UNIVERSITI PUTRA MALAYSIA

CHINESE CHARACTER RECOGNITION BY FIRST AND SECOND LANGUAGE LEARNERS IN PRIMARY SCHOOLS

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By

NG XIN JING

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Arts

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CHINESE CHARACTER RECOGNITION BY FIRST AND SECOND LANGUAGE LEARNERS IN PRIMARY SCHOOLS

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December 2014

Chair: Associate Professor Yap Ngee Thai, PhD
Faculty: Modern Languages and Communication

In alphabetic language systems, the processing of word-level units does not wait for "a complete specification of all letter units" before activating the word-level phonology (Liu, Wang & Perfetti, 2007, p. 472). Therefore, alphabetic language systems employ cascade processing during word recognition. However, in Chinese, a logographic language system, the word-level phonology can only be activated upon the full orthographic specification of a character (Liu, Wang & Perfetti, 2007). Therefore, logographic language system like Chinese is argued to employ threshold processing for word recognition. Given that Chinese second language (L2) learners learning to write in the L2 may have both orthographic and phonological representations that differ from their first language (L1), the question then arises: How do cross-linguistic differences in orthographic and phonological representations influence word recognition in Chinese among Malay speakers learning Chinese as an L2? A comparison was made between L1 and L2 learners to examine their similarity and differences in terms of Chinese character recognition.

The present study models the study by Liu, Wang and Perfetti (2007), which investigated threshold processing of Chinese characters for adult L2 learners. The present study however focused on learners at the primary school level. It aimed to investigate the priming conditions which facilitate or inhibit the learning of Chinese characters for two groups of learners: thirty-nine Malay learners of Chinese in Chinese primary schools, whose first language is an alphabetic language, and thirty-nine native Chinese learners. A primed matching task was administered where the 78 subjects from Chinese primary schools were required to match the logographic character with its corresponding *hanyu pinyin* or vice versa. Three priming conditions defined by the prime – target relation were applied. The three priming conditions include character pairs which are orthographically similar, phonologically similar (homophones) and

semantically related. Pinyin pairs which are semantically related were also included in the task. To control baseline effect, unrelated control primes were also included in the task. A Chinese proficiency test was administered to assign students into different proficiency level groups whereas the Naming and Meaning tasks were administered to verify subject selection for the Primed Matching Task. These tasks were also used to elicit errors done by the subjects in terms of orthography, phonology and semantic.

No significant differences were found between L1 and L2 learners from Chinese primary schools in terms of primed matching reaction time. Only semantically similar character pairs elicited a significant difference between the learners. Semantically similar character primes increased word recognition accuracy among L1 learners significantly more than L2 learners. The findings also showed that L2 learners are facilitated by homophonic priming whereas L1 learners are inhibited by homophonic priming due to the phonology to orthography feedback activation. Different methods of teaching can be applied to suit different learners accordingly.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sastera

PENGENALAN AKSARA CINA OLEH PELAJAR SEKOLAH RENDAH YANG MEMPELAJARI BAHASA CINA SEBAGAI BAHASA PERTAMA DAN KEDUA

Oleh

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Dalam sistem bahasa yang berunsur abjad, pemprosesan aksara berlaku tanpa menuggu pemprosesan spesifikasi lengkap semua abjad, sebelum pengaktifan fonologi pada aras aksara (Liu, Wang & Perfetti, 2007). Oleh itu, bahasa yang berunsur abjad memerlukan pemprosesan kaskade semasa aksara dipelajari. Namun demikian, dalam Bahasa Cina yang merupakan bahasa yang berunsur lambang, pemprosesan fonologi pada aras aksara tidak dapat diaktifkan sebelum pemprosesan spesifikasi lengkap ortografi aksara Cina (Liu, Wang & Perfetti, 2007). Oleh itu, pengenalan aksara dalam sistem bahasa yang berunsur lambang seperti Bahasa Cina memerlukan pemprosesan aksara secara ambang. Pelajar yang mempelajari Bahasa Cina sebagai bahasa kedua (L2) akan berhadapan dengan set perwakilan ortografi and fonologi yang berbeza dengan bahasa pertama (L1) mereka. Apakah perbezaan perwakilan ortografi and fonologi antara dua bahasa mempengaruhi pengecaman aksara Cina dalam kalangan pelajar Melayu yang mempelajari Bahasa Cina sebagai bahasa kedua? Perbandingan telah dibuat antara pelajar yang mempelajari Bahasa Cina sebagai bahasa pertama dan pelajar yang mempelajari Bahasa Cina sebagai bahasa kedua untuk mengetahui persamaan dan perbezaan mereka dalam pembelajaran aksara Cina.

Kajian ini merujuk kepada kajian Liu, Wang dan Perfetti (2007) yang menyelidik pemprosesan ambang aksara Cina dalam kalangan dewasa yang mempelajari Bahasa Cina sebagai bahasa kedua. Penyelidikan ini pula menumpu kepada pelajar dalam sekolah rendah dan bertujuan untuk mengetahui kondisi *priming* yang memerangsang dan mengganggu pembelajaran aksara Cina bagi dua kumpulan pelajar: tiga puluh sembilan pelajar Melayu dengan Bahasa Melayu sebagai bahasa ibunda; tiga puluh sembilan pelajar Cina dengan Bahasa Cina sebagai bahasa ibunda. Tujuh puluh lapan subjek yang belajar di sekolah rendah jenis kebangsaan Cina telah menjalani Ujian

Pemadanan Aksara, di mana pelajar perlu memadankan aksara Cina dengan *pinyin* atau sebaliknya. Tiga jenis hubungan yang berlainan mengaitkan perkataan pertama dan kedua: persamaan dari segi ortografi, persamaan dari segi fonologi (aksara sebunyi) dan perkaitan dari segi maksud. Subjek juga diuji dengan pasangan aksara *pinyin* yang berkaitan dari segi maksud. Pasangan aksara yang tidak berkaitan atau tiada persamaan juga digunakan dalam Ujian Pemadanan Aksara sebagai kawalan untuk menonjolkan perangsangan dan pengganggguan yang berlaku ketika pasangan aksara berkaitan ditunjukkan. Selain Ujian Pemadanan Aksara, Ujian Bahasa Cina turut dijalankan untuk membahagikan subjek ke dalam kumpulan mengikut tahap Bahasa Cina masing-masing. Ujian penyebutan dan maksud turut dijalankan untuk mengesahkan subjek yang layak untuk mengambil bahagian dalam Ujian Pemadanan Aksara. Kedua-dua ujian tersebut juga bertujuan untuk mengetahui kesalahan yang dilakukan oleh subjek dari segi ortografi, fonologi dan maksud.

Antara 2 kumpulan subjek yang belajar di sekolah rendah jenis kebangsaan Cina, tiada perbezaan yang ketara dikesan biarpun dari segi ketepatan mahupun tempoh masa yang diambil untuk melakukan tindak balas. Hanya pasangan aksara yang mempunyai maksud berkaitan menunjukkan perbezaan yang ketara di antara 2 kumpulan subjek, di mana ketepatan pelajar Cina dalam pengecaman aksara dipertingkatkan. Selain itu, aksara sebunyi didapati memerangsang pengecaman aksara dalam kalangan pelajar yang mempelajari Bahasa Cina sebagai bahasa kedua tetapi mengganggu pengecaman aksara dalam kalangan pelajar yang mempelajari Bahasa Cina sebagai bahasa pertama disebabkan pengaktifan berbalik dari fonologi ke ortografi. Cara ajaran aksara Cina yang berlainan perlu digunakan untuk pelajar dari golongan yang berbeza.

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I certify that a Thesis Examination Committee has met on 30 December 2014 to conduct the final examination of Ng Xin Jing on her thesis entitled "Chinese Character Recognition by First and Second Language Learners in Primary Schools" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Arts.

