2010

Radical Awareness Among Chinese-as-a-Foreign-Language Learners

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RADICAL AWARENESS AMONG CHINESE-AS-A-FOREIGN-LANGUAGE LEARNERS

By

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A Dissertation submitted to the School of Teacher Education in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Degree Awarded:
Summer Semester, 2010
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For Dad and Mom: None of this would have been possible without your great support! I love you!
ACKNOWLEDGEMENTS

First, I would like to express my sincere gratitude to all the committee members: Dr. Young-Suk Kim, Dr. Christopher Reenock, Dr. Alysia Roehrig, Dr. Gretchen Sunderman and Dr. Shelbie Witte. It is such an honor to have you all on my committee. Without your guidance and advices, I would not have finished this project.

Dr. Kim, thank you so much for taking the responsibility of the major professor when I was in great difficulties. You provided so much invaluable advice in the making and revising of this dissertation. Dr. Reenock, thank you for joining my committee. Your help really pulled me up from trouble. Dr. Roehrig, thank you for all the methodical and statistical advice during the designing and writing of this dissertation. Dr. Sunderman, thank you for providing so much helpful suggestions in the design of the instruments. Dr. Witte, thank you for the advice on pedagogical implications of this dissertation.

I also want to thank the following, each of whom contributed to the planning and completion of this dissertation: Dr. Susan Wood, who supervised my prospectus, and who provided great support in the early planning of this dissertation; Dr. Yanyun Yang, who provided statistical suggestions for data analyses; Dr. Elizabeth Platt, who gave me enormous moral support during my study.

Thanks should also go to all the participants at FSU and my friends, Xujun Feng, Li Li, Laci Mattison, Yi Pan, Chris Rivera, Tianhai Xie, Xiaodan Wang, Haiyan Wu, Yu Xiu, and Wenyang Zhai. Your help is also indispensable to the making of this dissertation.

Last, but surely not the least, I want to thank my sister Fuqun, Su for her continuous support for my study. I am so lucky to have you as my sister!
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ABSTRACT

This study examined radical awareness among college students who learned Chinese as a foreign language (CFL).

Radicals are subcomponents of characters. They follow positional constraints and they have meaning-cueing and pronunciation-cueing functions. Radical awareness, the knowledge about the positional and functional regularities of radicals has been found closely related to Chinese word reading and word writing among developing readers in first language literacy acquisition (Chan & Nunes, 1998; Ho, Ng, & Ng, 2003; Packard et al., 2006). The instruction on improving radical awareness was proved beneficial in character recognition, semantic categorization and character writing (Ho, Wong & Chan, 1999; Packard et al, 2006). Despite the wide interests in radical awareness in L1 literacy acquisition, relevant research in second language/foreign language is scant.

Three objectives guided the present study: 1) to determine radical awareness levels among CFL learners who differ in their Chinese proficiency levels; 2) to explore the relation between radical awareness and word recognition among CFL learners and to determine whether this relationship differ between advanced and beginning CFL learners; 3) to explore the shared and unique relations of radical awareness with word recognition in Chinese.

Ninety-seven CFL learners at a US southeastern university participated in the study. They were categorized as either beginning or advanced CFL learners based on a Latent Class analysis. A word recognition test and three tasks were created for the present study. These three tasks included a character legality decision task, a character-meaning matching task, and a character writing task. The character legality decision task was aimed at measuring learners’ implicit positional radical awareness; the character-meaning matching task was aimed at measuring learners’ implicit semantic radical awareness; the character writing task was used to measure the explicit radical awareness (both radical positional awareness and semantic radical awareness). ANOVA and multiple regressions were utilized as statistical analysis methods to answer the three research questions.

The results of the study showed that advanced CFL learners had higher levels of radical awareness than beginning CFL learners. They also yielded significant relations between implicit positional radical awareness, explicit positional radical awareness and explicit functional
semantic radical awareness and word recognition among CFL learners and that this significant relationship did not vary between advanced and beginning CFL learners. The third finding from this study was that explicit functional semantic radical awareness was the unique predictor of word recognition among CFL learners.

The present study is unique in several aspects. First, the present study extended the previous studies by exploring the relation between language proficiency and radical awareness among CFL learners. For the few that explored the radical awareness among CFL learners, exposure time was the only factor that has been considered. Second, this study systematically examined explicit and implicit radical awareness for two types of radical awareness (i.e., positional and semantic) to explore the nature of the relation between radical awareness and word recognition comprehensively. Third, this study investigated the shared and unique relations of various radical awareness tasks to word recognition in Chinese.

The present study also has pedagogical implications. It has the potential to inform the Chinese textbook writers and classroom teachers to have a better understanding as to how to teach characters in a more efficient way. For example, the results may inform teachers about the importance of explicitly teaching radicals, and approximately when to introduce the concept of radicals in language study.
CHAPTER ONE
INTRODUCTION

Due to the rising political, economic and commercial power of China, increasingly more and more people are learning Chinese. People around the world have begun to study the Chinese language for a variety of reasons, including to improve their chances of employment, to help them negotiate international business agreements, or to enhance their travel experiences. Students in high school and college learn Chinese with the hope that it will give them an edge in future careers. With the closer economic ties between China and the world, people want to become proficient in Chinese as a second or foreign language.

