the table indicates Pinyin symbols. (See Appendix 1 for the corresponding symbols of International Phonetic Alphabet (IPA).)
Table 1: Initials of Pinyin

<table>
<thead>
<tr>
<th></th>
<th>Bilabial</th>
<th>Labiodental</th>
<th>Alveolar</th>
<th>Retroflex</th>
<th>Alveolo-palatal</th>
<th>Palatal</th>
<th>Velar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plosive</td>
<td>b</td>
<td>p</td>
<td>d</td>
<td>t</td>
<td></td>
<td>g</td>
<td>h</td>
</tr>
<tr>
<td>Nasal</td>
<td>m</td>
<td></td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td></td>
<td></td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>approximant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affricate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approximant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>y</td>
<td>w</td>
</tr>
</tbody>
</table>

The conventional order (excluding w and y), derived from the Zhuyin system (Chinese phonetic system used before Pinyin system was created. Zhuyin uses unique symbols but not Roman letters as its own letters and tone marks. See section 4 in this chapter for more information about Zhuyin system.), is as follows: /b/, /p/, /m/, /f/, /d/, /t/, /n/, /l/, /g/, /k/, /h/, /j/, /q/, /x/, /zh/, /ch/, /sh/, /z/, /c/, and /s/. Pinyin has 35 finals. The following table of finals is formed in rows designating nucleus vowels and codas with columns indicating medials. (The table was translated and adapted from the corresponding table in Chinese in Lin & Wang (2004)’s Phonetics. And see Appendix 1 for the corresponding symbols of International Phonetic Alphabet (IPA).)
## Table 2: Finals of Pinyin

<table>
<thead>
<tr>
<th>Nucleus</th>
<th>Coda</th>
<th>Medial</th>
<th>Coda</th>
<th>Medial</th>
<th>Coda</th>
<th>Medial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>i</td>
<td>u</td>
<td>ü</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td>[a]</td>
<td>Ø</td>
<td>Ea</td>
<td>ia</td>
<td>ua</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[i]</td>
<td>ai</td>
<td></td>
<td>uai</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[u]</td>
<td>ao</td>
<td>iao</td>
<td></td>
<td></td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[n]</td>
<td>an</td>
<td>ian</td>
<td>uan</td>
<td>üan</td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[ŋ]</td>
<td>ang</td>
<td>iang</td>
<td>uang</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td>[ə]</td>
<td>Ø</td>
<td>e</td>
<td>ie</td>
<td>uo</td>
<td>üe</td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[i]</td>
<td>ei</td>
<td></td>
<td>uei</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[u]</td>
<td>uo</td>
<td>iou</td>
<td></td>
<td></td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[n]</td>
<td>en</td>
<td>in</td>
<td>uen</td>
<td>ün</td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>[ŋ]</td>
<td>eng</td>
<td>ing</td>
<td>ueng</td>
<td>iong</td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>Ø</td>
<td>yi</td>
<td>wu</td>
<td>yu</td>
<td></td>
<td>i</td>
</tr>
</tbody>
</table>

There are additional rules governing Pinyin system as follows:

1. In the syllables of “知、蚩、诗、日、资、雌、思”, the final is always “i”; therefore, the Pinyin of these characters is as follows: /zhi/, /chi/, /shi/, /ri/, /zi/, /ci/ and /si/.

2. The final [ə] (而, 二, etc.) is written as /er/. As a suffix, /-r/ is appended to the finals. For instance, 儿童 is as /ertong/ while 花儿 is as /huar/.

3. When the final /el/ is used alone, it is written as /el/.

4. All the finals of the /i/ column, with no initials, should be written as /yi/ 衣, /ya/ 呀, /ye/ 耶, /yao/ 腰, /you/ 忧, /yan/ 烟, /yin/ 因, /yang/ 央, /ying/ 英, /yong/ 雍. All the finals
along the /u/ column, with no initials, should be written /wu/ 乌, /wa/ 蛙, /wo/ 窝, /wai/ 歪, /wei/ 威, /wan/ 番, /wen/ 温, /wang/ 汪, and /weng/ 翁.

5. When the finals of the /ü/ column follow any of the initials /j/, /q/, and /x/, the two dots of /ü/ should be omitted. The Pinyin should be /ju/ 居, /qu/ 区, and /xu/ 虚. However, when the finals follow either /l/ or /n/, it should be written as /lü/ 吕 and /nü/ 女.

6. If there is an initial before any of the finals /iou/, /uei/, and /uen/, these finals should be written as /iu/, /ui/, and /un/ respectively. For instance, /niu/ 牛, /gui/ 归 and /lun/ 论.

The four tones in Chinese are represented respectively in Pinyin by the following tone marks: /－/ (the first tone), / / (the second tone), /\/ (the third tone) and /\ / (the fourth tone). The tone marks are put on top of the nucleus of each syllable. There is no tone mark on the light tone. The following table is an example of the rule of marking tones. (See Appendix 1 for the corresponding symbols of International Phonetic Alphabet (IPA).)

<table>
<thead>
<tr>
<th>1st tone</th>
<th>2nd tone</th>
<th>3rd tone</th>
<th>4th tone</th>
<th>Light tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>妈 mā</td>
<td>麻 má</td>
<td>马 mǎ</td>
<td>咧 mà</td>
<td>吗 mā</td>
</tr>
<tr>
<td>(mother)</td>
<td>(torpid)</td>
<td>(horse)</td>
<td>(scold)</td>
<td>(particle of questions)</td>
</tr>
</tbody>
</table>

The additional spelling rule of Pinyin is the dividing mark. When a syllable starting with /a/, /o/ or /e/ follows another syllable in a way which may cause confusion, it is essential to put the dividing mark /’/ in between the two syllables, e.g. /pi’ao/ 皮袄.

2. Chinese phonology

The phonological structure of each syllable in Chinese consists of a nucleus (which can be a monophthong, diphthong, or triphthong) with an optional onset or coda as well as a tone. There are some instances where a vowel is not used as a nucleus. An example of this is in Cantonese,
where the nasal sonorant consonants /m/ and /ŋ/ can stand alone as a syllable. Since Pinyin is the phonetic transcription based on Chinese Mandarin, there are no consonant only syllables in Pinyin.

Across all the spoken varieties, most syllables tend to be open syllables, meaning they have no coda, but syllables that do have codas are restricted to /m/, /n/, /ŋ/, /p/, /t/, /k/, or /ʔ/. In Chinese Mandarin, the only three consonants appearing in the end of a syllable are /-n/ and /-ŋ/ and /-r/, which are used as a grammatical suffix. Chinese syllables ending with any other consonant are either from a non-Mandarin language or dialect such as Cantonese, or minority languages of China. Consonant clusters do not generally occur in either an onset or coda. There are totally around 400 syllables and with tonal variation only about a thousand syllables, which is only about an eighth as many as English (Li & Shi, 1986). (See Appendix 3 for all syllables in Pinyin.)

A tone is an important phonetic feature of Chinese, which is, therefore, also considered as a tonal language. A few dialects of north China may have as few as three tones, while some dialects in south China have up to 6 or 10 tones. In Chinese Mandarin, there are 4 tones with an exceptional light tone. The first tone is the flat or high level tone, the second tone is the rising or high rising tone, the third tone is the falling-rising or low tone, and the fourth is the falling or high falling tone while the light tone is actually a neutral tone. A very common example used to illustrate the tones in Chinese is seen in the section of What Is Pinyin in this paper.

3. Overview of other perspectives of Chinese language

• Chinese spoken language

Chinese is identified as varieties of dialects or languages by linguists. Spoken Chinese is distinguished by its high level of internal diversity, although all spoken varieties of Chinese are tonal and analytic. There are between seven and thirteen main regional groups of Chinese (depending on classification scheme), of which the most spoken, by far, is Mandarin (about 850 million native speakers), followed by Wu (90 million native speakers), Cantonese (Yue) (70 million native speakers) and Min (70 million native speakers). Most of these groups are mutually unintelligible. Whereas, Chinese is also classified by some linguists as a macro-language with 13 sub-languages, though the identification of the varieties of Chinese as multiple "languages" or as "dialects" of a single language is a contentious issue. (Huang & Liao, 1997)
The standardized form of spoken Chinese is the standard Mandarin, which is the official language of the People's Republic of China and Taiwan as well as one of four official languages of Singapore. Chinese, the standard Mandarin, is one of the six official languages of the United Nations. Of the other varieties, Cantonese is common and influential in Guangdong Province of mainland China and Cantonese-speaking overseas communities, and remains one of the official languages of Hong Kong (together with Mandarin and English) and of Macau (together with Mandarin and Portuguese). Hokkien, part of the Min language group, is widely spoken in southern Fujian Province of mainland China, in adjacent Taiwan (where it is known as Taiwanese or Hoklo) and in Southeast Asia (where it dominates in Singapore and Malaysia). (Huang and Liao, 1997) Most research reviewed in this paper was conducted with monolingual and bilingual Chinese children who are either Mandarin or Cantonese speakers. (Also see Appendix 2 for information about use of spoken Chinese in mainland Chinese and other regions.)

• Chinese written language and Chinese characters

The relationship among the Chinese spoken and written languages is rather complex. Its spoken variations evolved at different rates, while written Chinese itself has changed much less. The Chinese orthography centers with Chinese characters, Hanzi (汉字), which are written within imaginary square blocks. Chinese characters are morphemes independent of phonetic change. Thus the number “one”, /yi/ in Mandarin and /yat/ in Cantonese, share an identical character “一”. Unlike English words that are composed of relatively simple units – letters, Chinese characters assembled by unpronounceable strokes in terms of a set of prescribed sequence rules. There are about 214 radicals recognized in the Kangxi Dictionary.