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This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
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Name of Member of Supervisory Committee: Wong Ling Yann, PhD

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LIST OF ABBREVIATIONS

Acc	Accuracy
ERP	Event-related Potential
fMRI	Functional Magnetic Resonance Imaging
L1	First Language
L2	Second Language
POL	Pupil's Own Language
RH	Right Hemisphere
RT	Reaction Time
SOA	Stimulus Onset Asynchrony

CHAPTER 1

INTRODUCTION

This chapter provides an overview of the study. For ease of understanding, this chapter first introduces the Chinese writing system and the challenges of learning Chinese. Problems which are left unanswered in the area of Chinese character recognition are also discussed in this chapter. The objectives, research questions, hypothesis will be presented next. Significance of the study will be discussed at the end of this chapter.

1.1 Background of the study

Chinese is also known as 汉语 /Hànyǔ/ [xan^{51}] [y^{214}] 'Han language'. In China, Chinese is known as 普通话 /Pǔtōnghuà/ [p^{h}u^{214}] [t^{h}ʊŋ^{55}] [xu̯a^{51}] 'Common language', whereas in Taiwan, it is known as 国语 /Guóyǔ/ [k^{h}u̯ɔ^{35}] [y^{214}] 'National language' (Chen, 1999). In Malaysia and Singapore, Chinese is referred to as 华语 /Huáyǔ/ [xu̯a^{35}] [y^{214}] 'Chinese language' (Chen, 1999). Chinese is a language used by the largest population in the world, and it is believed to be the oldest extant writing system, having appeared 3,200 years ago (Li, Shu, McBride-Chang, Liu & Peng, 2012). Nowadays, it has become increasingly important in the world. Codrington (2003), the Headmaster of Prince Alfred College, in Adelaide, Australia believed that the value of learning Chinese extends well beyond any financial benefits that might accrue. He also mentioned that, for many parents, the reality of 22% of the world's population living in China, plus the trading contact with places such as Singapore and Taiwan, are powerful reasons to encourage their children to learn Chinese.

Apart from that, a 2010 survey by the Confederation of British Industry (CBI) found that employers in the UK consider Chinese and Cantonese as second only to French as languages they would be looking for in future employees (Osborne, 2012). In 2010, the British government announced a partnership with China to train 1,000 additional Chinese teachers for secondary schools in England, as reported in the International Business Times. In a similar news article, Elizabeth Reid, Chief Executive at the Specialist Schools and Academies Trust pointed out that with the emergence of China as the centre of the global economy, the next generation will need to understand its culture and be able to work in its language (Osborne, 2012). Fu, Coordinator for Chinese, Cantonese and Korean at King's College London, said that the China's economic growth has led more professional people to learn Chinese. According to Fu, professional people are coming after work to study in order to speak Chinese language and increase their chances in business (Osborne, 2012).

However, Chinese is stated as one of the most difficult foreign languages for English native speakers to learn. In order to reach superior levels of proficiency, at least 2,200 hours of instruction is required (Foreign Service Institute, 2014; 1973; Sanatullova-

Allison, 2009). The complexity of Chinese orthography, requiring knowledge of between three thousand to four thousand different characters, is the main cause to the difficulty of Chinese learning (Xiao, 2002; Everson, 1998; Shi & Wan, 1998; Walker, 1989). Originally, Chinese character were written and decoded in terms of pictographic images several thousands of years ago (Jia & Jia, 2005). However, in present days, most of the Chinese characters have lost their pictographic contents (Ye, Fei & Wang, 2007; DeFrancis, 1989). Thus, a learner of Chinese will have to memorize the conventional rules of the inter-related strokes to be able to learn Chinese characters. This is very different from alphabetic languages which have grapheme to phoneme correspondences. As such, the opaque relationship between orthographic and phonological forms in Chinese has increased the level of difficulty in learning Chinese characters. The extreme complexity of Chinese character has caused the separation of spoken and written language for more than 2000 years (Kupfer, 2007). Some of the users of Chinese learnt the spoken language only without knowing how to read and write Chinese. This separation was still obvious in the teaching of Chinese as a foreign language (Kupfer, 2007). Similarly in Malaysia, Chinese language classes offered by language centers or those which teaches Chinese as a second language often focused more on the oral skills. Those teaching Chinese to native Chinese students, for example, in Chinese-medium schools, will provide instructions which covered all aspects of Chinese, including listening, speaking, reading, and writing skills, accordingly to their level of learning. Given that Malaysia is a multi-lingual country, non-Chinese parents would want to give their children an opportunity to learn Chinese, to be able to master another language other than their own mother tongue, which could help them to become more competitive in the future.

1.1.1 Chinese Writing System

For ease of understanding, it is essential to describe the Chinese writing system first. Chinese character is the basic morphosyllabic unit in the Chinese writing system used mostly by the Chinese as their mother tongue. Approximately one quarter of the world's population reads Chinese characters or a related logographic script in which the symbols represent meanings (Tavassoli, 2002). As opposed to alphabetic writing system, which consists of symbols that represent sounds; Chinese is a morphosyllabic (commonly known as logographic) writing system.

1.1.1.1 Chinese Character

In Chinese, words are written as characters, a basic unit of Chinese (Perfetti, Liu & Tan, 2005). Chinese, while as a spoken language, maps character onto single syllable morpheme instead of phoneme. In the spoken language, a single morpheme can usually be counted as a word (Perfetti, Liu & Tan, 2005). Chinese orthography consists of complex inter-related strokes (Tong et al., 2011). In total, there are 24 basic strokes in Chinese. The strokes which could not be pronounced were written based on a set of conventional rules (Tong et al., 2011). According to Li et al. (2012), fairly predictable internal structures of Chinese characters do exist. To recognize Chinese characters, the within-character component position and internal structures are crucial (Shu, Chen,

Anderson, Wu & Xuan, 2003). A learners' skill to memorize or differentiate graphic symbols is important for them in order to learn characters which are quite similar in the pronunciation or the visual orthographic structure (Siok & Fletcher, 2001; Ho & Bryant, 1997). A new learner of Chinese will have to learn and memorize all new characters and their corresponding spoken syllable or morpheme (Perfetti & Dunlap, 2008). According to Kennedy (1966), to say that a learner of Chinese is basically literate, he or she has to learn around two thousand different Chinese characters.

According to Tong et al. (2011), most Chinese characters that are learned at the early stage, are written out of repeated strokes which could be presented in slightly different visual patterns. For instance, the Chinese character "日" /rì/ [zɻ^{51}] 'sun/day' will become different characters which convey different meaning by just adding one stroke to it. Some characters which can be formed by adding a "丨" stroke are "田" /tián/ [tʰjɛn^{35}] 'field', "由" /yóu/ [joʊ^{35}] 'cause', "甲" /jiǎ/ [tɕja^{214}] 'armour/first', "申" /shēn/ [ʂən^{55}] 'explain' and "旧" /jiù/ [tɕjoʊ^{51}] 'old/past'. If a "一"stroke is added, the character "日" will then be transformed into "目" /mù/ [mu^{51}] 'eye', "旦" /dàn/ [tan^{51}] 'dawn/day', whereas if the stroke "丿" is added, it will become "白" /bái/ [paɪ^{35}] 'white', if "乚" was added, it will become "电" /diàn/ [tjɛn^{51}] 'electricity'. From the examples shown, we could also notice that the orthographically similar words are different in meaning and pronunciation. Moreover, if a stroke of a character is wrongly placed, it will also lead to character writing error. Take a character from the previous example, for instance, "白". If the stroke "丿" of the character "白" /bái/ [paɪ^{35}] 'white' did not touch the top left of "日", it will become "白́" which is wrong. Another example which students tend to get wrong is where the stroke "乚" was wrongly written as "㇀". The character "电" will become a non-existence character "电́" if the stroke "乚" is wrongly written as "㇀". Thus, it is very challenging for a child to memorize and differentiate the Chinese orthographic system.