Yet learning Chinese is very difficult, especially for learners whose first language (L1) has a very different language and orthography system from that of Chinese. For instance, the Foreign Service Institute of the U.S. estimates that in order to reach the same proficiency level, students need to go through approximately 1,320 hours of instruction in an intensive program of Chinese while they only need to receive 480 hours of instruction in a program of other commonly taught languages like French or Spanish (Jorden & Lambert, 1991). Many students, eager to enroll in Chinese class in the first place, often quit because of the intensive learning and great effort required for learning Chinese. For some, learning to speak Chinese is not worth so much time and effort. For those choosing to stay, many hurdles must be overcome.

Among all difficulties faced by English learners of Chinese, learning to read in Chinese is one of the biggest challenges (Everson, 1998). The visual complexity of the written forms of Chinese and the large number of words students need to acquire in the early stages of learning experience force them to study for long hours and cause many pressures and frustrations. These challenges imposed on the learners of Chinese have triggered a research interest in the nature of reading, related to exploration in why reading in Chinese is so difficult and how reading in Chinese compares to other languages (Perfetti & Liu, 2005).

Researchers have begun to examine the learning of characters, the basic written forms of Chinese. Radicals, the subcomponent of characters, have also received much attention (Taft & Zhu, 1997). As a component of Chinese characters, radicals are the smallest meaningful orthographic components (Shen & Ke, 2007). They have semantic and phonetic functions and they conform to position rules within characters (Jackson, Everson, & Ke, 2003). Radical
awareness, the knowledge about the positional and functional regularity of radicals, has been believed to play an important role in reading and spelling in Chinese (Shu & Anderson, 1997, 1999; Ho, Ng, & Ng, 2003).

Since research on reading in Chinese has not received wide attention until recently and does not have the scientific history as does research on reading in English (Shu & Anderson, 1997), it has drawn on theories and models developed from English reading research. Relevant to the issue proposed for this study is research or study in both English and Chinese as related to the processing of phonology, orthography and morphology in word recognition. Word recognition, the process of retrieving information about a word’s spoken form and meaning from its printed form, is widely accepted as the foundation of reading (Snowling & Hulme, 2005). The following section gives an overview of word recognition research in English-as-L1, English-as-L2 and Chinese literacy acquisition.

**Background on Research of First Language Reading at Word Level**

Research interest in word recognition is due to the extreme importance and great difficulties of reading (Snowling & Hulme, 2005). Reading is a major way of acquiring information in modern society (Koda, 2007). Although learning to read is a basic skill that all people need to acquire, learning to read is actually a very complicated process (Koda, 2005). Its acquisition demands great time and efforts (Koda, 2005; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001). Children do not acquire reading naturally as they do with speech and cases of dyslexia or reading difficulties have been reported throughout the world (Ho, Chan, Tsang & Lee, 2002). Given the primary importance of reading and wide occurrences of reading difficulties, researchers have been concerned with the process of reading for thousands of years (Bernhardt, 1991), and since Javal (1879) initiated a scientific study of reading phenomenon, reading has continued to be a focus in research disciplines like psychology, psycholinguistics, and education, and various theories and models about reading have been established (Grabe, 2009; Rayner et al., 2001; Venezky, 2006).

Reading is a complicated process whose development is contingent on linguistic, social, and cognitive factors (Carr & Levy, 1990). Multiple reading theories have been established based on the different emphases put on these linguistic, social and cognitive factors. While the social approach to reading focuses on variables such as motivations, prior knowledge, attitudes,
and their influence on reading comprehension, another major approach treats reading as a
cognitive process in which various skills are involved as readers gradually progress through the
text (Bernhardt, 1991; Koda, 2007). Adopting the componential view (Carr & Levy, 1990), the
cognitive approach treats reading as a process that involves the working of many subcomponent
cognitive skills such as decoding, reconstructing and comprehension (Koda, 2007). These skills
jointly work while reading is happening. Some researchers group these skills into lower-level
skills and higher-level skills (Koda, 1992; Schneider & Sheffrin, 1977). Grabe (2009), for
example, categorized word recognition, syntactic parsing and semantic-proposition encoding into
the lower-level skills while including attention, memory, and strategy use into the high-level
skills. The limited-capacity model claims that deficiency in lower-level processing operations
strains the limited capacity of short-term memory, and inhibits text integration into meaningful
sequence (Schneider & Sheffrin, 1977). This model predicts that when a reader is heavily
involved in lower-level processing operations, fewer cognitive capacities are available for
higher-level processing, such as making inferences and drawing upon prior knowledge, thus poor
comprehension is inevitable. Word recognition, the process of drawing semantics from the
graphic forms, is thus very important and reading without good word recognition skill is at best
inefficient (Snowling & Hulme, 2005).