Chinese characters evolved over time from earlier forms of hieroglyphs. In this paper, the categorization of characters and the corresponding examples are being used from either Xu (1997)’s Ancient Chinese or Huang & Liao (2007)’s Modern Chinese. Contrary to the idea that all Chinese characters are either pictographs or ideographs, most characters contain phonetic parts, and are composites of phonetic components and semantic radicals. Only a few characters, such as /ren/ 人 (human), /ri/ 日 (sun), /shan/ 山 (mountain), /shui/ 水 (water), may be wholly pictorial in origin. Based on how characters are created, all the characters can be classified into six categories, namely pictograms (象形字), simple ideograms (指事字), compound ideograms (会意字), phonetic semantic compounds (形声字), derivatives (转注字) and phonetic loans (假
It is assumed that the early stages of the development of characters were dominated by pictograms, which, however, make up only a small portion of Chinese characters. While characters in this class derive from pictures, they have been standardized, simplified, and stylized for easier writing, and their derivation is therefore not always obvious. Examples include 日 /rì/ for “sun”, 月 /yuè/ for “moon”, and 木 /mù/ for “tree”. It is estimated in Shouwen Jiezi (说文解字, the first dictionary in Chinese history edited by Xu Shen in A.D. 100) that 4% of characters fell into this category.

Simple ideograms, also called simple indicatives, are created either by modifying existing pictograms, or giving direct iconic illustrations. For instance, an ideogram 刃 /rèn/ for “blade” is obtained by modifying 刀 dāo, a pictogram for “knife” with a mark on the edge of the knife to indicate “blade”. Examples of direct illustration include 上 /shàng/ meaning “up” and 下 /xià/ meaning “down”. Compound ideograms symbolically combine pictograms or simple ideograms to create a new character. For instance, doubling the pictogram 木 /mù/ for “tree” produces 林 /lín/ for “grove”, while tripling it produces 森 /sēn/ meaning “forest”. Similarly, combining 日 /rì/ for “sun” and 月 /yuè/ for “moon”, the two natural sources of light, makes 明 /míng/ meaning “bright”. Other commonly cited examples include the character 休 /xiū/ for “rest”, composed of the pictograms 人 /rén/ for “person” and 木 /mù/ for “tree”, and also 好 /hǎo/ for “good”, composed of the pictograms 女 /nǚ/ for “woman” and 子 /zǐ/ for “infant”. The number of simple and compound ideograms is relatively small.

Derivatives and phonetic loans are another two methods of forming new characters in Chinese which represent a small portion of characters and are rarely employed to create new characters after the early stages. Derivative characters originally represented the same meaning but have bifurcated through orthographic and often semantic drift. For instance, 考 /kǎo/ for “to verify” and 老 /lǎo/ for “old” were once the same character, meaning "elderly person", but detached into two separate characters with different meanings. Phonetic loans cover cases where an existing character is used to represent an unrelated word with similar pronunciation; sometimes the old meaning is then lost completely, as with characters such as 自 /zì/, which has lost its original
meaning of “nose” completely and exclusively means “oneself”, or 万 /wàn/, which originally meant “scorpion” but is now used only in the sense of “ten thousand”.

In fact, majority of characters are phonetic semantic compounds. In Shouwen Jiezi of A.D. 100, there were roughly 80% characters of this category. By the time of Kangxi Dictionary (康熙字典) in the year of 1716 it was estimated that phonetic semantic compounds composed 90% of all characters due to the extremely productive use of this technique to extend the pool of Chinese characters. Phonetic semantic compounds usually consist of two parts or radicals: one of a limited set of pictographs, often graphically simplified, which suggests the general meaning of the character, and an existing character pronounced approximately as the new target word. Examples are 河 /hé/ for “river”, 湖 /hú/ for “lake”, 流 /liú/ for “stream”, 沖 /chōng/ for “riptide” (or “flush”), and 滑 /huá/ for “slippery”. All these characters have on the left a radical of three short strokes, which is a simplified pictograph for a river, indicating that the character has a semantic connection with water; the right-hand side in each case is a phonetic indicator. For example, in the case of 沖 /chōng/ (Old Chinese /drun/ [46]), the phonetic indicator is 中 /zhōng/ (Old Chinese /truŋ/ [47]), which by itself means “middle”. In this case it can be seen that the pronunciation of the character is different from that of its phonetic indicator; this process means that the composition of such characters can sometimes seem arbitrary today. Further, the choice of radicals may also seem arbitrary in some cases; for example, the radical of 貓 /māo/ “cat” is 象 /zhì/, originally a pictograph for worms, but this radical actually indicate an animal of any sort in many characters. This method is still sometimes used to form new characters, for example, 钚 /bù/ for “plutonium” is the radical of meaning “metal” 金 /jīn/ plus the phonetic component 不 /bù/, described in Chinese as 不 gives sound and 金 gives meaning. Many Chinese names of elements in the periodic table and many other chemistry-related characters were formed this way. Overall, 90% of all characters are phonetic semantic compounds. Nevertheless, over time, phonetic radicals and semantic radicals are far from providing accurate pronunciation and meaning of characters. It is estimated that only less than 20% of all phonetic semantic compounds have phonetic radicals indicating pronunciation of relevant characters accurately. (Huang & Liao, 1997) That is why Chinese characters are still regarded as logographs even with the fact that majority of characters have phonetic radicals.
There are currently two systems for Chinese characters. The traditional system, still used in Hong Kong, Taiwan, Macau and Chinese communities (except Singapore and Malaysia) outside mainland China, takes its form from standardized character forms dating back to the late Han dynasty. The Simplified Chinese character system, developed by the People's Republic of China in 1954 to promote mass literacy, simplifies most complex traditional glyphs to fewer strokes. Singapore, which has a large Chinese community, is the first—and at present the only—foreign nation to officially adopt simplified characters, although it has also become the standard for younger ethnic Chinese in Malaysia (Wang 2008; Wang & Yu 2007). (Also see Appendix 2 for information about use of written Chinese in mainland Chinese and other regions.) This paper reviewed the literature of the studies using simplified and traditional characters as well.

A well-educated Chinese in mainland China today recognizes approximately 6,000-7,000 characters; some 3,000 characters are required to read a newspaper. The PRC government defines literacy as knowledge of 2,000 characters, though this would be only functional literacy. (Huang & Liao, 1997) The national language curriculum for primary education in mainland China is that children in elementary schools acquire 2,000 characters in total from Grade 1 to Grade 6.

The features of the Chinese writing system introduced above are of significant relevance to Chinese reading acquisition. At some stage, learning to reach Chinese must be achieved by rote memory for radicals and characters, and their associations with corresponding meanings and pronunciations. This is true for simple characters that include no phonetic radical. In principle, it also true for phonetic and semantic compounds with a phonetic radical, because the phonetic radical is frequently irregular in signaling the pronunciation of whole characters. Further, radicals and characters are basically assembled by strokes following sequence rules. At the beginning, it is rather difficult for children to master these rules and assemble strokes into a character. (Siok & Fletcher, 2001) This is one of the fundamental reasons why a phonetic alphabet transcribing Chinese is a necessity in assisting children’s early literacy development in Chinese.

4. Brief history of Chinese phonetic transcripts and Pinyin

Chinese is a non-alphabetic language. That is the reason why a phonetic transcription is vitally needed to transcribe or decode the language. Throughout Chinese history, there have been two major trending methods of transcribing Chinese language: traditional character transcription and romanized transcription. The traditional character transcription went through several stages dated
back as early as 2000 years ago. Pikuangfa (譬况法) is the first recorded method, which describes pronunciation of sounds in Huainanzi (淮南子) of Xihan Dynasty. Duruofa (读若法) uses a character of similar pronunciation to transcribe another character, and it was found in all the phonetic illustrations in Shuowen Jiezi (说文解字) of Donghan Dynasty. Zhiyinfa, found in Dialects (方言) of Xihan Dynasty, phonetically transcribes one character using another character of the same pronunciation. The last stage of traditional character transcription is Fanqiefa (反切法), created in the late Donghan Dynasty, which uses two characters to decode the pronunciation of a different character. The initial of the first character is the same as that of the decoded character while the final of the second character is the same as the final of the decoded character. Fanqiefa, deemed more accurate and convenient, had prevailed for more than 1800 years from Donghan Dynasty till Qing Dynasty when the romanized transcription started to appear. Kangxi Dictionary of Qing Dynasty, one of the most important Chinese language dictionaries in history, uses Fanqiefa as its phonetic transcription of all the characters and words. There are noticeable limitations of traditional character transcriptions. Since Chinese language is enriched in homophones, it is difficult to decide which character to select from a group of homophones to transcribe other characters in the same group. Changes of pronunciation of characters frequently occur over time. In addition, polyphones used to decode other characters may also cause confusion. (Zhou, 1997)

The effort of creating an alphabetic method to phonetically transcribe Chinese started as early as Tang Dynasty. Nevertheless, no romanized transcription methods were ever created and widely used until the end of the 19th century and the first half of the 20th century. Among all the Romanization systems during the time, the Wade-Giles system (WG, 威氏拼音) was the first widely used romanized phonetic transcription of Chinese, which was devised by British Sinologists Sir Thomas Wade and Herbert Allen Giles at the end of the 19th century. The system was the standard Romanization used in printed works in the West for most of the twentieth century. With application of major principles of Wade-Giles system, Chinese Postal Map Romanization (邮政式拼音) was only used to transcribe names of places after the WG system for half a century before Pinyin became official in 1950s. Additionally there were two more systems, experimented but short lived: Gwoyeu Romatzyh (国语罗马字) devised by Chinese scholars Yuanren Zhao and Yutang Lin in 1928 and Latinxua Sin Wenz (拉丁化新文字) created
by Chinese scholar Qiubai Qu and Russian Linguist V.S. Kolokolov in 1931. Even though the
effort of using these two Romanization systems designed during the New Culture movement to
replace Chinese characters (汉字) was unsuccessful, the work done on Romanization of Chinese
language contributed to the development of Pinyin. (Zhou, 1997)

Along with the movement of Romanization, phonetic transcriptions of Chinese with non-
romanized symbols had been intensely explored. Zhuyin Fuhao (注音符号) is one of the
transcription systems with no use of a roman alphabet. At the turning of the 20th century,
patriotic Chinese scholars felt the urgency to reform Chinese language and culture so as to
modernize their country. Zhuyi Fuhao was designed by Chinese linguists and put into use in
1910s by the Chinese government at the time. Zhuyi Fuhao system employs diacritic markings as
its phonetic symbols in the alphabet. It had been successfully used in mainland China for nearly
half a century and used in Taiwan until 2009. (See Appendix 4 for comparisons of symbols in
IPA, Pinyin, Zhuyin, Wade-Giles and corresponding Chinese characters.)