To learn the Chinese characters, the learners need to understand the basic composition of characters. With reference to the Chinese character derivation history, the structural composition of characters was divided into four categories according to the structural composition of the characters, which includes Pictographic Characters (象形字), Referential Characters (指事字), Associative Compounds (会意字) and Ideophonetic Compounds (形声字) (Xing, Shu & Li, 2002). Referential Characters are also known as Self-explanatory or Indicative Characters whereas Ideophonetic Characters are also known as Semantic-Phonetic Compounds or Phonetic Compounds. Pictographic characters and Self-explanatory characters appear as simple characters, whereas the Associative Compounds and Semantic-Phonetic Compounds appears as compound characters which are a combination of two or more components. The simple characters are those semantic and phonetic radicals which are free morphemes (Feldman & Siok, 1999). The remaining radicals and phonetics are bound morphemes. They appear only as radicals of compound characters.

Pictographic characters were derived from pictures or things. The combination of strokes could convey meaning, for example, “女” /nǚ/ [ny^{214}] ‘female’, “日” /rì/ [ʐɻ^{51}] ‘sun/day’, “月” /yuè/ [ɥœ^{51}] ‘moon/month’, “田” /tián/ [tʰjɛn^{35}] ‘field’ and “山” /shān/ [ʂan^{55}] ‘mountain’. One the other hand, abstract ideas which were turned into graphical representations are called Self-explanatory Characters. A few examples of Self-explanatory Characters are as follows: “一” /yī/ [yi^{55}] ‘one’, “二” /èr/ [ɤɻ^{51}] ‘two’, “中” /zhōng/ [ʈʂʊŋ^{55}] ‘middle’, “凹” /āo/ [ɑʊ^{55}] ‘concave’, “凸” /tū/ [tʰu^{55}] ‘convex’ and “刃” /rèn/ [ʐən^{51}] ‘knife-edge/blade’. Associative Compounds are a combination of Pictographic characters and/ or Self-explanatory characters (Overseas Chinese Language and Culture Education Online, 2009). Both components contribute to the semantic of the word. Examples of Associative Compounds are “明” /míng/ [miŋ^{35}] ‘bright’, a combination formed by “日” /rì/ [ʐɻ^{51}] ‘sun/day’ and “月” /yuè/ [ɥœ^{51}] ‘moon’. The pronunciation for the compound word “明” /míng/ [miŋ^{35}] ‘bright’ is different from both “日” /rì/ [ʐɻ^{51}] ‘sun/day’ and “月” /yuè/ [ɥœ^{51}] ‘moon/month’. Pronunciation is not shared among the three corresponding characters. The number of these characters is comparatively few in contrast to the semantic-phonetic compound characters (Wang, Perfetti & Liu, 2003).

Chinese compound characters, on the other hand, are made up from basic components, which are called radicals. There are a total of 541 radicals (Chinese Radical Position Frequency Dictionary, 1984). According to Wang, Perfetti and Liu (2003), most of the radicals can stand alone as a single pronounceable and understandable single character. For instance, “土”, pronounced as /tǔ/ [tu^{214}] ‘soil’. An example of character which uses “土” as a radical is “坡” /pō/ [pʰʮɔ^{55}] ‘slope’. A number of 238 radicals could not stand alone as a single character. Some of these radicals are “忄”, “氵” These radicals could sometimes provide meaning cues for the whole character (Wang, Perfetti & Liu, 2003). Stroke positional constraints must be followed to form a legal radical. Some radicals have a consistent position. Some only appear at the left, for example, “冫” as in “凉” /liáng/ [liɑŋ^{35}] ‘cold’, “次” /cì/ [tsʰɻ^{51}] (classifier: number of times) and “犭” as in “猫” /māo/ [mɑʊ^{55}] ‘cat’, “狗” /gǒu/ [koʊ^{214}] ‘dog’; whereas some only appear at the right, for example “页” as in “顺” /shùn/ [ʂwən^{51}] ‘follow’, “顶” /dǐng/ [tiŋ^{214}] ‘top’. Other radicals may be seen at two or more positions, for example, “子” which could appear in either the left or top or bottom, as in the word “孙” /sūn/ [swən^{55}] ‘grandchild’, “孟” /mèng/ [məŋ^{51}] ‘first in series/ surname’, and “学” /xué/ [ɕɥœ^{35}] ‘learn’.

Researchers have pointed out that more than 80% of Chinese characters are semantic-phonetic compound characters (Shu & Wu, 2006; Shu et al., 2003; Taylor & Taylor, 1995; Kang, 1993) which are formed by radicals and single characters. The semantic component contains morphemic information which provides hints at the meaning of the character, whereas the phonetic radical provides syllabic information as a clue to the pronunciation of the whole character (Chen, Weekes, Peng, & Lei, 2006; Hoosain, 1991). Semantic-Phonetic Compound characters are formed by combining semantic and phonetic radicals, for example, “晴” /qíng/ [tɕʰiŋ^{35}] ‘sunny’, with semantic radical “日” /rì/ [ʐɻ^{51}] ‘sun/day’ and phonetic radical “青” /qīng/ [tɕʰiŋ^{55}] ‘green’. Another

example can be shown by the character “旺” /wàng/ [wɑŋ^{51}] ‘prosperous’, which has two components, as seen in Figure 1.1. The component on the left, “日” /rì/ [ʐɻ^{51}] ‘sun/day’ is a semantic component which stands for sun or day, while the right component, “王” /wáng/ [wɑŋ^{35}] ‘king/royal’ is a phonetic component, which provides the pronunciation for this character.

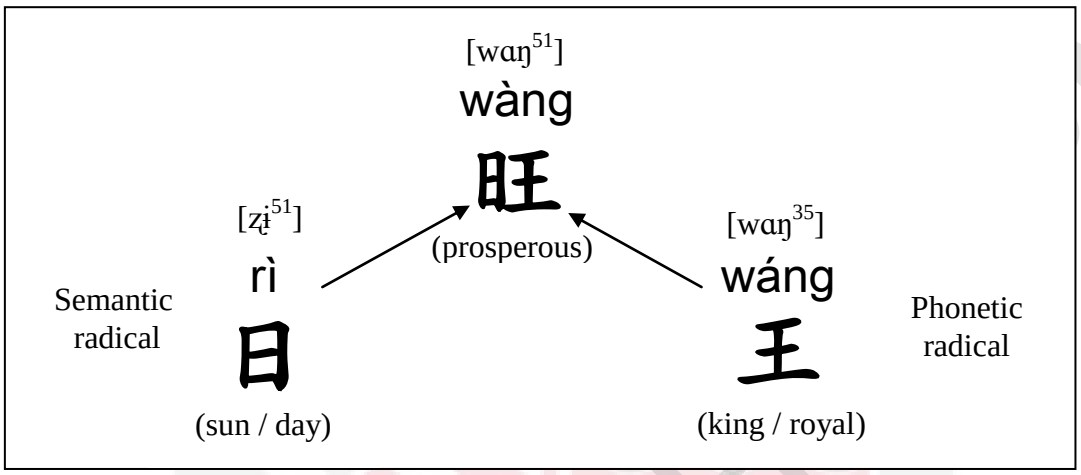

Figure 1.1. Chinese compound character with semantic and phonetic radicals (Adapted from Perfetti & Dunlap, 2008)

Moreover, according to Shu et al.’s (2003) analysis, among all semantic-phonetic compound characters, about 39% are regular. Regular semantic-phonetic compound characters are those which the phonetic radical gives reliable information about a character's pronunciation, for example, “城” /chéng/ [ʈʂʰəŋ^{35}] ‘city’ with the phonetic “成” /chéng/ [ʈʂʰəŋ^{35}] ‘to succeed or to complete’, and examples given earlier: “晴” /qíng/ [tɕʰiŋ^{35}] ‘sunny’, “旺” /wàng/ [wɑŋ^{51}] ‘prosperous’. Other than that, the number of semi-regular semantic-phonetic compound characters is around 26%. The phonetic radical of the semi-regular phonetic-compound character provides partial information about the pronunciation of a character, for example, “剪” /jiǎn/ [tɕjɛn^{214}] ‘to cut’ with the phonetic radical “前” /qián/ [tɕʰjɛn^{35}] ‘front’. Apart from that, there are also irregular characters. The phonetic radical provides no clue for the pronunciation of a character. Figure 1.2 shows an example where the character, “猜” /cāi/ [tsʰaɪ^{55}] ‘to guess’ is a semantic-phonetic compound with a phonetic radical with invalid phonetic. The phonetic radical for “猜” is “青” /qīng/ [tɕʰiŋ^{55}], but the word is read as /cāi/ [tsʰaɪ^{55}], and not as /qīng/ [tɕʰiŋ^{55}]. The ambiguity of Chinese character mapping are said to become more complicated when there are also homophones which share the same pronunciation, including tone, but do not share any similar component. As shown in Figure 1.2, “轻” (light weighted) and “清” ‘clear/distinct’ shared the same pronunciation, /qīng/ [tɕʰiŋ^{55}], but they have different components.