Theories about word recognition began to develop during the last century (Snowling &
Hulme, 2005). Three major models about word recognition have been created: the direct access,
the dual route, and the connectionist model. The direct access model (Smith, 1973) posits that
the meaning of a printed word is accessed directly from its orthographic input. The dual-route
model (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) posits that there are two pathways to
access the word meaning. One access to the meaning is directly reached from the orthographic
input, and the other is indirectly via phonology. These two pathways are separate mechanism
and parallel to each other. The first process is responsible for the processing of irregular words
while the second process responsible for the processing of regular words. The third theory of
word recognition is the connectionist model (Harm & Seidenberg, 2004; Seidenberg &
McClelland, 1989), which posits that there is a division of labor between the phonologically
mediated and direct routes. This model emphasizes the dependence between the visual and
phonological processes and the way they jointly and co-operatively achieve an efficient solution
in the course of learning to master the task.
Although the dual-route and connectionist theories differ from each other with regard to the relationship between the visual and phonological processes, they both hold that word meaning could be accessed by two pathways. A substantial number of studies have demonstrated that the phonemic awareness, the awareness that sounds are composed of phonemes, is a pre-requisite to reading (Bradley & Bryant, 1983; Stanovich, Cunningham, & Cramer, 1984; Ziegler & Goswami, 2005). Both cross-sectional and longitudinal studies showed the close relationship between phonemic awareness and reading (Bradley & Bryant, 1978, 1983; Seymour, 2006; Vellutino & Scanlon, 1987). Other studies have suggested that instruction can bring gains in phonological awareness and, in turn, reading (Bradley & Bryant, 1983; Rayner et. al., 2001). These findings call for the primary importance of sound manipulation skills in reading, and instruction practices on improving these skills have been included in schools (Rayner et al, 2001).

At the same time, some researchers argued that orthography is equally important in reading. Orthographies, the visual representation of language as conditioned by phonological, syntactic, morphological, and semantic features of a language (Joshi & Aaron, 2006), vary as to the degree of correspondence between graphic form and phonology (Katz & Frost, 1992). Orthographies having reliable and consistent one-to-one grapheme-phonology or spelling-pronunciation relationship are called “shallow” or “transparent orthographies” while those having unreliable and inconsistent grapheme-phonology relationship are called “deep” or “opaque languages” (Katz & Frost, 1992; Seymour, 2006). The depth of orthographies is believed to affect the rate of reading acquisition and the strategy that readers apply in their reading (Goswami, 2006; Landerl, 2006). The Orthographic Depth Hypothesis (Katz & Frost, 1992) states that it is easier for the learners to acquire the decoding skills in languages that have transparent or shallow orthography than to acquire the decoding skills in languages that have opaque or deep orthography. It also predicts that children are faster and more accurate in reading transparent orthographies. This hypothesis is confirmed by several cross-language studies that looked at reading acquisition of orthographies which vary in terms of orthographic depth (Caravolas, 2006; Goswami, 2006; Seymour, Aro, & Erskine, 2003). For example, Ellis and his colleagues (2004) reported several experimental findings showing that the learning of orthographically shallow language like German, Spanish, or Turkish was faster than the learning of English. It was explained that the crucial factor, the phonemic awareness may develop more
slowly in English, which has an inconsistent relationship between graphemes and phonemes (Goswami, 2006). The Orthographic Depth Hypothesis also posits that the depth of the orthographies will affect the strategy that language users apply in reading and spelling (Katz & Frost, 1992). After the learners are gradually exposed to the orthography, they will develop certain strategies that could work efficiently in the reading process (Hung & Tzeng, 1981; Wang, Koda, & Perfetti, 2003). It is argued that the deeper the orthography is, the more likely that the user will need to apply the visual route strategy (Aro, 2006).

Reading strategy differences exist among languages of different writing systems as well as languages sharing the same writing system (Aro, 2006). It has been reported that processing strategies used for logographic and phonolographic (alphabetic and syllabary) writing systems are qualitatively different (Saito, Inoue & Nomura, 1979; Tzeng & Wang, 1985). Mann (1985) found that the recall of Japanese kanji (based on Chinese) is correlated with both non-linguistic memory (visual nonsense design) and linguistic memory (spoken nonsense words), while the recall of alphabetic and syllabic words correlates only with linguistic memory.

In addition to phonological awareness and orthographic skills, the third factor that is believed to be vital to word recognition is morphology, a subword unit that provides semantic information (Carlisle, 2003; Verhoeven & Carlisle, 2006). Though most of the previous research work focuses on the importance of phonology and orthography in reading, more interests have been attracted to morphological processing in reading recently (Kuo & Anderson, 2008). Carlisle and Stone (2005), for example, investigated the effect of morphemic structure on students’ word reading. They found that elementary students read words with two morphemes (derived words with a base word and one suffix) faster than words with one morpheme. Their study also showed that the derived words of phonological transparency were recognized and read faster than derived words of less phonological transparency. These findings indicated that morphemes play a role in word reading. Various studies have established a connection between morphological awareness and reading achievement (e.g. Mahony, 1994; Carlisle, 2000). Deacon and Kirby’s (2004) experiment showed that morphological awareness contributed to reading development beyond verbal and nonverbal intelligence and phonological awareness.
Background on Research of Second Language Reading at Word Level

Most existing theories and findings are primarily concerned with first language (L1) reading acquisition, and they provide theoretical underpinnings and starting points for reading research in a language other than L1. With globalization and technology, the ability to read and write in a second language (L2) has become one of the most important skills for students, scientists, businessmen and computer users. Because of social-political, pedagogical and cognitive interests, L2 reading research has grown rapidly during the last two decades.

Despite many differences between L2 and L1 reading (e.g., learners’ oral language proficiency, learners’ prior language experience, cognitive maturation), researchers believe L2 reading is also based on the learners’ knowledge about how a language’s writing system encodes the spoken language (Perfetti & Liu, 2005; Perfetti, Liu, & Tan, 2005). L2 reading is a process that builds on the learners’ knowledge about the orthography, phonology, semantics, and the link among the three (Shu & Anderson, 1999).