Zhuyin Fuhao, often abbreviated Zhuyin, and colloquially Bopomofo consists of 37 letters and 4
tone marks. The letters and tone marks are the unique symbols created by Binglin Zhang, and
mainly taken from ancient or cursive Chinese characters, or parts of such characters. Considered
as an alphabet, Zhuyi, however, is not based on consonants and vowels but on onsets and rimes.
As in an alphabet, the onsets are represented by 21 distinct symbols. However, excluding the
medial glide, each rime also has a distinct letter, which conflates vowels, diphthongs, and final
consonants. For example, /luan/ is written /ㄩㄢ/, where the last letter ㄢ represents the entire
final -an. These finals constitute the other 16 letters of Zhuyin. The following is the table of
Zhuyin letters with the corresponding Pinyin letters.
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Despite of the wide and long time use of Zhuyin, its disadvantages are easily identified by users. Zhuyin contains a set of symbols which are different from any existing system of transcripts. It takes beginners quite some time to master the system. For learners who have no exposure of Chinese characters, Zhuyin is even harder to grasp since the letters of Zhuyin were generated from some characters or parts of some cursive characters. Therefore Chinese scholars continued their effort of exploring a better and easier system to phonetically transcribe the Chinese language particularly when China was eager to educate millions of the illiterate so that the country could march into modern civilization in the middle of the twentieth century.

Pinyin was the latest Romanized phonetic system of Chinese developed by the Committee for the Reform of the Chinese Written Language in the People's Republic of China in 1950s. This committee developed Pinyin based upon several pre-existing systems such as Gwoyeu Romatzyh, Latinxua Sin Wenz and Zhuyi). The main force behind pinyin was Chinese linguist, Youguang Zhou, who was assigned to help the development of a new romanization system. The first edition of Pinyin was approved and adopted at the Fifth Session of the 1st National People's Congress on February 11, 1958. It was then introduced to primary schools as a way to teach Standard
Mandarin pronunciation and used to improve the literacy rate among adults in mainland China. In 2001, the Chinese Government issued the National Common Language Law, providing a legal basis for applying pinyin.

Today Pinyin is recognized as the standard Chinese phonetic alphabet worldwide. The International Organization for Standardization (ISO) adopted Pinyin as the standard romanization for modern Chinese in 1982; the United Nations followed suit in 1986. It has also been accepted by the government of Singapore, the United States’ Library of Congress, the American Library Association, and many other international institutions. Moreover, Pinyin also became the national standard in Taiwan on January 1, 2009.

5. Pinyin usage and instruction in China and other countries and regions

Pinyin has been widely and actively used in China and other parts of the world ever since it was first issued more than 50 years ago. Pinyin plays a key role in early Chinese literacy at school. Pinyin facilitates character recognition, pronunciation, standard Mandarin, and as well assists the development of early reading and writing. At primary level of Chinese learning, all the new characters are introduced with Pinyin as prompts, which give the pronunciation of a new character and help children to make a connection between the new character and an already known “oral” character/word in their mind. Upon receiving deliberate instruction of Pinyin, young children are able to be aware of basic phonetics such as initials, finals, tones and even possibly phonemes. Using Pinyin, Chinese children may be capable of reading and writing simple or complex texts even before they are exposed to any instruction of characters since it takes a longer time to master all the characters necessary to produce the texts of the same complexity level as the ones in Pinyin. Therefore, Pinyin may enhance young children’s language and cognitive development. (Wang, 2010)

Moreover, Pinyin helps Chinese whose language or dialect is not standard Mandarin to learn the standard Mandarin. As previously discussed in the paper, mainland Chinese and Chinese in other parts of the world speak a great variety of Chinese languages and dialects. With the assistance of Pinyin, it is much easier to acquire spoken Mandarin since Pinyin is developed based on Mandarin phonetic system. At home, Chinese families who speak some other language or dialect
as their mother tongue/home language can use the Pinyin system to teach their young children Mandarin pronunciation when their children learn vocabulary in school.

Historically, Pinyin had been of great significance in eliminating and reducing illiteracy in mainland China. Pinyin makes it easier for the illiterate to continue with self-study after a short period of literacy instruction. Since 1958, Pinyin has been actively used in adult education. During that first year of Pinyin usage in adult literacy education alone, 40 million illiterate people in China were able to become literate, or to acquire around 1,000 – 1,500 characters. Today the illiteracy rate in mainland China is 15% among adults and less than 5% among young adults, both of which dropped from 52% in 1982, and 80% in 1949. Pinyin has made noticeable contribution to this achievement. (Zhou, 1986)

Additionally, Pinyin has become a tool for foreigners to learn Chinese, and is used to introduce new characters, to explain grammar and spoken Chinese together with characters. Books containing both Chinese characters and Pinyin are often used by foreign learners of Chinese; Pinyin's role in teaching pronunciation to foreigners and children is similar in some respects to furigana-based books (with hiragana letters written above or next to kanji) in Japanese or fully vocalized texts in Arabic (“vocalized Arabic”). Pinyin is considered as the cornerstone for foreigners to learn Chinese with assistance of Pinyin three times faster than they learn Chinese starting from characters and without Pinyin. (Wang, 2010)

Pinyin is used to perform many other functions in society what characters are deemed impossible to perform. Chinese geographical or personal names in pinyin have become the most common way to transcribe the names in English and other languages using Latin alphabet. Chinese reference books such as dictionaries and encyclopedias usually have several ways to allow users to retrieve an item. However, alphabetic order in Pinyin is the most frequently used in most of the newly edited reference books in the past 50 years. Further, Pinyin can be seen in data sequencing and retrieving, product serial numbers and codes, and communications of signal flags and signal lights. Posters and slogans in and around public buildings and on streets often have characters annotated with Pinyin. The tone-marking diacritics are commonly omitted in news stories and even in scholarly works. An unfortunate effect of this is the ambiguity that results about which the Chinese characters are being represented.
In the era of new technology, Pinyin has also become a useful tool for entering Chinese language text into computers and mobile communications devices. It has been called upon that Pinyin should be given an equal status of characters so that Chinese written language would progress to the form of digraphia. (Su, 2001; Rohsenow, 2001)

Pinyin instruction, the first step towards literacy in Chinese language, is a common practice in schools. In mainland China, according to the national curriculum, first grade children of Chinese native speakers learn and acquire Pinyin in the first three months after they start school. Characters are introduced gradually with assistance of Pinyin after that. Presence of Pinyin in textbooks reduces as children progress to higher grades. Nevertheless, Pinyin always provides pronunciation of a new character or word. It is an easy way to search a character or word in a dictionary with reference to the alphabetic order of Pinyin. Thus, Pinyin is used to help introduce a new character or word throughout stages of literacy education.

Pinyin instruction not only prevails in Chinese teaching and learning in mainland China but also other parts of the world. In Hong Kong, currently Chinese and English are two official languages while three official spoken languages are Cantonese, English and Chinese – Mandarin since 1997. Cantonese Pinyin (粤语拼音), developed by Linguistic Society of Hong Kong in 1990s, is a romantized phonetic system transcribing Cantonese similar to Pinyin (汉语拼音). To learn Chinese – Mandarin in primary schools, Pinyin has been always used for more than 2 decades even when Hong Kong was still under British colonization. In Taiwan, it was Zhuyin which had been used for the past 60 years. Zhuyin is the phonetic transcription system employing diacritic markings as its alphabetic symbols instead of Roman letters. As of January 1, 2009, Taiwan officially suspended Zhuyin system and adopted Pinyin as its standard of Chinese phonetic system for primary education and all other government and public settings. In Singapore, more than 80% of the population is Chinese natives. Pinyin and simplified characters have always been in use in the country.