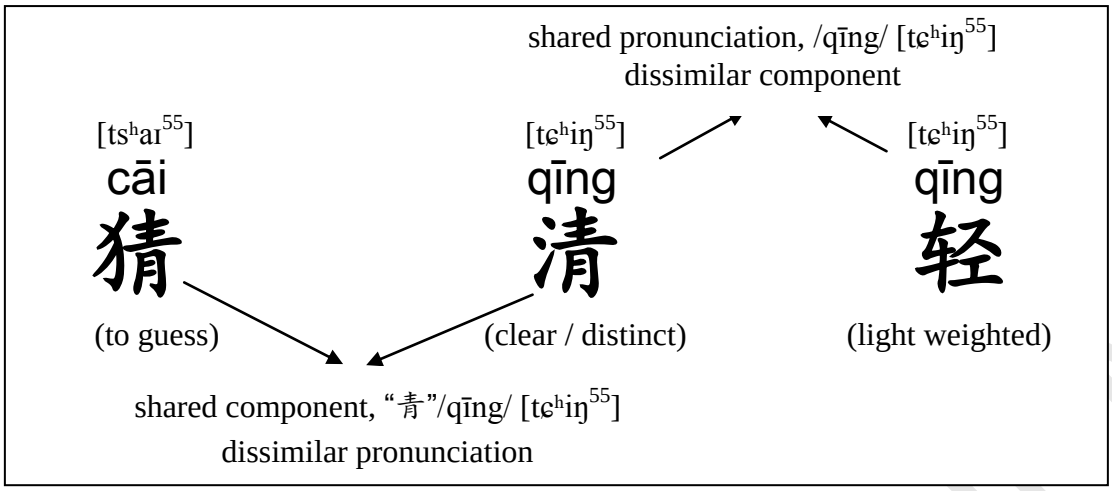

Figure 1.2. Examples of the ambiguity of grapheme-phoneme mapping

In compound characters, the semantic radicals provide information on character meaning. However, it is also known that understanding spoken Chinese relies a lot on the language context. According to Language and Teaching Institute of Beijing Linguistic College (1986), there are a number of 420 different syllables (disregarding tone) which are mapped onto about 4,574 Chinese characters, in modern-day usage. On average, a single pronunciation was shared by eleven Chinese characters. For example, the pronunciation /xīn/ [ɕin55] was shared by 心 ‘heart’, 新 ‘new’, 欣 ‘happy’, 锌 ‘zinc’, 辛 ‘hard/suffering’, 馨 ‘fragrant’, 昕 ‘dawn’, 薪 ‘fuel/ salary’, 鑫 (used in names of people and shops, symbolizing prosperity), 芯 ‘core’, 歆 ‘pleased/ moved’, 忻 ‘happy’, 莘 ‘long/ numerous’ and a few lower familiarity words. When one of these words was read without context, nobody could tell which character the speaker was referring to. Therefore, as compared to other alphabetic languages, pronunciation tends to be ignored as it did not play a major role in conveying meaning. Nonetheless, keeping track of morphemes sharing similar pronunciation is a skill that Chinese learners have to acquire (Tong et al., 2011). If the learners are sensitive enough to the homophones, it would facilitate the specific sounds to specific morpheme mapping process.

1.1.1.2 *Pinyin*

In order to assist the learning of Chinese characters, the pronunciation of Chinese characters using a Romanized orthography, which is the *hanyu pinyin* or sometimes abbreviated as *pinyin* was introduced. The use of *pinyin* was established in China since 1958 as an official writing system which coexists with the Chinese character writing system (DeFrancis, 1984). In Malaysia, *hanyu pinyin* is also used since 1983 (Guo, 2006). The use of *pinyin*, which is an alphabetic writing system with the standard 25 Roman letters plus a /ü/ (/v/ removed), has made the underlying phonological structure of Chinese syllable clearer and more straightforward; thus enabling children to learn Chinese characters better. With *pinyin* knowledge, the link between spoken and written language is created. A learner will be able to use *pinyin* in order to obtain pronunciations of characters and link them to the existing phonological representations in the mental lexicon after acquiring the *pinyin* principles. Thus, learners with *pinyin*

knowledge can even recognize characters which are familiar in auditory but unfamiliar in the visual form.

Pinyin syllables consist of initial, final and tone (Jiang, 2009). For example, in the syllable /dà/, /d/ is the initial, /a/ is the final and "\" above the final is the tone. A number of 21 initials and 38 finals can be found in *pinyin* (Tang, 2002). According to Jiang (2009), finals can be divided into 5 types, which are the simple finals (for example: /a/, /o/, /e/), compound finals (for example: /ai/, /ou/, /ie/), triple finals (for example: /uai/, /iao/), nasal finals (/en/, /ang/, /uan/, /iong/), and special finals (for example: /er/). However, not all combinations of initials and finals can form a Chinese syllable (Siok & Fletcher, 2001). For example, the combination of /r/ and /ü/ or the combination of /j/ and /ua/ are not possible *pinyin*s in Chinese. Chinese is a tonal language; it has pitch variation within every syllable (Jiang, 2009). Different tones for a same syllable convey different meaning. There are 4 tones in Chinese: the first tone (-), the second tone (/), the third tone (∨), and the fourth tone (\). In addition, there is also a neutral tone, which is pronounced soft and short. The absence of a tone-marker represents neutral tone. Not all tones could be applied to all Chinese syllables. For example, the second and third tone cannot be applied to /jun/, therefore /jún/ and /jǔn/ are not possible syllables in Chinese.

Pinyin is governed by rules. There are a few rules which govern the combination of initials and finals. First, /i/, /u/, /ü/ can each form syllables alone. However, /i/ should be written as /yi/, /u/ should be written as /wu/and /ü/ should be written as /yu/. Next, for finals which begin with /i/, /i/ need to be replaced by /y/. For example, the final without initial /ia/ needs to be written as /ya/. Also, finals beginning with /u/, without initial, /u/ should be replaced by /w/, for example /uen/ should be written as /wen/. Next, finals without initial which begin with /ü/ need to add /y/ before it, for example /üe/ should be written as /yue/. On the other hand, if preceded by an initial, the finals /iou/, /uei/ and /uen/ should be written as /iu/, /ui/ and /un/. In *pinyin* spelling, syllable-dividing mark (') is used when a syllable beginning with /a/, /o/, /e/ is preceded by another syllable, so that it will not be wrongly recognize as a single syllables instead of two. For example, 饥饿/jī'è/ (two syllables) which means "hunger" is different from 借 / jiè / (one syllable) which means "borrow or lend". There is also a rule saying that /ü/ should be written as /u/ if it is preceded by /j/, /q/, /x/ or /y/. The dots above /ü/ will need to be omitted. The word "鱼" /yú/ [y^{35}] and "女"/nǚ/ [ny^{214}] shared the same [y] but was differently written in *pinyin* as the /ü/ is preceded by /y/. Another combination rule is regarding the retroflexed ending (儿化韵). According to Jiang (2009), "儿" /ér/ is sometimes used after another final and causes the final to become a retroflexed one. In *pinyin* transcription, retroflexed ending is showed by adding a /r/ to the original final, for example 这/zhè/ plus 儿/ér/ becomes /zhèr/. Apart from that, similarly to English or Malay, capitalization should be done for the first letter of the first word in the sentence, the first letter of a proper noun and the first letter of names, for example: "See you tomorrow!" /**M**íngtiān jiàn!/, "Malaysia" /**M**ǎláixīyà/, a Chinese name "陈明" /Chén Míng/.