Details for the linkage or mapping, however, are different across writing systems and written languages. For a writing system (e.g., logographic, alphabetic, syllabic writing systems), the basic orthographic units could be mapped onto morphemes, phonemes, or syllables (Perfetti, 2003). For a written language (e.g., English, French, Chinese), the mapping between orthography and phonology could be one-to-one or many-to-one (Seymour, 2006). These differences in mapping details call for differential requirements on learners to read in that language and result in variations in reading development across languages (Koda, 2008).

As written languages represent spoken languages at different levels (Hung & Tzeng, 1980) and phonological awareness is vital to reading development across languages (Perfetti, 2003), L2 learners need to be aware of phonological units that may not be represented in their L1. For example, Chinese learners of English need to become aware of phonemes, which are not represented or mapped in the Chinese orthography. Differences in correspondence between graphemes and phonological units may be one factor that leads to variations in phonological awareness (PA) development, which could eventually influence the reading acquisition (Goswami, 2006).

The reliable one-to-one correspondence between graphemes and phonological units could facilitate the awareness development of phonological units while the unreliable relationship could cause delay in phonological awareness development (Goswami, 2006). For some written
languages like Italian, Serbo-Croatian, the association between graphemes and phonemes is one-to-one, thus reliable, but for English or French, the association could be one-to-many or many-to-one, thus less reliable. For Chinese, this correspondence is even more unreliable (Cook & Bassetti, 2005). In fact, comparative studies have shown that the performances of English-as-a-L2 (ESL) learners with different orthography background exhibit variations in phonological tasks (Koda, 2008). For example, the phonological task performance of ESL learners whose L1 is an alphabetic language is better than that of ESL learners whose L1 is a non-alphabetic language (Kuo & Anderson, 2008).

Holm and Dodd (1995), for example, compared 40 university ESL learners on a series of tasks that assessed phonological awareness and reading and spelling skills in English. These 40 ESL learners were enrolled international students at an Australian university. They came from mainland China, Hong Kong, and Vietnam. It was found that Hong Kong students had limited phonological awareness compared to students from Vietnam, which has an alphabetic language system. However, the phonological awareness between mainland Chinese students did not differ significantly from those Vietnamese students. It was explained by the fact that mainland Chinese ESL learners learned to read Chinese using Pinyin, an alphabetic system, to help them read the new characters. This study has given evidence that language distance has an effect on PA development in L2 (Koda, 2008).

Another factor related to the “mapping” issue is the orthography of the L2. Studies have shown that children learning to read are faced with a ‘mapping problem’, and learning how sounds are represented by graphic symbols is critical in the reading development because it allows access to the words that are already in the child’s phonological lexicon (Goswami, 2006). Yet the ease or speed of relating sounds to print is different across different writing systems and orthographies. For alphabetic writing systems, the orthography is based on sound and there is a systematic association between the written form and the sound (Ho & Bryant, 1997). However, this systematic association is not present in Chinese, which is traditionally labeled logographic writing system. Though the term ‘morphosyllabic’ has been considered more accurate to describe the writing system, there is no systematic relationship between the graphic forms and sounds (Ho & Bryant, 1997).

In addition to acknowledging that mapping differences could influence literacy acquisition across languages, second language reading research has shown that some of the L1
reading processing skills are transferrable to the L2 reading (Koda, 2007, 2008). According to some L2 reading studies, there is a close relationship between phonological awareness in the L1 and phonological awareness in the L2, and the phonological awareness in L1 is significantly related to reading in the L2 (Kuo & Anderson, 2008). Durgunoglu, Nagy and Hancin (1993), for example, investigated the relationship between L1 phonological awareness and word recognition skills in a group of Spanish-dominant bilingual first graders who learned English as L2. They found that their Spanish phonological awareness was a powerful predictor of subsequent word recognition skills in both languages. This cross-linguistic relationship between phonological skills and word-reading ability was also showed by Wade-Wooley and Geva (2000), who studied second grade children learning to read English and Hebrew.

Based on empirical findings, Koda (2008) proposed the Transfer Facilitation Model which stated that the metalinguistic awareness (e.g., phonological awareness, morphological awareness) gained in L1 will facilitate L2 reading. This model predicts that learners are more accurate and rapid in learning a L2 which has a similar metalinguistic sophistication with their L1 than those who has a L1 that has different metalinguistic sophistication. This prediction has been proved by various studies (e.g., Cisero, Carlo, & Royer, 1992; Durgunoglu et al., 1993). Holm and Dodd’s (1995) findings about the significant differences in phonological awareness and nonword reading between ESL learners from Viet Nam and Hong Kong confirmed the prediction.

**Background on Research of Reading in Chinese**

Limited numbers of studies investigated reading in non-alphabetic languages and they have drawn on theories and models developed from English reading research. For example, research in reading in Chinese draws on the theory of Universal Grammar of Reading, which asserts that learning to read a language is fundamentally learning how a language’s writing system encodes the spoken language (Perfetti, 2003) and learning to read requires becoming aware of the basic units of spoken language, the basic units of the writing system, and the mapping between the two (Shu & Anderson, 1999). These studies of reading in Chinese has based on the underpinning that learning to read in Chinese shares many similarities with reading acquisition of other languages (Koda, 2008). They examined the acquisition of orthography, phonology and morphology and the importance of these three factors in reading acquisition in
Chinese. Studies have shown that the acquisition of each of the three sub-skills may cause challenges to the learners and deficits in any aspect could lead to reading difficulties (Kuo & Anderson, 2008). Based on empirical findings, Ho, Chan, Tsang and Lee (2002) proposed a multiple-deficit hypothesis, which states that causes to Chinese dyslexic children could be one or many deficits in rapid naming, phonological, orthographic, and visual processing.