For the other countries and regions of the world, Pinyin is an international standard of transcribing Chinese phonetically; but most important of all, it is used for Chinese children living in these countries and regions outside Chinese speaking countries and regions such as mainland China, Hong Kong, Taiwan and Singapore, to learn their home language – Chinese, and as well for non-Chinese native children or adults to learn Chinese as a second language. But there is, yet
not any widely accepted model of Pinyin instruction for Chinese children to learn their home language or learn Chinese as a second language. The reason is that it is still in debate among researchers and educators of Chinese teaching and learning in terms of how to incorporate Pinyin in Chinese literacy education for these Chinese children. Frequently raised questions in debate by are as follows: at what stage Pinyin instruction should start, kindergarten or grade one; whether Pinyin causes confusion for young children to learn other alphabets with Roman letters such as English alphabet or not; whether children’s dependence on Pinyin hinders character acquisition; and other methodological issues related to classroom instruction and textbooks. (Wang, 2010) While various models of Pinyin instruction are being experimented and used through different Chinese learning programs, instructors and schools, research has made major findings regarding Pinyin and Chinese children’s bi-literacy development. One of the major findings is about the relationship between Pinyin and phonological awareness.
Chapter Three: Phonological awareness

Phonological awareness refers to the ability to segment and blend units of speech such as syllables. Based on PA’s effects on different units of speech, PA is categorized into syllable awareness, onset-rhyme awareness and phonemic awareness. Syllable awareness refers to the ability to detect constituent syllables in words. For instance, “cowboy” should be sensed as two syllables. Onset and rime awareness is the ability to detect that a single syllable can have two units: an onset and a rime. For instance, in the word “bike”, the onset is /b/ and the rime is /aik/. Phonemic awareness refers to the insight that words can be separated into a sequence of phonemes. A phoneme is the smallest sound unit. Phonemic awareness emphasizes the awareness of every constituent phoneme in words. For example, the word “bike” consists of three phonemes /b/, /ai/, and /k/. Tone awareness is an additional facet of PA implicated in learning to read in Chinese (Chen, et al, 2004). Every syllable in Chinese is differentiated according to one of the four tones. For example, a child with tone awareness is able to distinguish among 妈 /mā/ (mother), 麻 /má/ (torpid), 马 /mǎ/ (horse) and 骂 /mà/ (scold), which differ only in tone.

One of the reasons why studies on relationship between Pinyin and PA are of importance is that PA was found to be a predictor of later reading success in many alphabetic languages such as English and Spanish. For instance, Durgunoglu et al. (1993) and Cisero & Royer (1995) both found that the development of PA has significant impact on children’s reading in Spanish. Further examples about PA and reading in English are elaborated in the following sections. Nevertheless, it is in debate whether or not phonological awareness of non-alphabetic languages has the same role in reading development as PA of alphabetic languages. So far, some of the research found both universal and specific characteristics of PA in different writing systems. Some of the research has generated mixed evidence about the question. In addition to the
question about PA’s role in different writing systems, language experience such as training on alphabet and spelling, and orthography improves PA in alphabetic languages. But there are only a few studies on whether or not this rule applies to non-alphabetic languages. (Cheung and Chen, 2004; Leong, Cheng and Tan, 2005; McBride-Chang, Bialystok, Chong, and Li, 2004; Siok and Fletcher, 2001; Shu, Peng and Mcbride-Chang, 2008) Learning Pinyin is a linguistic and meta-linguistic training experience for children to acquire Chinese language. Thus the investigation of the relationship between Pinyin and Chinese children’s PA sheds some light not only on whether or not Chinese PA relates to Chinese reading but also more importantly on whether or not PA relates language training experience from the perspective of a non-alphabetical language.

1. English PA to reading in English

• PA in English

The concept of phonological awareness first emerged in the studies of the American researcher Lieberman and his colleagues. (Lieberman et al, 1974) Over the past 20 years, considerable research has been devoted to PA in English and the role it plays in the development of young children’s reading in English (Adams, 1990; Bear et al., 2004; Cunningham, 1990; National Reading Panel, 2000; Stanovich, 1986; Wagner et al., 1997).

Researchers argue intensely about the meaning of the term PA and about the nature of the tasks used to measure it in English language. Stanovich (1993-94) defines "phonological awareness" as the ability to deal explicitly and segmentally with sound units smaller than the syllable. Adams (1990) uses "phonemic awareness" almost exclusively and describes 5 levels of phonemic awareness in terms of abilities: to hear rhymes and alliteration as measured by knowledge of nursery rhymes; to do oddity tasks (comparing and contrasting the sounds of words for rhyme and alliteration); to blend and split syllables; to perform phonemic segmentation (such as counting out the number of phonemes in a word); to perform phoneme manipulation tasks (such as adding, deleting a particular phoneme and regenerating a word from the remainder). According to a joint position statement by the International Reading Association (IRA) and the National Association for the Education of Young Children (NAEYC) in 1998, phonemic awareness is
"typically described as an insight about oral language and in particular about segmentation of sounds that are used in speech communication". In other words, phonemic awareness is the ability to auditorily recognize and manipulate individual sounds in words.

- **PA is a predictor of early reading success**

PA in English is not only correlated with learning to read, but research indicates a stronger statement is true: PA appears to play a causal role in reading acquisition and is a foundational ability underlying the learning of letter-sound correspondences. Research indicates that it is the best predictor of the ease of early reading success, better even than IQ, vocabulary, and listening comprehension (Ball & Blachman, 1991; Cunningham and Allington, 1991; Eldredge, 1996; Stanovich, 1993-94; Yopp, 1992). For instance, a relationship exists between young children's phonemic awareness and their subsequent reading achievement in the 1st and 2nd grades. That is, children who know how to manipulate sounds in words at an early age have greater success in learning how to read in the 1st and 2nd grades (Adams, 1990; Juel, 1988; Stanovich, 1986). Moreover, lack of phonemic awareness turns to be a major obstacle for some children in learning to read in English (Vellutino & Scanlon, 1987; Wagner & Torgesen, 1987). The National Reading Panel of US (2000) has found that phonemic awareness improves children's word reading and reading comprehension, as well as helping children learn to spell. Phonemic awareness is the basis for learning phonics.

- **Different levels and stages of PA development**

Children’s PA develops over time, and it may be different for each child. Researchers have found out that PA in English appears to develop in a sequence (Goswami, 2000; Goswami & Bryant, 1990; Treiman & Zukowski, 1991). Children first become aware of words as separate entities and then realize that words are made up of syllables. Next, they become able to break apart words into onsets and rimes, and finally, into individual sounds (phonemes) (Lieberman et al, 1974). Treiman & Zukowski (1991) provide evidence that syllable awareness seems to precede awareness of the intrasyllabic division into onset and rime, which in turn seems to precede awareness of phonemes.

- **Reciprocal relationship of PA and reading**
Another major finding of the studies in PA is the reciprocal relationship of PA and reading. Once beginning readers have some awareness of phonemes and their corresponding graphic representations, research has indicated that further reading instruction heightens their awareness of language, assisting them in developing the later stages of phonemic awareness mentioned above. Phonemic awareness is both a prerequisite for and a consequence of learning to read (Yopp, 1992). As further evidence, Whitehurst and Lonigan (1998) also draw a conclusion that phonological sensitivity is critical to learning to read, and learning to read increases phonological sensitivity.

• Explicit instruction enhances development of PA

Research indicates that phonological awareness can be taught and that students who increased their awareness of phonemes facilitated their subsequent reading acquisition (Adams, et al. 1998; Allor, 2002; Ball & Blachman, 1991; Cunningham, 1990; Fuchs et al. 2000; Lundberg et al, 1988). Lundenberg et al. (1988) conducted a study showing that children who receive phonemic awareness training in kindergarten significantly outperformed those who had not participated in training, and those students were found to be superior spellers during their first grade year. Their study also demonstrated that specific language experiences should be offered to young children who would then significantly affect their progress in literacy acquisition.

As a matter of fact, explicit phonemic awareness instruction is more effective than implicit instruction (Cunningham, 1990). In a study by Ball and Blachman (1991), seven weeks of explicit instruction in phonemic awareness combined with explicit instruction in letter-sound correspondences for kindergarten children was more effective than instruction in letter-sound correspondences alone and more effective than other language-related activities conducted by the control group. Similarly, Fuchs et al. (2001) conducted a study to determine if phonological awareness training differentially affects student performance on phonological tasks, as well as to determine if beginning decoding instruction and practice influence student performance on letter sounds, reading, and spelling measures. Results indicated that combining phonological awareness training with decoding instruction and practice strengthens beginning reading performance more so than phonological awareness training alone.

As research points to the direction that embedding PA instruction within the daily curriculum is absolutely critical, Adams, Forman, Lundberg and Beeley (1998) developed a supplemental
language and reading curriculum – Phonemic Awareness in Young Children: A Classroom Curriculum. The curriculum is geared to accommodate individual learning and teaching styles. The goal of the program is to develop linguistic awareness, in particular phonemic awareness, to cognitively prepare young children to learn to read and write.

Generally, studies have explicitly demonstrated that PA instruction results in improved PA skills, more rapid response to beginning reading instruction, and improved subsequent reading development (Allor, 2002).

2. Chinese PA to reading in Chinese

As overwhelming evidence in English has shown the key role PA plays in children’s early literacy in English. Researchers are interested in whether or not PA in a non-alphabetic language has a similar effect in children’s reading in the language. Ample research has been documented in the past 15 years. In the recent studies, it is found that Chinese PA predicts Chinese reading among young children of Grade 4 or under in mainland China, Hong Kong and Taiwan. (Cheung, Chan & Chong, 2007; Chow, McBride-Chang & Burgess, 2006; Ding & Peng, 1998; Ho, 1997; Liao, 2007; McBride-Chang & Kail, 2002; Meng, Sha & Zhou, 2004).

Chow, McBride-Chang and Burgess (2006) in the 9-month longitudinal study investigated relations between Chinese native language phonological processing skills and early Chinese and English reading abilities among 227 kindergarteners in Hong Kong. PA, rapid automatized naming, and short-term verbal memory differed in their relations to concurrent and subsequent Chinese and English word recognition. The significant bidirectional relations between PA and Chinese reading ability remained even after accounting for the variance due to age, vocabulary, and visual skills performance. When all predictors were considered simultaneously, only PA remained a significant predictor of Chinese and English reading abilities both concurrently and longitudinally.

In McBride-Chang and Kail (2002)’s study, the measures of Chinese character/English word recognition, phonological awareness, speeded naming, visual-spatial skill, and processing speed were administered to 190 kindergarten students in Hong Kong and 128 kindergarten and grade 1 students in the United States. Across groups, the strongest predictor of reading itself was phonological awareness; visual processing did not predict reading. Despite diversities of culture,
language, and orthography to be learned, models of early reading development were remarkably similar across cultures and first and second language orthographies.