Another challenging part of Chinese *pinyin* is that it has changes of tone. First, there is the change of the third tone: when two third-tone syllables appear in a row, for example: 你好 /nǐ hǎo/ [ni^{214}] [xɑʊ^{214}], 你 /nǐ/ [ni^{214}] should be pronounced with second tone [ni^{35}], but the written original third tone marking remains. When a third tone syllable precedes a syllable of first, second, fourth or neutral tone (for example: 早安 zǎo'ān [tsɑʊ^{214}] [an^{55}]), it needs to be pronounced as a half third tone, where the first falling part is retained. The original third tone marking remains despite the change of tone. Other than that, tone changes can still be found for the word "一" /yī/ [yi^{55}] and "不" /bù/ [pu^{51}], depending on the tone of the syllable it precedes. If "一" /yī/ [yi^{55}] is used preceding a fourth tone syllable, it will be changed to /yí/ [yi^{35}] (second tone), for example 一致 /yízhì/ [yi^{35}] [ʈʂɨ^{51}]. However, if "一" /yī/ [yi^{55}] is used preceding a first, second or third tone syllable, it will be changed to /yì/ [yi^{51}] (fourth tone), for example 一只/yì zhī/ [yi^{51}] [ʈʂɨ^{55}], 一时/yì shí/ [yi^{51}] [ʂɨ^{35}], 一晚/yì wǎn/ [yi^{51}] [wan^{214}]. As for "不" /bù/ [pu^{51}], if it precedes a fourth-tone syllable, it will be changed to /bú/ [pu^{35}] (second tone), for example 不是 /bú shì/ [pu^{35}] [ʂɨ^{51}]. If "不" /bù/ [pu^{51}] is used alone or precedes a first, second or third tone, it remains its original tone /bù/ [pu^{51}] (fourth tone). (Jiang, 2009)

1.1.1.3 Chinese Phonology

The syllable is the basic speech unit of Chinese. There are four possible syllable structures in Chinese. A Chinese syllable could either consist of only a vowel (V), or a combination of consonant and vowel (CV), vowel preceding consonant (VC) or a combination of consonant, vowel followed by another consonant (CVC). Unlike English and Malay which has consonant clusters, Chinese syllables do not have consonant clusters. The onset of Chinese syllable has only one consonant. There are only two consonants which could occur at the end of the rime: /n/ and /ŋ/. Apart from that, there are combinations of Chinese consonant and vowel(s) which could not form a syllable. Also, not all 4 tones could apply to all available syllables. Thus, the comparatively simple structure of Chinese syllable suggests the large number of homophones existence (Su, 2010).

1.1.2 Challenges faced by students learning Chinese in Chinese-medium Schools

Perhaps no one can give an exact number of Chinese characters available in the world. *Zhongwen Da Cidian* (Great Dictionary of the Chinese Language), edited by Zhang Qiyun, in 1971, had a vocabulary of 49,888 characters. As a result, when learners of Chinese are presented with words, they will search through their mental lexicon for the semantics of it first in order to understand what is being presented. It is excusable for people to not know the pronunciation of the words as all speakers of Chinese will understand that it is impossible to know the pronunciations of every Chinese character as the orthography of the words do not suggest the way to pronounce them, except for phonetic compound characters which provide useful phonetic clues. This is very much different from the alphabetic languages. Therefore, phonological perception of Chinese

words will be slower as the search for the pronunciation in the mental lexicon will take a longer time.

Moreover, teaching approaches in Malaysia lack explicit teaching of the principle of the Chinese orthographies. Teachers often do not know how Chinese characters are derived from the past, due to the enormous number of Chinese characters available. Without the knowledge of how each Chinese character is derived from the past, it will be harder for students to imagine the original pictograph and try to link it with the current Chinese characters formed by abstract strokes. However, there may also be some teachers who know the derivation of characters, but do not have time to explain. From past experience, teachers have said that they just drew out the pictographs and next the Bronze Script followed by the Small Seal Characters, then the traditional script, without further explanation.

It is also challenging for Chinese learner to learn the characters as most of the pictographic contents were lost in the process of evolution. Identifiable pictographs contents were estimated by DeFrancis (1989), to be less than 1% of the currently used Chinese character lexicon. Some of the examples are shown in Figure 1.3. As seen in the simplified script, the characters are so much different from the once it used to be when they were written using the Oracle Bone Script. Oracle Bone Script are pictographs but not any more when it comes to simplified script. Each abstract stroke which does not convey meaning is tough for both Chinese first and second language learners.

Instead of analysing the combination of words, the learning of Chinese characters was done by rote memorizing and continuous practicing. These rote drilling methods of language learning could affect the way children learn Chinese characters. The character-copying skill (生字抄写) was found to strengthen the association between orthography and reading skills (Tan et al., 2005). By stressing on the orthography, the connections from orthography to the mental representations could be strengthened (Liu, Wang & Perfetti, 2007). However, if the students are not pronouncing the words either silently or aloud while doing character-copying, the connections between orthography to phonology will not be strengthened. The phonology mental representation retrieval will thus be slower.

Other than character-copying exercises, "Listen and Write" (听写) are also commonly practised. Teachers will read aloud the Chinese characters; students have to write them down after hearing them pronounced. Similar to spelling, the only difference here is that the students need to write the Chinese character out instead of its pinyin. This in-class assessment could help students strengthen the connections between phonology and orthography. Nevertheless, due to the extensive homophones that are found in Chinese, teachers will read the character, and provide its meaning, in order to let students know which character they are referring to. For example, if the teachers were to ask students to write the word "长" 'long' , they will be reading it as /cháng/ [ʈʂʰɑŋ^{35}], and provide meaning, "长" 'long' as in "长短" 'long short'. To be able to

write out words read by teachers, the students need to retrieve the orthographic form from the pronunciation they heard. The absence of direct phoneme to grapheme correspondence makes the task difficult for children to complete.

Name of Script Dynasty (Year)	Bird	Tortoise	Dragon	Car
Oracle Bone Script (甲骨文) *Shang* Dynasty (1600-1046 B.C.)				
Bronze Script (金文) *Shang* Dynasty (1600-1046 B.C.) & *Zhou* Dynasty (1046-256 B.C.)				
Small Seal Characters (小篆) *Qin* Dynasty (221-207 B.C.)				
Traditional Script (繁体) *Han* Dynasty (207 A.D. - present)	鳥	龜	龍	車
Simplified Script (简体) People's Republic of China (1949 - present)	鸟	龟	龙	车
Pinyin (拼音) People's Republic of China (1958 - present)	niǎo	guī	lóng	chē

Figure 1.3. Evolution of Chinese characters from pictographs to characters used nowadays
(Adapted from Perfetti & Dunlap, 2008 and Li, 2000)

Although the *pinyin* writing system was said to be parallel to the Chinese character writing system (DeFrancis, 1984), it is still another writing system which has no direct correspondence between the grapheme (characters) and phoneme (*pinyin*). As Shibles (1994) sees it, the *pinyin* orthography is not as helpful as it claimed in helping learners pronounce Chinese characters. According to Shibles (1994), the *pinyin* could not provide reliable phonetic information which leads to many possible pronunciations. For instance, the written *pinyin* orthography /u/ is actually /ü/ [y] if it is preceded by /y/, /j/, /q/, /x/ as /u/ [u] will never come after /y/, /j/, /q/ and /x/. This special treatment of /ü/ is difficult for basic learners to understand, and thus, it is quite normal to hear learner pronounce "鱼" /yú/ [y] as [yu]. Khor, Arriaga and Mah (2013) have found that second language students tend to pronounce /ü/ as [u] instead of [y].