Research on reading in Chinese also benefits from the cross-language reading theory. Informed by the Orthographic Depth Hypothesis (Katz & Frost, 1992), some researchers examined the orthographic features of Chinese and tried to find out what might be the causes to reading difficulties (e.g., Shu & Anderson, 1997; Jackson, Lu & Ju, 1997). Shu and Anderson (1997) pointed out that Chinese orthography does not have the systematic correspondence between the graphic forms and phonological forms and the relationship between the graphic forms and spoken language is largely irregular and unsystematic. This deep orthography of Chinese may ask for a different process in reading and may entail a different development pace of reading acquisition (Wang & Yang, 2008). Also, the sheer number of basic graphic forms (characters) in Chinese far outnumbers the number of basic graphic forms in any alphabetic language. Learning to read and write in Chinese has been a daunting task that hinders these learners in their study.

Inspired by word recognition research in alphabetic languages, research about reading in Chinese explored the processing of phonological, orthographic and morphological information in Chinese character recognition (e.g., Ding et al., 2004; Perfetti et al., 1995; Perfetti et al., 2007). Character acquisition stages

Chinese adopts a quite distinct writing system, and the model of character acquisition development in Chinese differs from that of alphabetic languages in many ways (Cheung, McBride-Chang, & Chow, 2006; Shu, 2003). Ho, Yau and Au (2003) created a six-stage model of Chinese character learning development. The first stage is that the learners acquire the character configuration – i.e., they recognize Chinese characters are square patterns of strokes with proper spatial arrangement and orientation. In this stage, the learners are able to distinguish characters from other visual symbols. In the second stage, learners progress from treating compound characters as unanalyzed wholes to knowing to break down a character into different stroke patterns. This structural-segmentation knowledge at the character level helps a reader to reduce the number of processing units from more than ten thousands to a more manageable
number of around one thousand radicals. In the third stage, children begin to attend to the meaning of semantic radicals and the sound of phonetic radicals. Also in this stage, children acquire explicit positional knowledge. They are able to point out the exact positions of semantic and phonetic radicals within the characters. Next stage is when children acquire the functional knowledge. They begin to apply the sound of the phonetic radical to get the pronunciation of pseudocharacters, and apply the meaning of semantic radicals to guess the meaning of novel characters and pseudocharacters. Then comes the amalgamation stage, where children gradually develop a thorough understanding of the positional regularity and functions of radicals and gradually acquire the skill to apply both positional and functional knowledge in spelling pseudocharacters. The last stage is when learners acquire complete understanding of radical awareness and could apply this knowledge in both reading and spelling.

This model of character learning development had been tested by some studies. For example, Ho and colleagues (2003) reported the finding of an earlier study of Chan and Louie-kindergarteners were able to distinguish clearly characters from drawing as early as age 3. Wang and Gao’s (2005) study showed that after five weeks of study, the CFL learners began to tell the differences between the characters and pictures. Though Shu and Anderson (1997) suggested that first graders first treat the compound characters as unanalyzed wholes, Ho and colleague (2003) demonstrated that first-graders made use of two constituents to form compound characters. This showed the implicit knowledge about the character structure. Chan and Wang (2003) reported that over 70% of the eight- and nine-year-olds used the phonetic radicals to generate pronunciations via analogy or derivation to read novel words.

Ke (1998) proposed a three-stage model of character learning by CFL learners. The first stage is called pre-component processing stage, where all the characters are learned as whole. The second stage is called component processing stage, where learners begin to realize that each character is composed of several components and they could distinguish the radicals and their functions within each compound character. The third stage is called the automatic component processing stage, where the learners possess an awareness of orthographic rules that Chinese-as-L1 learners have.

This theory is supported by later experiments (e.g., Jackson et al., 2003; Jiang, 2003), yet researchers disagreed on the timeline for each stage. Jackson, Everson and Ke (2003) argued that by the end of the first year of study, the CFL learners were able to decompose characters
into subcharacter components. Lu (2002) concluded that it would take 2 years for the learners to get into the second stage of character learning. Jiang (2003), however, concluded that after six months of study, the learners possessed the basic understanding of orthographic constraints of Chinese characters.

**Chinese character recognition processes**

Influenced by word recognition theories established from reading in English and some European languages, theories about Chinese character recognition also looked at the relationship between the orthography, phonology and semantics. A typical view is that the link between orthography and semantics is more fundamental in character recognition as Chinese characters are originated from pictures and it is the only writing system that has never ceased to function during its long history (Hung & Tzeng, 1980). Reading in Chinese has been considered a good example to support the direct access theory.