Ho (1997)’s study investigated the importance of phonological skills and visual skills in Chinese word reading and sentence comprehension among 47 Chinese second graders. A total of 7 tasks were employed in the study including Raven’s Standard Progressive Matrices, Chinese word reading and sentence comprehension, rhyme detection, Chinese character-string memory, and spatial relations tasks. The reading scores were found to correlate significantly with the phonological scores (rhyme detection and memory for non-rhyming Chinese characters) but not with the visual scores (spatial relations and memory for abstract designs). These findings suggested that the significance of phonological skills in early reading success is not restricted to alphabetic languages but also applies to non-alphabetic Chinese.

The three studies above were conducted over ten years span on the relationship between PA and reading in Chinese with distinctive conditions. Ho (1997)’s study was one of the early investigations and the subjects were just Chinese speaking Grade two students. McBride-Chang and Kail (2002)’s study was able to move one step forward by comparing Chinese speaking children and English speaking kindergarten children. Finally, Chow, McBride-Chang and Burgess (2006)’s study represents the latest experimental research on the topic. It was a 9-month longitudinal study and 228 kindergarteners were tested on their PA and Chinese and English reading abilities. One of the results of these studies is that Chinese PA does highly correlate with Chinese reading ability. This contributes further evidence on the universality of PA’s effects in reading development.

3. Chinese PA, English PA and cross-language transfer

- Language specific uniqueness of PA

Besides the universality of PA, evidence from some studies shows that there is language specific uniqueness of PA. Compared with English, onset-rime awareness has more power in predicting reading success than phonemic awareness in Chinese. Siok and Fletcher (2001) examined the role of PA and visual–orthographic skills in Chinese reading acquisition. The subjects were 154 1st, 2nd, 3rd, and 5th graders in Beijing who had learned Pinyin to help read Chinese characters. The children’s performance on the tests of various cognitive skills, reading ability, and Pinyin knowledge were examined. One of findings with hierarchical regression analysis was that onset-
rime awareness, but not phonemic awareness, predicted Chinese reading, which indicates the nature of PA predicting reading success is contingent on the characteristics of the writing system. This finding provides an illustration of the uniqueness of PA among alphabetic languages and non-alphabetic languages. Onsets and rimes reflected in Pinyin are initials and finals which are the smallest units in use in the Chinese phonetic alphabet. With the knowledge of initials and finals, children should be able to form into new syllables and to associate the new syllables with the corresponding characters since Chinese characters, basic units of writing in Chinese, only map onto syllables. Thus, it is explainable why onset-rime awareness is more powerful in predicting reading success in Chinese than phonemic awareness is.

In addition, research has also found that tonal awareness is essential to Chinese PA. McBride-Chang, et al. (2008) investigated PA of Chinese and English with 211 Hong Kong Chinese children aged 4 and 5. The tasks and tests administered were wording in Chinese and English, non-verbal IQ, speeded naming, and units of syllable onset, syllable and tone detection awareness. In separate regression equations, syllable awareness was equally associated with Chinese and English word recognition. In contrast, syllable onset awareness was uniquely associated with English reading only, whereas tone detection was uniquely associated with Chinese reading only. The results underscore both the universality of PA and the importance of different psycholinguistic units (Ziegler & Goswami, 2005) for understanding reading acquisition: Tone units are integral to Chinese character recognition, whereas phonemes are more strongly associated with English word recognition, even within the same children.

In an early study, Xu, Dong, Yang and Wang (2004) focused on the investigation of the development of Chinese PA in primary school children with no comparison with English PA. This study employed both cross-sectional and short-term longitudinal approaches. For the longitudinal approach, the subjects were 53 first graders who were administered rime detection, onset detection, phoneme deletion and tonal awareness tasks. The tests were conducted three times throughout the school year: the first was the beginning of the term, the second was in the middle of the term and the last was right before the end of the term. For the cross-sectional study, the subjects were 89 first graders, 114 third graders and 117 fifth graders who were administered the same four tasks as the ones used in the longitudinal study. The results showed that there was no significant difference of accuracy among rhyming, onset and tone awareness tasks in the beginning of the first grade. But tonal awareness developed faster that onset-rime awareness,
while all of them developed faster than phonemic awareness. Nevertheless, there were a few methodological issues that remain in question: First, it was not clear whether the subjects in the longitudinal study and the subjects in the cross-sectional study were from the same school or not; second, it was not clear whether the 53 first graders were among the 89 first graders in the cross-sectional study if both groups were from the same school; third, it was about the instruments used in the study. Regarding rime, onset and tone detection tasks, the study used Wenling Li’s experimental research while regarding syllable deletion task, the study used the test based on “relevant studies”. But neither Wenling Li’s study nor the “relevant studies” was found in the references of Xu, Dong, Yang and Wang (2004)’s article.

To sum up, the results of these studies above support the following statements that tonal awareness is unique to Chinese language, and it develops earlier than other levels of PA, and it has more power to predict reading development than other levels of PA.

- The effects of cross-language transfer between English and Chinese

Evidence has also been documented in the recent studies in terms of the correlation of Chinese PA and English PA, and the effects of cross-language transfer (Chen, et. al, 2004; Cheung, Chan and Chong, 2007; Chow, McBride-Chang and Burgess, 2006; McBride-Chang, et. al. 2008; Pang, 2004; Wang and Geva, 2003; Wang, Perfetti and Liu, 2005).

Some researchers have found positive effects of cross-language transfer between Chinese and English. Wang, Perfetti and Liu (2005) provided evidence that PA of Chinese correlated PA of English but orthographic processing skills of Chinese and English did not predict each other’s word reading. This study investigated cross-language and writing system relationship in biliteracy acquisition of children learning to read two different writing systems-Chinese and English. Forty-six Chinese (Mandarin) speaking children were tested for their first language (Chinese-L1) and second language (English-L2) reading skills. The comparable experiments in Chinese and English were designed focusing on two reading processes -- phonological and orthographic processing. The word reading skills in both writing systems were tested. The results revealed that Chinese onset matching skill was significantly correlated with English onset and rime matching skills. Pinyin was highly correlated with English pseudo-word reading. Furthermore, Chinese tone processing skill contributed a moderate but significant amount of variance in predicting English pseudo-word reading even when English phonemic-level
processing skill was taken into consideration. The orthographic processing skill in the two writing systems, on the other hand, did not predict each other's word reading. These findings suggest that bilingual reading acquisition is a joint function of shared phonological processes and orthographic specific skills.

In a recent study, Cheung, Chan and Chong (2007) tested Chinese-English bi-lingual 4th graders in Hong Kong on reading aloud and comprehension in Chinese and English and their understanding of some structural principles underlying Chinese orthography. One of the findings in the study is that Chinese PA predicted Chinese reading and English reading as well.

Pang (2004) investigated bilingual English-Chinese children's knowledge of L1 and L2 to determine the nature of transfer of literacy skills between languages. The study was conducted in an elementary school in Singapore where the children were learning English as L1 and Chinese as L2. Both qualitative and quantitative methods were utilized to obtain information about the school environment and the extent of the children’s language and literacy skills in English and Chinese. The qualitative data showed that language, orthographic, motivational and environmental factors affected literacy development in English and Chinese. The quantitative analysis, using parallel measures, showed that despite differences in language (non-cognates) and orthography (alphabetic vs. non-alphabetic), there was evidence of transfer of literacy skills. Furthermore, this transfer was bi-directional: English skills predicted Chinese reading, and Chinese skills predicted English reading. However, there were limitations of the study: the subjects in the study were not randomly selected and the instruments in this study were not often used by other researcher. That means the results of the study cannot be generalized to a broader context.

In Chen, Anderson, Li, Hao, Wu and Shu (2004)’s study, the effect of bilingualism on the development of PA of Chinese children was investigated in two studies comparing bilingual speakers of both Cantonese and Mandarin with monolingual speakers of Mandarin. Cantonese-speaking children had developed more advanced onset and rime awareness by 2nd grade as they learned Mandarin in school and became bilingual. Bilingualism seemed to accelerate the development of phonological awareness. But the advantage had mostly disappeared by 4th grade.

Contrarily, some researchers have found negative transfer effect from a non-alphabetic first language to an alphabetic reading acquisition. Liow and Poon (1998) studied PA’s impact on
multilingual Chinese children. The subjects were 57 multilingual elementary school children (aged 9 and 10) from one school in Singapore, whose language backgrounds were English, Chinese (Mandarin) or Bahasa Indonesia. The instruments were homophone decision task, an English lexicality spelling test, and a Pinyin spelling test. All the three groups of children were studying English and Mandarin in the same school, and the influence of their language background (especially script exposure) could be tested with no significant difference among the teaching methods by which the children were treated. In terms of English PA, the results showed that a relationship between script exposure and PA develops in line with the orthographic depth hypothesis. The Bahasa Indonesia group exhibited the highest levels of PA, followed by the English group and then the Chinese group even though Bahasa Indonesia has a very shallow alphabetic orthography. In terms of Chinese PA, the children’s performance on the Pinyin spelling test suggested that tonal awareness is independent of other levels of PA in Chinese and English.