Apart from that, fake initials in *pinyin* orthography are also challenging for beginners. Again, using the word "鱼" /yú/ [y] as an example, /y/ is the fake initial which will not be pronounced. Other fake initials include /w/ which precedes /u/ [u]. Moreover, there are also other spelling exceptions such as vowel omission and pronunciation rules for *pinyin* which is hard for learners who are learning both Chinese character orthography and *pinyin* orthography simultaneously. This is also why observations showed that some teachers tend to not go in depth of the *pinyin* orthography and just articulate the pronunciation of Chinese characters when teaching.

Since the establishment of *hanyu pinyin*, students who could not remember the orthography of the character will use Romanization in place of Chinese characters. However, the Romanization that the students wrote might not always be correct, as they use their understanding of alphabet pronunciation. For example, the initials /j/, /q/, /x/, /z/, /c/, /zh/, /ch/, /sh/, and /r/ are differently pronounced in Malay (Table 1.1), causing children to face difficulties while pronouncing them. Most of these phonemes do not exist in Malay, for instance /zh/, /ch/ and /sh/. Apart from that, /q/ and /x/ are rarely seen in Malay except for loan words. Khor, Arriaga & Mah (2013) reported that Chinese second language learners have difficulties in mastering Chinese pronunciation. Error rates were highest when students were asked to pronounce the initials especially those mentioned above. These alphabets are differently pronounced in different languages. The differences of *pinyin* and Malay graphemes to phonemes are shown in Table 1.1.

Chinese which is tonal increases the level of challenges for young learners too. Native speakers often face problem, knowing how to pronounce but do not know how to mark the tones. It is even harder for second language learners as they are new to tones and yet have to pronounce it and write it out correctly. The second (rising) tone of Chinese is the hardest for Malay learners to master, followed by the third (falling-rising) tone which students always got it mixed up with the second (rising) tone (Khor, Arriaga & Mah, 2013; Wong, 2011). According to Hao (2012), the contrast between the first and second tone is tough for second language learners, irrespective of their native language.

Table 1.1. Different pronunciations of initials in *Pinyin* and Malay

pinyin	**IPA (*pinyin*)**	**IPA (Malay)**
j	[tɕ]	[dʒ]
q	[tɕʰ]	[k] (rarely encounter)
x	[ɕ]	[z] (rarely encounter)
z	[ts]	[ks] or [z]
c	[tsʰ]	[tʃ]
zh	[tʂ]	-
ch	[tʂʰ]	-
sh	[ʂ]	-
r	[ʐ]	[r] (trilled)

Apart from that, Chinese is also very challenging for learners as its character may convey different meaning when paired with different words and is dependent on the context of use. The following sentence used five repetitions of the same character and yet is grammatically and semantically coherent.

提*着****提****袋的****提****小姐****提****起要****提****货的事。*

English translation: *Miss **Ti** (Surname) who is **carrying** a **handbag mentioned** about the commodity **pickup**.*

Even though all the five "提" in the above sentence is pronounced identically as /tí/ [tʰi^{35}], they refer to different meanings. "提" could mean 'to lift or carry (by hand)' 提笔 'take up (a pen)', 提款 'draw out(money)'; 'to mention or to bring up for discussion': 提起 'mention', 提出 'bring up', 提及 'refer to'; 'to guide, promote or lead': 提携, 提拔; 'to extract': 提取; 'of law action, bring out and bring to court': 提解，提押，提审; or as a noun as in 提袋 'handbag' which means 'hand-held' (Chinese-English Dictionary of Modern Usage, 1972) and many more (see http://humanum.arts.cuhk.edu.hk/Lexis/Lindict/). Learners of Chinese are already having a hard time needing to know the long list of meanings for the very same character with the same pronunciation, and yet they still need to know that the same character could also be pronounced differently with different meanings. For example, the word 提(/dī/ [ti^{55}])防 means 'to guard against'. The challenges faced by young Chinese learners raise the need to look into Chinese character recognition by both native and second language learners.

1.2 Problem statement

To be literate in Chinese, one has to know how to read and write Chinese. They have to learn both the spoken and written system. The Foreign Institute Service of the US Department of State (2014) and the National Virtual Translation Center (2007) have listed Chinese among the most difficult languages to learn. In order to reach the general professional proficiency, the English speakers need to learn Chinese for almost 88

weeks (Foreign Institute Service, 2014; Sanatullova-Allison, 2009). Moreover, according to Wang (2013) in *Chinanews.com*, Chinese was listed as "top 1 hardest language to learn" by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The reasons given included the complex relationship between its spoken and written form, no clues indicating pronunciations, homophones and the tones of Chinese. Acknowledging the challenges which need to be faced by the Chinese learners, as mentioned earlier, solving the problems faced by these learners could significantly help people learn Chinese. However, before going into that, the learning of Chinese should be examined. To address this, we need to identify the learning process of Chinese characters, the most fundamental unit in Chinese. If one fails to recognize Chinese characters, he or she will not be able to acquire literacy in Chinese.

Most early literacy development studies have looked into the learning of alphabetical languages, especially English. In Asian countries, research that investigates the acquisition of Chinese which transit across different language system is almost zero in number. Most relevant studies done in Asia are those motivated or participated by McBride-Chang and Shu (Li et al., 2012; Siok & Fletcher, 2001; McBride-Chang et al., 2005; McBride-Chang, 2004; Shu et al., 2003; McBride-Chang, 1996). Having said that, the studies mentioned above were done with children, and they focused on the early acquisition of Chinese. Therefore, the present study could fill the gap by investigating Chinese character acquisition by primary school students, who are slightly older in age.

Previous researches have also reported on native Chinese acquiring their first language (e.g. Li et al., 2012; Shu et al., 2003; McBride-Chang et al., 2003), showing the stages and processes undergone by native Chinese speakers. There are also many researches done on Chinese character processing by Chinese adults, using the psycholinguistics approach (e.g. Spinks et al., 2000; Zhou et al., 1999). The acquisition of Chinese characters by Chinese children has also been looked into by a growing number of researchers (Li et al., 2012; Shu et al., 2003; Chan & Siegel, 2001; Siok & Fletcher, 2001; Shu, Anderson & Wu, 2000; Shu & Anderson, 1997; Ho & Bryant, 1997). Among them, some are comparative studies which compared the learning of Chinese with the learning of English, for example those done by Perfetti and colleagues (e.g. Perfetti, Liu, Fiez, Nelson, Bolger & Tan, 2007; Wang, Perfetti & Liu, 2005; Liu & Perfetti, 2003; Wang, Perfetti & Liu, 2003; Perfetti, Zhang & Berent, 1992; Lam, Perfetti & Bell, 1991). The learning of two distinct languages have been compared and contrasted. However, very little has been said about the learning of Chinese characters by young alphabetic language users.

Apart from that, in the Malaysia context, there is a need to identify the difficulties faced by second language learners of Chinese that made them drop out of Chinese-medium schools. Even native Chinese learners are refusing to sit for Chinese examinations as Chinese is too hard for them to score. Therefore, the present study aims to examine the underlying process of the very basic character recognition before venturing into the broader scope. Chinese acquisition researches previously done in Malaysia focused on the acquisition of grammar (e.g. Quek, 2012), language interference (e.g. Wang &

Mohan, 2011), and learning orientations (e.g. Tan, Ooi & Hairul, 2012). Techniques that have been used by past researches in Malaysia include questionnaires (e.g. Khor, Arriaga & Mah, 2013; Wong & Lim, 2011; Ang, 2008), grammaticality judgement and error analysis (e.g. Lim & Wong, 2012; Wong, 2011; Lau & Ng, 2011). These techniques provide very little insight to the mental representations and the mental processing involved while a person is processing a language. By using psycholinguistics approach, the present study seeks to examine the mental encoding and decoding process of language.