Yet this view has been recently challenged by Perfetti and his colleagues. They believed that phonology plays an equally important role in Chinese character recognition as it does in alphabetic languages. They did a series of laboratory experiments showing that phonological processing is automatic in not just character naming but also in a stroop test, where sounding out the character is not forced (Perfetti & Tan, 1998; Spinks, Liu, Perfetti, & Tan, 2000). Based on these findings, they established the threshold theory (Liu, Wang, & Perfetti, 2007), which states that the processing of orthography is activated first and once the threshold of the activation is reached, its phonological information is automatically activated, and when whose threshold is met, the meaning of the character is accessed. In this theory, the importance of phonological processing is emphasized and it is not a supplementary access but an indispensable access to the semantics of the character. And the threshold-processing model also could explain their finding of the facilitation effect of orthographically similar prime when short SOA (stimulus onset asynchrony) were given while semantic related prime facilitated the processing of target characters.

Using an eye-monitoring technique, Wong and Chen (1999) investigated the processing of orthographic and phonological information in Chinese text reading. A character in a short passage was changed so that various combinations of orthographic and phonological information were altered. The disruption times were compared in order to reveal the use of orthographic and phonological information from individual characters during reading for comprehension. Results
showed orthographic manipulations created a reliable and early interruption in time while phonological manipulations created later interruption. This experiment demonstrated that it is the orthography rather than phonology that plays an early and dominant role in character processing in Chinese.

A relevant topic to the present study is the role of radical awareness in reading acquisition. Radicals are subcharacter components. They encode the semantic and phonological information of characters (Ho & Bryant, 1997; Shu & Anderson, 1997). Studies have demonstrated that radical awareness, the knowledge that radicals have positional regularity and functional regularity, is closely related to reading and writing (Ho et al., 2003; Packard et al., 2006). Ho and colleagues (2003) showed that radical awareness developed gradually among elementary school students and that radical awareness is significantly related to word reading and sentence comprehension. Packard and colleagues (2006) demonstrated that instruction on radical awareness could enhance children’s performance in writing.

Despite the increasing interest in learning Chinese, studies on learning to read in Chinese as a L2 or foreign language (FL) are far from sufficient to inform how these L2 readers learn to read in Chinese and what could be possible reasons for potential difficulties these L2 or FL learners in their Chinese learning (Shen & Ke, 2007). Radical awareness is a less explored area in Chinese-as-a-foreign-language (CFL) learning. Shen and Ke’s (2007) study, however, demonstrated that radical awareness increased among CFL learners as they progressed in Chinese study. This study also reported a medium-size, positive relation between word reading and radical awareness among the first-year and second-year learners. The relation between radical awareness and word reading among third-year and fourth-year learners, however, was not reported.

Guided by the hypothesis that reading different writing systems of various orthographic depths may entail different processes (Gibson, 1975; Katz & Frost, 1992; Hung & Tzeng, 1981), the present study intended to explore the learning of the unique orthographic unit, radicals, by CFL adult learners and to address the question about the radical awareness levels among CFL learners and its involvement and importance in reading Chinese as a L2/FL.

Next, a brief introduction to the Chinese writing system, its orthography, phonology and morphology follows.
Chinese Language and Writing System

*Chinese writing system and orthography*

Although writing system and orthography are interchangeably used in reading research, they are differentiated by some researchers. For example, in the book *Handbook of Orthography and Literacy* (Joshi & Aaron, 2006), a writing system is referred to as the written language described in terms of linguistic units. According to this definition, written languages are categorized into four groups: morphemic writing, syllabic writing, alphabetic-syllabic writing and alphabetic writing systems. This definition and way of differentiating writing system is similar to the first definition given by Coulmas (2003), which stated that a writing system is “a set of visible or tactile signs used to represent units of language in a systematic way” (Coulmas, 2003, p. 35). At the same time, writing system is also referred to as the set of rules employed in a particular language for spelling, punctuation etc. (Cook & Bassetti, 2005). Thus, a writing system is language specific. Researchers rarely agree on the definition of a writing system, and they shift between the more generalized and specific meaning of writing system. For the purpose of the present study, the writing system is defined as the ways in which written symbols connect to the language. Thus writing systems could be roughly categorized as alphabetic or syllabic, depending on whether the graphemes (the basic unit of the written symbols) connect to phonemes or syllabics.

Orthography, on the other hand, is referred to as “the visual representation of language as conditioned by phonological, syntactic, morphological, and semantic features of the language” (Joshi & Aaron, 2006, p.xiii) and as “the set of rules for using the graphic forms of a writing system in a particular language” (Cook & Bassetti, 2005, p. 3). Research has demonstrated that young children are aware that writing follows conventions that differ from drawing (Levin & Bus, 2003), and knowledge of these orthographic constraints and regularities benefit reading (Kirby, Desrochers, Roth, & Lai, 2008). Levy and her colleagues (2006), for example, have shown that the children’s knowledge about these orthographic regularities is a significant predictor of their reading skills even after the phonological awareness is partialled out.

Chinese has developed a writing system that is quite different from that of the other languages. As the linguistic units represented by its basic graphic forms are syllables that are also morphemes, it is a morphosyllabic writing system. A traditional term for the Chinese writing system is logographic, which emphasizes the unique feature that the basic graphic forms
have meanings. This feature is considered to be inaccurate as it seems to lead to a false assumption that the written language is not based on pronunciation but meaning (Perfetti, 2003). The basic graphic form, or script of Chinese orthography, is called Hanzi, or Chinese characters. Each Hanzi is phonetically represented by a syllable and has a meaning. This is quite different from most of the modern languages, most of which adopt the alphabetic writing system. The basic graphic form in an alphabetic writing system is a letter, which is realized by a phoneme in oral language. A letter usually does not have a meaning and it is only through the combination of letters do they have the meanings. Therefore, Hanzi is considered to be a meaning-based writing system while the alphabetic writing system is a sound-based system.