What is very interesting is that Wydell and Butterworth (1999) studied a 16-year-old English and Japanese bilingual boy, who showed reading difficulties in English but not in Japanese. He performed as well as his Japanese peers on logographic Kanji and syllabic Kana reading tasks. However, he demonstrated much poorer performance on phonological processing tasks as well as reading and spelling tests in English, even compared to his Japanese counterparts. Their results point to a clear dissociation between the boy’s skills in reading English and Japanese. Japanese has a similar logographic writing system as Chinese language.
Chapter Four: Pinyin and PA

1. Pinyin to Chinese PA and reading in Chinese

Pinyin, as a preliminary step to Chinese reading, has been widely used in primary Chinese literacy education in mainland Chinese for more than 3 decades. The research on Pinyin’s relationship with PA has been a relatively recent event. (Cheung and Chen, 2004; Leong, Cheng and Tan, 2005; McBride-Chang, Bialystok, Chong, and Li, 2004; Shu, Peng and McBride-Chang, 2008; Siok and Fletcher, 2001; Xu and Ren, 2004; Ren, Xu and Zhang, 2006) The majority of these studies provide more evidence from the perspective of a non-alphabetic language that metalinguistic training improves PA.

Among these studies, there are only two studies dedicated to investigation of the relationship between Pinyin and Chinese children’s PA: they are Xu and Ren (2004), and Ren, Xu and Zhang (2006). In Xu and Ren (2004)’s study, the subjects selected were 87 first graders, 110 second graders and 112 fifth graders from an elementary school in Beijing. In terms of Chinese PA, the tests on onset and rime, and tone awareness from the previous study (Xu, Dong, Yang and Wang (2004)) were utilized again in form of oddity tasks. The phoneme deletion task was also administered. In terms of English PA, the tests on onset and rime, and end-phonemic tasks were adapted so that they were able to reflect the difference of the two languages. The phoneme counting task was added. The children’s ability was tested with two 30 items tasks. The results showed that: first, both Chinese PA and English PA have significant correlation with Pinyin; second, there is a clear distinction between high and low Pinyin level groups in completing the tasks of Chinese PA and English PA; and last, the development of Chinese PA can be predicted from the scores of Pinyin test but no such result can be found in the development of English PA.

In two years after the study of Xu and Ren (2004), Ren, Xu and Zhang (2006) conducted quasi-experimental research to look into further evidence on Pinyin’s role in the development of PA. In the new study, the subjects of the experimental group and the control group were selected from two childcare centers of regular programs in Beijing. They were senior kindergarteners of 5 years old. The experiment group was the Pinyin group who was taught Pinyin and primary English. The control group was the non-Pinyin group who was only taught primary English. The pre-test
and post-test were taken in September and June of the following year respectively. Both the Chinese PA tasks and English PA tasks were administered including syllable, onset and rime awareness in form of oddity tasks except that the end-phonemic awareness task was added since final phoneme awareness was found to be predictive of success in English reading with Chinese children in the previous studies (Cheung, et al. 2001; Xu, Dong, Yang and Wang, 2005). The results of this quasi-experimental study revealed first the universality of PA development across languages. The syllable awareness of Chinese, and the syllable awareness and end-phonemic awareness of English had improved greatly in both the Pinyin group and the non-Pinyin group over the one year period. Thus, PA development follows the rule that different levels of PA emerge at certain age, that is, larger units (syllable awareness) appear earlier than sub-syllabic units (onset and rime awareness) and phonemic awareness. And this rule of PA development applies universally across languages. Secondly, the study showed that learning Pinyin not only facilitates the development of Chinese PA but also improves the development of English PA. Further, this role of Pinyin had differential effects on levels of PA, that is, learning Pinyin promoted the development of onset and rime awareness but has little effects on syllable awareness of Chinese and English, and end-phonemic awareness of English. Overall, the study provided further evidence to the theory that PA develops through a natural process and metalinguistic training concurrently.

Ren, Xu and Zhang (2006)’s study was the only experimental study dedicated only to investigation of the effects of Pinyin on PA development, which so far could be found in the current literature. Notwithstanding the study’s contribution to experimental research on Pinyin, there are still a few methodological issues in question. First, it was not explained in the article that the selection of the experimental group and the control group was random. At least it should provide the explanation on how the two classes were chosen to be either of the groups. Then, there was no demonstration on what the control group was doing while the experimental group was learning Pinyin. What was clear is that the control group didn’t learn Pinyin either at the day care center or at home. But what was a regular curriculum without Pinyin? Does the curriculum have a component of early literacy including rhymes, songs, poems and stories? Are Chinese characters also part of the curriculum? The answers to these questions are important because they are relevant to the study’s validity and reliability and they may affect the results of the study. Third, there was no explanation in the article about how Pinyin was taught to the experimental group. The last two questions are related. If the Pinyin group receives intensive literacy training
while the non-Pinyin group receives little training of early literacy in any form such as nursery rhymes and shared book reading, then it is arguable that the effects were from learning Pinyin because they could be due to the intensive training itself. That is to say, if the non-Pinyin receives equal amount of intensive training in early literacy without Pinyin, the same effects – improvement of onset and rime awareness could appear.

There are a few more studies with the findings about the role of Pinyin on PA development in Chinese children from preschool to grade 5. (1) Preschool children. Shu, Peng and McBride-Chang (2008) revealed in their recent study involving 146 Chinese young children aged 3 to 5 in preschool that these children’s PA including awareness of phoneme, onset and tone awareness increased strongly and significantly to 70 % in first grade, when the children first received Pinyin -- phonological coding instruction. This study was not an explicit research on Pinyin’s role in early literacy development but the result best illustrates that Pinyin instruction can significantly improve children’s PA in Chinese.

(2) Kindergarten and first grade children. McBride-Chang, Bialystok, Chong, and Li (2004) provided the evidence that pinyin training may promote PA at the syllable and phoneme onset levels. The evidence came from the result that kindergarten and first-grade children from Xian (a city in mainland China), who were proficient in pinyin, did much better than their counterparts from Hong Kong, who did not expose to pinyin training, in both syllable and phoneme onset deletion tasks.

(3) Kindergarten to Grade 3. Cheung et al (2001) compared younger and pre-reading children to older and literate children from different language backgrounds on their PA. 60 Hong Kong subjects and 60 Guangzhou subjects selected both spoke Cantonese. The latter subjects had early experience with Pinyin in addition to their logographic Chinese reading; the former read only logographic Chinese. 49 New Zealand subjects spoke English and read the Roman alphabet. It revealed that the Hong Kong and Guangzhou pre-readers performed very similarly at all levels of phonological awareness. Another finding was that Guangzhou outperformed their Hong Kong counterparts only on onset and coda analysis. Yet, these results contradict the results of Xu and Ren (2004)’s, and McBride-Chang, Bialystok, Chong, and Li (2004)’s studies which found Pinyin promotes PA at different levels including syllable awareness and onset and rime awareness.
Grade 4 and 5 children. Leong, Cheng and Tan (2005) studied the effect of phonological sensitivity of Chinese children from two comparable grades 4 and 5 groups, one a Mandarin-speaking group from Beijing and the other a Cantonese-speaking group from Hong Kong on English and Chinese pseudo-word reading. The results confirmed the hypothesis that the Mandarin group outperformed the Cantonese group. They pointed out that the results might be explained by the phonologically more salient Mandarin group mediated by the use of pinyin as an adjunct in character and word reading.

Interestingly there is an early study on Zhuyin’s effect on Chinese PA. Huang and Hanley (1997) conducted a short term longitudinal study. The subjects were 40 first graders aged 6 from an elementary school in Taiwan. At the time Zhuyin was the official phonetic alphabet taught at schools in Taiwan. The children’s PA and visual skills were tested in three separate testing sessions during the school year. These tests took place once just before the children started to learn Zhuyin, once immediately after the children had learned Zhuyin, and finally once at the end of the first year. The test materials included a Chinese characters reading test, a set of PA tests, a Visual Pairs Associates learning test, and a vocabulary and IQ test. The study showed that PA was significantly related to success in the first year of Chinese reading but the study was unable to establish whether or not differences in phonological skills were the cause of difference in the reading ability of Chinese children. However, the 10 weeks of instruction in Zhuyin led to an increase in performance on all tests of PA. This result is consistent with the view that learning an alphabetic script improves PA since Zhuyin is a phonetic transcript with unique alphabetic script.

2. Pinyin to English PA and reading in English and cross-language transfer

Pinyin learning enhances Chinese children’s phonemic awareness in Chinese and also more significantly in English. It plays a role as a facilitator of the PA’s cross-language transfer process: Chinese to English and vice versa. (McDowell and Lorch, 2008; Ren, Xu and Zhang, 2006; Zhang and Lin, 2002) As discussed before, Ren, Xu and Zhang (2006) showed the effects of pinyin learning on development of PA in Chinese kindergarten children. The results of their study lead to the conclusion that learning pinyin promoted the development of onset-rime awareness of Chinese and English, and, syllable awareness and end-phonemic awareness of English.
Different from most research focusing on young children, Zhang and Lin (2002) studied the connections of the levels of Pinyin, and English phonetic awareness and spelling ability in higher grade students. 162 students were selected from a middle school in China. The subjects completed an English spelling test, an English phonetic awareness test, and a Pinyin test. The results revealed the levels of Pinyin correlated with the ability of English spelling, which were further confirmed in a 1-yr follow-up study in 40 students with high level of Pinyin and 40 students with low level of Pinyin. Yet, due to limited information about the methodology of the study, it is nearly impossible to evaluate the study’s validity and reliability. Thus, it would be hard to generalize the results to a broader context.

Very recently McDowell and Lorch (2008) have investigated the factors, considered as the main facilitators of phonemic awareness, including written language experience, spoken language experience, and meta-linguistic training. One of the results of the research is that mainland Chinese students who had pinyin – meta-linguistic training outperformed Hong Kong children who were not literate in pinyin on a phoneme-grapheme non-word matching task, which clearly indicates that pinyin, as an access to explicit demonstration of phonemes, enhances phonemic awareness of Chinese L1 readers of English.