The present study used the primed matching task, in order to measure the effect of having previously processed a prime item on the subsequent processing of the target (Garrod, 2006). If the prime triggered the recognition of the target word, it reflects that there is some relationship between the prime and target word mental representations (Garrod, 2006). For example, a person decides "tiger" is an animal in shorter time if the prime is "lion", which is of the same category, and has a close semantic relationship. To decide whether or not "tiger" is an animal or an object, if it is preceded by the word "orange", the response received might be slower. By using this approach, the mental process of Chinese character recognition which has not been investigated before in Malaysia could be examined. The cognitive processing of Chinese characters will then be able to provide an insight of how Chinese words are processed. We need to identify possible primes which could facilitate their learning of Chinese.

Second language learners face complex challenges while learning a second language, especially in a different language system. In the present study, non-Chinese speakers need to learn the logographic words and also the semantic and phonological mappings of these visual forms of characters, and also the knowledge of the mappings itself (Liu, Wang & Perfetti, 2007). Young learners who are at the age of nine have not acquired all the conceptual units of the world yet. They are still simultaneously acquiring literacy from both languages which they have not completely mastered. Thus, this study will also address these issues and look into the character acquisition of these second language learners of Chinese which transit across different language systems. Wang, Perfetti and Liu (2003) have studied the processing of learning a new writing system (Chinese) by skilled reader of another writing system (English). The subjects were found to be sensitive to the orthographic form of Chinese characters. In 2007, Liu, Wang and Perfetti tried to explain how word form and meaning were acquired in an unfamiliar writing system. Their study examined undergraduate students who were learning Chinese in an elementary Chinese class. Their study showed that adult second language learners learn Chinese in a similar way as the Chinese skilled learners do. They focus on the learning of orthographic form. However, their study did not account for young learners of Chinese. Young native Chinese learners are learning the written form of Chinese characters and *pinyin* orthography after they have already acquired most of the meaning and phonological expressions of Chinese. They would be expected to have a stronger foundation in the meaning and phonological aspect whereas Malay learners of Chinese may rely more on the phonological aspect and *pinyin* orthography as their first language is an alphabetic one. It is thus interesting to investigate which aspect they put a premium on for learning Chinese characters? Is it the orthographic form, phonological or the semantic aspect? How about the second language learners who are yet to be skilled reader in their first language? Moreover, their studies did not

discuss about the effects of *pinyin* learning on Chinese character recognition. Will *pinyin* learning affect the recognition of Chinese characters? This study could fill these gaps by comparing the cognitive processing of Chinese characters by Malay learners of Chinese with native Chinese users. Identifying linguistic factors which could facilitate these learners is thus important to be reported.

1.3 Purpose of the Study and Research Questions

This study serves four main purposes. Firstly, the study seeks to investigate the differences between Malay learners of Chinese and Chinese native learners in terms of Chinese character recognition. The study would also examine the effect of the learners' Chinese proficiency level on their recognition of Chinese characters. The third purpose of the present study is to identify priming conditions which could facilitate or inhibit character recognition among first and second language learners. Lastly, the study also identifies some problems faced by L1 and L2 learners in recognizing Chinese characters.

The following research questions are addressed in this study:

1. In what way do Malay learners of Chinese differ from Chinese native learners in terms of Chinese character recognition?

2. How does Chinese proficiency level of the learners affect Chinese character recognition by first and second language learners of Chinese?

3. What priming conditions facilitate or inhibit Chinese character recognition by first and second language learners?

4. What are some problems faced by L1 and L2 learners in recognizing Chinese characters?

Research Hypothesis

Based on the first three research questions listed above, three research hypotheses have been identified:

H_1: L1 learners are predicted to react faster than L2 learners in recognizing Chinese characters on the overall.

H_2: Word recognition by L2 learners are predicted to be facilitated by homophonic Chinese characters and also by *pinyin* orthography.

H_3: Learners with a higher level of proficiency in Chinese are predicted to perform better and faster in Chinese character recognition than those with a lower level of proficiency, regardless of priming conditions.

The final research question will be addressed qualitatively with a description of the errors found in the study.

1.4 Theoretical Framework

Word learning is a path which guides human between conceptual and linguistics system (Waxman & Lidz, 2006). Learners need to be able to connect a word to its corresponding concept. The successful establishment of such connections marks the success of word learning. But before that, learners will first need to recognize the conceptual units and the linguistic units (words) to be able to map them together. Many theories have been proposed to explain the cognitive processing of language learning. The main theory that will be guiding this study is the Universal Grammar of Reading (Perfetti, 2003), which posits that reading is guided by universal properties. From the Universal Grammar of Reading, Lexical Constituency Model was developed by Perfetti, Liu and Tan (2005) to address word reading across different languages. However, this theory did not account for second language learners. Therefore, in 2007, Liu, Wang and Perfetti (2007) came up with the Threshold-style processing as a processing framework for the learning of Chinese as a second language which could simulate Chinese word learning by both first and second language learners.

1.4.1 Universal Grammar of Reading

According to Perfetti (2003), universal properties of reading can be observed across different writing systems. In 2003, Perfetti pointed out that there is a universal grammar of reading, where reading is "jointly defined by a language and by the writing system that encodes the language" (Perfetti, 2003, p.4). Well-structured subcomponents: grammar, phonology and pragmatics defined language, which is an abstract system (Perfetti, 2003). There are two levels of understanding in writing system, the mapping principles, which is of a higher level and the spelling or orthographic constraints which is of a lower level. In the same journal article, Perfetti (2003) stated that many different languages could also be included in the mapping principles of writing systems. The mapping principles refer to the connection between the "graphic units" and the "language units" (Perfetti & Dunlap, 2008, p.17). The alphabetic writing system, such as Malay, connects graphs with their phonemes; the syllabic writing system, such as Japanese Kana system, connects graphs with spoken syllables; the logographic writing system, such as Chinese, links graph (character) to "words and morphemes, units of meaning" (Perfetti & Dunlap, 2008, p.17). Even though orthographic constraints might be identical across closely related languages, Perfetti (2003, p. 4) said that they are "definitionally language specific". Perfetti (2003, p. 5) concluded that "reading is embedded in two interrelated systems: the Language System and the Writing System". Therefore, writing system learning, in the present study, Chinese characters learning was said to take place when the learner can recognize written words as words in the spoken language that he or she uses (Perfetti, 2003). For instance, learning was said to occur when a Chinese learner is able to recognize familiar Chinese characters, as well as using compositional principles to make "informed guesses" (Perfetti, 2003, p. 16) to

pronounce and understand the meaning of unfamiliar characters. As for an alphabetic learner, for example, if a Malay learner has the ability to read familiar, unfamiliar words, and even non-words in his or her language, he or she is said to have learned the writing system.

1.4.2 Processing framework for Chinese as Second Language Learners

In alphabetic languages, coarse-grained processing "optimizes fast access to semantics by using minimal subsets of letters that maximize information with respect to word identity, while coding for approximate within-word letter position independently of letter contiguity"; whereas fined-grained processing "is sensitive to the precise ordering of letters, as well as to position with respect to word beginnings and endings" (Grainger & Ziegler, 2011, p. 54). Liu, Wang and Perfetti (2007) provided the following framework as illustrated in Figure 1.4 below as a way to sketch the Chinese word activation function for a second language learner. This framework is a coarse-grained activation function as it serves a general descriptive purpose. As a Chinese processing framework for second language learners, the present model does not capture precise within character strokes position. Mental word representation will only become increasingly fine-grained over learning time (Adlof, Perfetti & Catts, 2011).

There are two main differences between the model for skilled reading and the learner framework. Firstly, the learner framework has a much smaller vocabulary and slightly stronger connection weights from orthography to meaning than from orthography to phonology (Liu, Wang & Perfetti, 2007). The second assumption, however, would be reversed in the weight differences, if learning was emphasized more on phonology than meaning. For the case mentioned, connection weights will be slightly stronger from orthography to phonology than from orthography to meaning.