Each Chinese character is composed of basic strokes, the smallest building material for characters. There are 24 basic strokes (Wang & Yang, 2008), and sets of specified strokes are combined to form radicals, the basic components of Chinese characters. The combination of strokes must follow certain stroke-positional constraints, and random combinations of strokes that do not abide by these constraints will produce illegal radicals.

Chinese characters can be classified into two categories based on their structural complexity: single-component characters and multiple-component characters (Shu, 2003). The simple-component characters are often called simple characters while the multiple-components characters are often called compound characters. Simple characters are those that cannot be further broken down into separate radicals. In other words, they comprise one radical; for example, 父 is a simple character with the pronunciation /ma/3 (the number associated with the sound indicates the tone). When it is combined with a radical, like 女, we have a compound character 思, with the pronunciation of /ma/1, meaning ‘mother’. Among the 3,000 commonly used Chinese characters (Ho, Ng, & Ng, 2003), more than 80% of Chinese characters are compound characters (Zhu, 1988, cited in Wang & Yang, 2008).

The radicals in compound characters can be classified into two categories based on their functions in the formation of compound characters. One group is called semantic radicals as they always provide semantic categories of the whole characters, the other group is called phonetic radicals as they give clues to the pronunciation of the characters. According to Hossain (1991), there are about 200 semantic radicals and 800 phonetic radicals in Chinese. While most of the phonetic radicals could also be independent characters, most of the semantic radicals can
only be combined with phonetic radicals to form characters. An example is given in Figure 1 to denote the formation of a character.

![Diagram of character formation](image1)

Figure 1: Formation of a character

**Chinese phonology**

There are many different dialects spoken in China. These dialects differ from each other drastically so that people would probably not understand each other if they use their own dialects to communicate (Cheung & Ng, 2003). Yet there is a spoken language that is shared by all people, Mandarin, the official language of the nation. Mandarin is the also called ‘common language’ in China. And in this study, Chinese refers to Mandarin hereafter.

The phonological structure of spoken Chinese is relatively simple. The basic speech unit of Chinese is the syllable. A Chinese syllable is of one of four structures: V (vowel), CV (consonant-vowel), VC (vowel-consonant), and CVC (consonant-vowel-consonant). Each syllable is divided into two parts: the onset and the rime (Taylor, 2002). The onset of a Chinese syllable is always a single consonant, and there is no consonant cluster in Chinese. For most syllables, the rimes consist of vowels only. Only two consonants, /n/ and /ng/ appear at the end of a rime in Chinese. Given this relatively simple syllable structure, Chinese has a much smaller number of unique syllables than spoken English, leading to a large number of homophones in spoken Chinese. This large number of homophones is reduced somewhat by the use of tones in the language, since a change in the tone of a syllable indicates a change in meaning. For example, the syllable /ma/ could have first, second, third and fourth tone, meaning ‘mother’, ‘numb’, ‘horse’ and ‘to scold,’ respectively. Even though the tones reduce the number of
homophones in Chinese, because of the simple structure, homophones are still common existence in Chinese.

*Chinese morphology*

Written Chinese has two levels of morphological structure (Shu & Anderson, 1997). One is at the radical level and the other is at the word level. At the first level, within an individual character, there are semantic radicals, which provide information on the meaning of the whole character. Yet semantic radicals may not provide reliable meaning information. Those that do provide reliable meaning information, are called transparent semantic radicals, while those do not are called opaque semantic radicals (Shu & Anderson, 1997).

The second level of morphological structure is at the word level. For words that consist of two characters, each character represents an independent meaning. For example, the two-character word, 牛肉 ‘beef’ is the result of the two separate meanings contributed by the character 牛 ‘cattle’ and 肉 ‘meat’. Words that share a character share similar meanings, as in for example, 牛奶 ‘cattle milk’, 牛油 ‘cattle oil’ and 牛肉 ‘cattle meat’.

*Nature of the Problem*

Much attention has been paid to phonological processing in Chinese character recognition in L1 reading acquisition (Cheung, McBride-Chang, & Chow, 2006). While some believed phonological awareness is vital in reading development of any L1 (e.g., Huang & Hanley, 1995), others argued for the greater importance of orthographic skills in Chinese reading development (e.g., Zhou, Shu, Bi, & Shi, 1999).

Research examining the orthographic processing in character recognition has shown that radical is an important processing unit for adult skilled readers in character recognition (Chen et al., 1996; Feldman & Siok, 1999; Taft & Zhu, 1997) and word recognition (Zhou & Marslen-Wilson, 2000). Some researchers have argued that the position and function of radicals are main factors that determine how characters are processed in both skilled reading (e.g., Feldman & Siok, 1999) and emergent reading (e.g., Ho et al., 2003). Some argued that knowledge about the positional and functional rules develop gradually among children (Ho & Bryant, 1999; Ho et al., 2003; Shu, 2003) and this awareness is closely related to reading (Ho et al., 2003; Shu & Anderson, 1997, 1999).
Although the importance of this knowledge about the positional and functional rules/regularity has been widely acknowledged in L1 reading acquisition, researchers disagreed on the terms to define it. “Morphological awareness” and “graph-morphological awareness” have been used to define the knowledge about semantic function of semantic radicals (Koda, 2008; Li et al., 2002; Wang & Yang, 2008). “Orthographic knowledge” (Wang & Yang, 2008) has been used to define the knowledge about positional rules of radicals. Some researchers put it under the umbrella term of “metalinguistic awareness” (e.g., Kuo & Anderson, 2008). Shu and Anderson (1997) were among the first to use “radical awareness” to refer to this knowledge. Ho and colleagues (Ho et al., 2003) used the term “radical knowledge”, and they differentiated it into implicit and explicit radical knowledge.