Nevertheless, there are research findings that contradict the conclusion that Pinyin improves English PA. Yeung and Cheung (2005) examined the vocabulary learning of English in the Cantonese-speaking children from mainland China and Hong Kong, who were categorized into three groups, one having pinyin training, one with English phonics and no Pinyin trainings and one without English phonics and Pinyin trainings. The results showed that the phonics group was more efficient overall than the Pinyin and non-phonics groups, but no difference was found between the Pinyin group and the non-phonics group. That indicated Pinyin did not have necessarily positive effect on English reading in terms of vocabulary learning. But it was not clear what non-Pinyin and non-phonics group was learning while the other two groups were receiving their treatments.
Chapter Five: Conclusion

1. Major findings of the reviewed research

Chinese is a non-alphabetic language. Its graphemes do not map onto phonemes but instead correspond to characters, the syllabic morphemes. Consequently a phonetic system is needed to transcribe the language so as to acquire pronunciations of characters and thereafter acquire reading. Replacing several phonetic systems used in the past, Pinyin, the Chinese phonetic alphabet, becomes the most successful and most commonly used system transcribing Chinese phonetically today. It has been widely used in mainland China, United Nations, ISO, and various other countries and regions.

Pinyin instruction is the first step for Chinese monolingual children to start early literacy in Chinese. According the national curriculum in mainland China, first graders acquire Pinyin in the first 3 months starting school. Due to the role of Pinyin in Chinese children’s literacy development, research has been drawn the field in terms of how Pinyin is related to reading in Chinese and PA, the predictor of early reading development.

Phonological awareness is the ability to segment and blend sound units of speech, which can be categorized into different levels: syllable awareness, onset-rime awareness and phonemic awareness. Ample research has documented the relationship of PA in English and reading in English: PA is a reliable predictor of early reading success; PA in English develops in a sequence, and syllable awareness precedes onset-rime awareness, which precedes phonemic awareness; the relationship of PA and reading is reciprocal; and explicit instruction enhances the development of PA.

Does PA correlate with reading in Chinese? The answer is yes. Not only so but PA in Chinese is regarded as a good indicator of early reading success in Chinese. Existence of PA in Chinese provides further evidence on the universality of PA across languages. Nevertheless, various levels of PA weigh in differently in Chinese and English. Onset-rime awareness and tonal awareness are more reliable to predict reading success in Chinese whereas phonemic awareness is more powerful to English. That indicates uniqueness of each individual language has impact on PA.
Does Pinyin correlate with PA in Chinese? The majority of the studies reviewed in this paper show a positive answer to the question. Strong evidence shows that PA predicts reading success in alphabetic languages and PA can be enhanced through meta-linguistic training. At the same time, the results of the studies overwhelmingly demonstrate that PA in Chinese is a good indicator of children’s later reading success in Chinese. Consequently it is worth intense investigation whether or not PA in Chinese can be improved through meta-linguistic training such as Pinyin training. The studies have found that Pinyin highly correlates with PA in Chinese. Further, explicit Pinyin instruction improves young children’s PA in Chinese. The elementary school children, first graders to fifth graders who received Pinyin training in mainland China outperformed their counterparts who didn’t receive Pinyin instruction in Hong Kong when other factors such as IQ were under control. However, there was only one study (Cheung, et. al. 2001) that did not find Pinyin has impact on PA in Chinese.

Does Pinyin correlate with PA and reading in English? It is a question in debate. The question is pertinent to cross-language transfers which have been discovered between alphabetic languages. Pinyin instruction enhances PA in Chinese and reading in Chinese but will Pinyin instruction improve PA in English or will Pinyin instruction help Chinese PA transfer to English PA? Some studies have found that in addition to enhancing PA in Chinese, Pinyin instruction plays a positive role in facilitating PA in English. Therefore, Pinyin in these studies is considered as a facilitator of the PA’s cross-language transfer process: Chinese PA to English PA and vice versa. Whereas, some studies have found that Pinyin instruction does not necessarily help reading in English.

2. Directions of future research

The review shows the directions for future study. Current research has been conducted to test whether Pinyin enhances PA and whether it helps children learn to read. However, there are still questions needing further attention from researchers. First, research is needed to further investigate the correlation of Pinyin and PA, and Pinyin’s effect on cross-language transfer since the reviewed studies generate mixed results. Pinyin highly correlates PA in Chinese and Pinyin instruction significantly enhances PA in Chinese and consequently reading in Chinese. However, whether or not Pinyin correlates to PA in English and Pinyin training improves PA in English remains in debate. The effects of cross-language transfer between non-alphabetic languages and alphabetic languages are not clear yet.
Second, research is needed to identify the effects of Pinyin on Chinese bilingual children’s learning to read. Bilingual children’s language background provides a unique context of relevant studies. Not all the conclusive statements generated from the studies on monolingual children necessarily apply to bilingual children. So far, most of the studies were conducted with Chinese monolingual children only. Chinese young children whose home language is Chinese and learn English at school in an English speaking country would be completely different subjects of study from young children in mainland China who speak and learn Chinese at school and start to learn English as a second language at later grades. Chinese bilingual children who are still emergent readers of English may possibly be confused with letters of Pinyin which employs the same Roman letters as English alphabet. Based on my observation as a Chinese language instructor for almost ten years in Canada, bilingual children of kindergarten grade in heritage language programs do sometimes mix Pinyin letters particularly finals with English alphabet. Are the effects of Pinyin on Chinese monolingual children the same as they are on bilingual children? Is the confusion about Pinyin and English alphabets avoidable? And why is it? These are the questions which have not been studied yet.

Third, research is needed to determine when and how Pinyin might be taught more effectively so that the transfer to PA and as well reading is maximized. It is still in debate whether to start teaching Pinyin from kindergarten or from grade one. Children in mainland China learn Pinyin at Grade 1 and start to learn English as a second language from Grade 3 at school, and kindergarten programs are not mandatory in primary education. However, Chinese bilingual children in North America, for instance, use Chinese at home, start kindergarten at age of 4 and learn English at school. These bilingual children usually learn to read and write Chinese in heritage language programs which are often part time after school programs starting from kindergarten. There is no consensus among Chinese instructors in these heritage language programs in terms of when and how Pinyin should be instructed. There is not much research on the topic to help develop generic curriculum about Pinyin for Chinese bilingual children’s learning Chinese as a heritage language or international language either.

Fourth, research is needed to evaluate a number of Pinyin instructional modules and programs for Chinese monolingual children and bilingual children, which may provide direct pedagogical recommendations of reading instruction for teachers. Currently there is not much research on the topic at all. Several teaching methods employ various approaches to Pinyin instruction, which
reflect distinct views on Pinyin’s role in early literacy development. Overall these methods can be categorized into two kinds: one is Pinyin Only and the other is Pinyin Plus Characters. In Pinyin Only module, children start to learn Pinyin without any input of Chinese characters at the beginning, and then learn reading in Chinese still with Pinyin only. Children may not be exposed to any characters during the first three months of school. The advantage of using this module would be that children are able to improve quickly their reading skills such as larger vocabulary and reading authentic materials by reading in Pinyin since it takes much longer for children to read characters compared with to read in Pinyin. However, the disadvantage would be that the module may increase children’s dependence on Pinyin. For Chinese bilingual children who speak Chinese and English, continued dependence on Pinyin may eventually delay characters acquisition since bilingual children who are exposed very much to English alphabet prefer to learn Pinyin more than characters and would be reluctant to learn characters later on. In Pinyin Plus Characters module, children start to learn Pinyin first but always with exposure to characters. Pinyin becomes prompts only after one month of focusing on Pinyin. There are numerous textbooks reflecting different modules of Pinyin instruction. But there is seldom any study to evaluate how effective of these teaching methods for Chinese monolingual children or bilingual children.

Finally, many present studies need to be repeated because the results of these studies have not been sufficiently positive to sustain confidence that Pinyin is indeed effective on PA in Chinese or English or reading in Chinese or English across a variety of training conditions. Contrast to the report of National Reading Panel (2001) who critically reviewed 1962 related articles on the relationship of phonemic awareness instruction and reading development in English, this review has screened only 52 potentially relevant studies on Pinyin. Among these studies, only 9 of them meet the following criteria: Studies adopted an experimental or quasi-experimental design with a control group; studies appeared in a refereed journal; and studies tested the hypothesis that instruction in Pinyin improves PA and reading performance in Chinese or English over no instruction in Pinyin or alternative forms of instruction. Due to the fact that the number of the studies on the relationship of Pinyin, PA and reading is very limited, the results of the studies are not ready for any change or implementation in the classroom instruction of Pinyin. Therefore, more studies are definitely needed to draw a conclusion on Pinyin’s causal effect in PA and reading.
Appendices

1. Pinyin and the Corresponding IPA Symbols

Tones: 1st tone [55], 2nd tone [35], 3rd tone [214], and 4th tone [51]

(The following three tables were adapted from the corresponding tables from Lin & Wang (2004)’s Phonetics.)