The process of character recognition begins by a visual input, the stroke and position information are then sent to the orthographic level. Each unit in the orthographic stage corresponds to an acquired character. Each input combination of strokes can send a full activation to the corresponding character unit in the orthographic level, and even partial activation to all the character units that are orthographically similar (Liu, Wang & Perfetti, 2007). However, after the threshold of any orthographic unit has been reached, inhibition effect will be sent to all the other orthographic units. Also, the phonological and semantic levels will be activated. One important feature is that, while the number of characters learnt increases, the number of units at the orthographic level will also increase continuously.

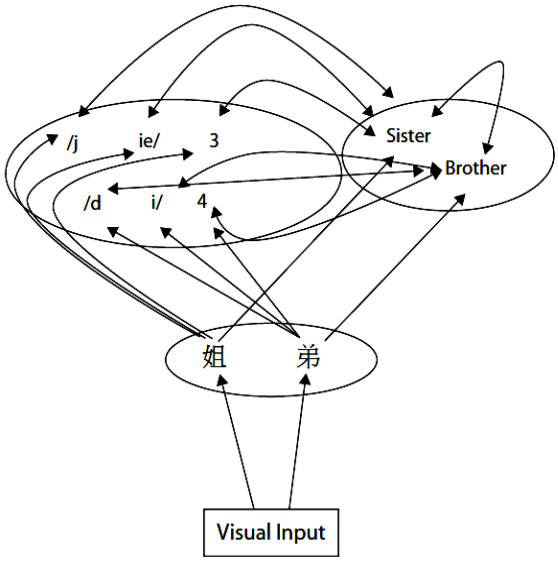

Figure 1.4. Framework for processing Chinese as a second language
(Source: Liu, Wang & Perfetti, 2007, p. 477)

On the other hand, Liu, Wang and Perfetti (2007) has also pointed out that the phonological level is of a distribution representation level that contains units according to the Chinese national standard *pinyin* system. Phonological level which is a distributed representation level does not have within-level linkage (Perfetti, Liu & Tan, 2002). Chinese has 21 onsets, 38 vowels, and 5 tones (including a neutral tone) (Tang, 2002). The combinations of the onsets, vowels, and tones above are sufficient to represent all the syllables of Chinese.

As for the semantic level, character meaning, according to Liu, Wang and Perfetti (2007, p. 477), is a "localized representation". Each such representation corresponds to a unique meaning of a single character that has been learned. Figure 1.4 showed the semantic representations in English translation, however, it should be different for different people. At this point, the semantic level does not contain representations of sublexical semantic features. Between-character connections were to reflect the semantic relations. The connections between the corresponding phonological and semantic units are bidirectional.

The implemented model (Liu, Wang & Perfetti, 2007), as shown in Figure 1.4, simulates the sublexical processes. The visual input will activate a group of corresponding orthographic units, little by little. This process will not only activate the orthographic unit group of the seen character, it will also activate other orthographically similar characters, though giving most activation to the orthographic units of the seen character. Given the most activation, the unit is said to reach its threshold before other units. At the same time, inhibition will be sent to other units. The unit which first reaches the threshold will then activate phonological and semantic units which correspond to it. The semantic units have internal connections with semantically related characters. Therefore, a group of semantically related characters will then be activated and will start to activate their corresponding phonology. The onset, rhyme

and tone units for the seen character will reach the threshold before other phonological units, as the phonological units for the seen character will be receiving most activation from both the orthographic and semantic levels.

In this study, priming is used. Thus, there will be an exposure of a prime character preceding the target character. This study aims to examine the priming effect of the pre-activation of certain units, either causing facilitation or inhibition effect. From the researches and theories mentioned above, the present study hypothesized that the acquisition of word form and meaning are reflective of the threshold style of the mental lexicon, in which character recognition is achieved by an activation that reaches a character-specific threshold. Phonological and meaning processes will be delayed until the point where the orthographic threshold has been reached. High character frequency may as well enable the character to reach its threshold faster.

1.5 Significance of the Study

Only limited researches were found in the investigation of language system transition involving the Chinese language system. Looking into the second language acquisition of a logographic language system by alphabetic language users could offer unique data regarding the transition of language system acquisition, thus enhancing our knowledge of how L2 learners of Chinese acquire the Chinese character. By comparing first and second language learners of Chinese, the similarity and difference in their learning of Chinese characters will be clearer. Moreover, previous studies on the acquisition of Chinese in Malaysia did not use psycholinguistic approaches. This study could then contribute substantially to our knowledge regarding the acquisition of logographic systems.

This study also aims to contribute to the new line of second-language reading research, which is currently dominated by studies on learning alphabetic languages. By recognizing the effects of having learnt an alphabetic language for subsequent learning of a logographic language, a more effective way of teaching could be implemented to meet the needs of Chinese learning by native Chinese and Malay students.

1.6 Definition of Key Terms

There are a few terms which need to be defined first as they will be discussed frequently in the thesis. The key terms are: Chinese character, character recognition, first language (L1), second language (L2), and the learning of L1 and L2.

Character is "the name for a single symbol of a writing system" (Cook & Singleton, 2014, p. 206). For example, in Chinese, "大" ('big') is a character. According to Perfetti and Liu (2006), "characters consist of smaller components or radicals, which may themselves have a pronunciation or meaning" (p. 226). Characters could be simple

or compound. Simple characters are mostly "pictographic in origin". Matthew (2014) has used "水" 'water', which is composed by wavy lines, as an example of simple character. However, most of the characters are actually compound characters. A compound character is composed by combining two or more radicals. In most cases, compound character is a combination of a radical which provides phonetic cues and another radical which provides meaning (Matthew, 2014), for example "旺" which consist of a semantic radical "日" /rì/ [zɻ^{51}] 'sun/day' and a phonetic radical "王" /wáng/ [wɑŋ^{35}] 'king/royal'.

Word recognition can be defined as "determining the identification of a written word, i.e., the pronunciation (and meaning) of a word encountered in print or writing" (Kurvers, 2007, p. 23). Similarly, character recognition is the identification of a written character. Recognizing a word requires one to know the pronunciation and meaning of a written character. According to Snowling and Hulme (2005), character recognition refers to the corresponding pronunciation and meaning retrieval process from the written form of character. This thesis investigates Chinese character recognition by first and second language learners in primary schools. Hence, the present study which seeks to investigate Chinese character recognition by primary school students, examines the pronunciation and meaning retrieval process of Chinese characters.

First language (L1) is "the language first learned, best known, and/or most used" (Skutnabb-Kangas & McCarty, 2008, p. 5). First language is "often a synonym for mother tongue" (Skutnabb-Kangas & McCarty, 2008, p. 5). Skutnabb-Kangas and McCarty (2008) have defined mother tongue as "language(s) one learns first, identifies with, and/or is identified by others as a native speaker of" (p. 9). Mother-tongue is also defined as "the first language acquired by a child and it is successfully used for communication at that level"; "the language a human being learns from birth" (Patrick, Sui, Didam & Gyang, 2013, p. 285). In the context of the present research, the first language or the mother tongue refers to the language one learns from birth. The acquisition of first language might not necessarily include its writing system. "Chinese L1 learners" in this thesis refers to those who learnt Chinese as their first language.

UNESCO has defined second language as "a language acquired by a person in addition to his mother tongue" (Cook, 2013, p. 12). The term "second language (L2) learning" is defined by Cook (2013) as "all learning of languages other than the native language, in whatever situation or for whatever purpose" (p. 12). Second language learners "already know how to mean" and thus the learning of a second language is "different from learning a first language since there is already one language present in their mind" (p. 13). In the present study, Malay learners of Chinese are learning Chinese as a second language. Therefore, Malay is already present in their mind; Chinese is acquired in addition to Malay. On the other hand, the present study recruits students who are studying in Chinese-medium schools. These students learn Chinese together in the same classroom context, regardless of their first language. In such context, teachers could not teach the students separately. Therefore, "teaching Chinese as a second language" is not applicable.

After introducing the present study, including its background and objectives, some important theories, concepts, and terms, a review of previous literature on relevant studies has also been done. The review of literature will be presented in the next chapter.

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