Table 5: Initials in Pinyin and IPA

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<td>[tʂ’]</td>
<td>r</td>
<td>[z]</td>
</tr>
<tr>
<td>t</td>
<td>[t’]</td>
<td>x</td>
<td>[ɕ]</td>
<td>y</td>
<td>[j]</td>
</tr>
<tr>
<td>n</td>
<td>[n]</td>
<td>z</td>
<td>[ts]</td>
<td>w</td>
<td>[w]</td>
</tr>
<tr>
<td>l</td>
<td>[l]</td>
<td>c</td>
<td>[ts’]</td>
<td>v</td>
<td>[v]</td>
</tr>
</tbody>
</table>

Table 6: Simple Finals in Pinyin and IPA

<table>
<thead>
<tr>
<th>Pinyin</th>
<th>IPA</th>
<th>Pinyin</th>
<th>IPA</th>
<th>Pinyin</th>
<th>IPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>[ɑ]</td>
<td>e</td>
<td>[ɣ]</td>
<td>u</td>
<td>[u]</td>
</tr>
<tr>
<td>o</td>
<td>[o]</td>
<td>i</td>
<td>[i]</td>
<td>ü</td>
<td>[y]</td>
</tr>
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</table>
Table 7: Compound Finals in Pinyin and IPA

<table>
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<th>Pinyin</th>
<th>IPA</th>
<th>Pinyin</th>
<th>IPA</th>
</tr>
</thead>
<tbody>
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<td>ing</td>
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<td>[ui]</td>
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<td>ia</td>
<td>[ia]</td>
<td>ui</td>
<td>[uei]</td>
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<tr>
<td>ao</td>
<td>[au]</td>
<td>iao</td>
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<td>uan</td>
<td>[uan]</td>
</tr>
<tr>
<td>ou</td>
<td>[ou]</td>
<td>ian</td>
<td>[iæn]</td>
<td>uang</td>
<td>[uŋ]</td>
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<tr>
<td>an</td>
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<td>iang</td>
<td>[ian]</td>
<td>un</td>
<td>[uən]</td>
</tr>
<tr>
<td>en</td>
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<td>ie</td>
<td>[iə]</td>
<td>ueng</td>
<td>[uəŋ]</td>
</tr>
<tr>
<td>in</td>
<td>[in]</td>
<td>iong</td>
<td>[ŋə]</td>
<td>üe</td>
<td>[yɛ]</td>
</tr>
<tr>
<td>ang</td>
<td>[an]</td>
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<td>[iou]</td>
<td>üan</td>
<td>[ŋæn]</td>
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<tr>
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<td>ua</td>
<td>[uə]</td>
<td>ün</td>
<td>[yn]</td>
</tr>
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<td>[uo]</td>
<td>ng</td>
<td>[ŋ]</td>
</tr>
</tbody>
</table>

2. Chinese Pinyin Syllables

The following chart was adapted from the corresponding chart in Li & Shi (1986)’s *Chinese Putonghua Phonetic Standards*.

Table 8: Syllables of Pinyin

<table>
<thead>
<tr>
<th>ba</th>
<th>bo</th>
<th>bai</th>
<th>bei</th>
<th>bao</th>
<th>ban</th>
<th>ben</th>
<th>bang</th>
<th>beng</th>
</tr>
</thead>
<tbody>
<tr>
<td>pa</td>
<td>po</td>
<td>pai</td>
<td>pei</td>
<td>pou</td>
<td>pao</td>
<td>pan</td>
<td>pang</td>
<td>peng</td>
</tr>
<tr>
<td>ma</td>
<td>mo</td>
<td>mai</td>
<td>mei</td>
<td>mou</td>
<td>mao</td>
<td>man</td>
<td>mang</td>
<td>meng</td>
</tr>
<tr>
<td>fa</td>
<td>fo</td>
<td>fei</td>
<td>fou</td>
<td>fao</td>
<td>fan</td>
<td>feng</td>
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<td></td>
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<tr>
<td>da</td>
<td>de</td>
<td>dai</td>
<td>dei</td>
<td>dou</td>
<td>dao</td>
<td>dan</td>
<td>dang</td>
<td>deng</td>
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<td>ta</td>
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<td>tao</td>
<td>tan</td>
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<td>teng</td>
<td>tong</td>
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<tr>
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<td>nai</td>
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<td>nou</td>
<td>nao</td>
<td>nan</td>
<td>nang</td>
<td>neng</td>
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<tr>
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<td>lai</td>
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<tr>
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<td>hang</td>
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<td>seng</td>
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<td>zeng</td>
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<tr>
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<td>ci</td>
<td>cai</td>
<td>cou</td>
<td>cao</td>
<td>can</td>
<td>cen</td>
<td>cang</td>
<td>ceng</td>
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<tr>
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<td>ri</td>
<td>rou</td>
<td>rao</td>
<td>ran</td>
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<td>shi</td>
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<td>shei</td>
<td>shou</td>
<td>shao</td>
<td>shan</td>
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<tr>
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<td>zhei</td>
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<td>zhao</td>
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<td>chai</td>
<td>chou</td>
<td>chao</td>
<td>chan</td>
<td>chen</td>
<td>chang</td>
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</tbody>
</table>
3. Current language use in mainland China, Hong Kong and Taiwan

<table>
<thead>
<tr>
<th></th>
<th>Spoken Language</th>
<th>Written Language</th>
<th>Phonetic Alphabets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mainland China</td>
<td>Mandarin and dialects including Cantonese and Hokien</td>
<td>Simplified characters</td>
<td>Pinyin</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>Cantonese, Mandarin and English</td>
<td>Traditional characters</td>
<td>Pinyin for Mandarin and Yueyu Pinyin for Cantonese</td>
</tr>
<tr>
<td>Taiwan</td>
<td>Mandarin</td>
<td>Traditional characters</td>
<td>Zhuyin (until January 2009) and currently Pinyin</td>
</tr>
</tbody>
</table>
4. Comparison of Pinyin, Wade-Giles, Zhuyin and examples of Chinese characters (adapted from the corresponding charts in Zhou (1986)’s Modernization of Chinese Language and Script.)

| IPA | ɑ | ɔ | ɤ | ɛ | a | ɪ | e | ɪ | ɑ | ʊ | ɤʊ | an | ə | n | ɑ | ŋ | ɤ | ŋ | ɑ | ɻ | ʊ | ŋ | i | ɪ | ɛ | ɡ | ɪ | ŋ |
| Pinyin | a | o | e | e | ai | ei | ao | ou | an | en | ang | eng | er | ong | yi | ye | you | yan | yin | ying |
| Wade-Giles | a | o | o/ê | eh | ai | ei | ao | ou | an | ên | ang | êng | êrh | ung | i | yeh | yu | yen | yin | ying |
| Zhuyin | ㄚ | ㄛ | ㄜ | ㄝ | ㄞ | ㄟ | ㄠ | ㄡ | ㄢ | ㄣ | ㄤ | ㄥ | ㄦ | ㄨㄥ | ㄧ | ㄧㄝ | ㄧㄡ | ㄧㄢ | ㄧㄣ | ㄧㄥ |

example 阿 哦 俄 艾 黑 凹 偶 安 昂 冷 二 中 一 也 又 言 音 英

<table>
<thead>
<tr>
<th>IPA</th>
<th>ʌ</th>
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<th>ɔe</th>
<th>ɑi</th>
<th>ən</th>
<th>ɤn</th>
<th>ʊ</th>
<th>ɤŋ</th>
<th>ɪ</th>
<th>ɪŋ</th>
<th>y</th>
<th>ɛ</th>
<th>ɛn</th>
<th>yŋ</th>
<th>ɪŋ</th>
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</thead>
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<td>wo</td>
<td>wei</td>
<td>wai</td>
<td>wan</td>
<td>wen</td>
<td>weng</td>
<td>yu</td>
<td>yue</td>
<td>yuan</td>
<td>yun</td>
<td>yong</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wade-Giles</td>
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<td>wo</td>
<td>wei</td>
<td>wai</td>
<td>wan</td>
<td>wèn</td>
<td>wèng</td>
<td>yǔ</td>
<td>yüeh</td>
<td>yuān</td>
<td>yūn</td>
<td>yung</td>
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<td></td>
</tr>
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<td>ㄨㄛ</td>
<td>ㄨㄟ</td>
<td>ㄨㄞ</td>
<td>ㄨㄢ</td>
<td>ㄨㄣ</td>
<td>ㄨㄥ</td>
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<td>ㄨㄝ</td>
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<td>ㄩㄥ</td>
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</table>

example 五 我 位 外 完 文 翁 玉 月 元 云 用
### Table 12: Comparison of Non-sibilant Consonant Symbols

<table>
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<th>Zhuyin</th>
<th>example</th>
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<tbody>
<tr>
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<td>玻</td>
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<td>ㄆ</td>
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<td>feng</td>
<td>fêng</td>
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<td>ㄉㄧㄡ</td>
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<td>tuei</td>
<td>t'</td>
<td>ㄉㄨㄟ</td>
<td>兑</td>
</tr>
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<td>h</td>
<td>tnü</td>
<td>t'</td>
<td>ㄉㄩ</td>
<td>特</td>
</tr>
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<td>lü</td>
<td>nü</td>
<td>ㄝ</td>
<td>旅</td>
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<tr>
<td>ly</td>
<td>ger</td>
<td>lû</td>
<td>ㄌㄩ</td>
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<td>k'</td>
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</tr>
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<td>he</td>
<td>kʰ</td>
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<td>何</td>
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</table>

### Table 13: Comparison of Sibilant Consonant Symbols

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<th>IPA</th>
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<th>Wade-Giles</th>
<th>Zhuyin</th>
<th>example</th>
</tr>
</thead>
<tbody>
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<td>chien</td>
<td>ㄐㄧ</td>
<td>件</td>
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<td>jiong</td>
<td>chiung</td>
<td>ㄐㄩ</td>
<td>窘</td>
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<td>zhi</td>
<td>che</td>
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### Table 14: Comparison of Tone Symbols

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<td>ma₂</td>
<td>ma₃</td>
<td>ma₄</td>
<td>ma⁰</td>
</tr>
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<td>ㄇㄚˊ</td>
<td>ㄇㄚˇ</td>
<td>ㄇㄚˋ</td>
<td>ㄇㄚ・</td>
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<td><strong>example</strong></td>
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<td>麻</td>
<td>马</td>
<td>骂</td>
<td>吗</td>
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References