Research on reading in Chinese as a L2/FL is scant. Among those focusing on reading on character or word level (Chinese words are made of one, two or more characters), a few investigated the processing order of phonology, orthography and semantics in character/word recognition (e.g., Liu, Wang, & Perfetti, 2007), and a few examined awareness of orthographic structure among beginning CFL learners (e.g., Jackson et al., 2003; Wang et al, 2003). Although learners’ acquisition of the knowledge about the positional and functional regularities has been well studied in L1 literacy acquisition, its development and importance in L2 reading is still not clear.

**Research Questions**

Due to the problems stated above, three research questions were proposed for the present study.

Question 1. Do advanced CFL learners have higher levels of radical awareness than beginning CFL learners?

Question 2. Is radical awareness significantly related to word recognition for CFL learners? Does the relationship between word recognition and radical awareness differ between advanced and beginning CFL learners?

Question 3. What are shared and unique relations of radical awareness with word recognition in Chinese?

For Question 1, I hypothesized that advanced CFL learners would have higher levels of radical awareness than beginning CFL learners due to the findings from L1 reading acquisition.
that students in higher grades have higher levels of radical awareness than those in lower grades (Chan & Nunes, 1998). I also hypothesized that radical awareness is significantly related to word recognition for CFL learners because previous studies in L1 literacy acquisition had shown that radical awareness is significantly related to word recognition (Ho, Ng., & Ng, 2003; Li et al., 2002).

Significance of the Study

The present study has both theoretical and pedagogical significance. Most existing studies focused on exploring radical awareness among Chinese-as-L1 learners (Shen & Ke, 2007). Few studies have been done from L2/FL perspective. Thus, questions remain about what role radical awareness plays in reading Chinese-as-a-foreign-language, and whether the development of radical awareness among CFL learners follows the same pattern as that of L1 learners.

The present study is unique in several aspects. First, the present study extended the previous studies by exploring the effect of language proficiency on radical awareness among CFL learners. For the few that explored the radical awareness among CFL learners, exposure time was the only factor that has been considered. Second, I systematically examined explicit and implicit radical awareness for two types of radical awareness (i.e., positional and semantic) to explore the nature of the relation between radical awareness and word recognition comprehensively. Third, I investigated the shared and unique relations of various radical awareness tasks to word recognition in Chinese.

The present study also has pedagogical implications. It has the potential to inform the Chinese textbook writers and classroom teachers to have a better understanding as to how to teach characters in a more efficient way. For example, the results may inform teachers about the importance of explicitly teaching radicals, and approximately when to introduce the concept of radicals in language study.

Definition of Terms

Many terms are adopted for the study. For the purposes of this study, the following definition of terms will be used:
**Character:** The smallest Chinese orthographic unit that has meaning and pronunciation (Shu & Anderson, 1997).

**Graphemes:** The smallest units in a writing system, it is also called written symbol (Cook & Bassetti, 2005).

**Morphemes:** The smallest phonological units that carry semantic information (Kuo & Anderson, 2008).

**Morphological awareness:** The ability to reflect on and manipulate morphemes and to control word formation processes (Kuo & Anderson, 2008).

**Orthographic awareness:** The knowledge of specific conventions and rules concerning the visual and orthographic aspects of print, and the use of this knowledge in reading and literacy acquisition (Kirby et al, 2008).

**Orthographic depth:** The regularity of grapheme-phoneme pattern. It is a continuum from the transparent to opaque correspondence between graphemes and phonemes. For transparent orthographies, the relationship is stable and consistent, while for opaque orthographies, the relationship is variable and inconsistent (Joshi & Aaron, 2006).

**Orthography:** Visual representation of language as conditioned by phonological, syntactic, morphological, and semantic features of the language. Examples of orthographies are Chinese orthography and English orthography (Joshi & Aaron, 2006).

**Phonological awareness:** The ability to reflect upon and manipulate phonological units (such as phonemes, onsets, rhymes, syllables) in a language and may entail sensitivity to the phonological structure of the language (Kuo & Anderson, 2008).

**Radical:** The basic components of Chinese characters, built on sets of specified strokes (the smallest building materials for characters) (Wang & Yang, 2005).

**Radical Awareness:** the knowledge about the positional constraints and functions of radicals in forming Chinese characters and the ability to use this knowledge consciously in learning characters (Shen & Ke, 2007).

**Implicit radical awareness:** for the purpose of the study, it refers to the knowledge that enables the learners to determine whether a pseudo-character look like a real character and the knowledge to infer the meaning of unfamiliar characters with the help of semantic radicals.
*Explicit radical awareness:* for the purpose of the study, it refers to the knowledge that semantic and phonetic radicals have positional and functional regularities and the knowledge that enables students to create pseudo-characters and helps to memorize characters.

*Word recognition:* the process of retrieving information about a word’s spoken form and meaning from its printed form (Snowling & Hulme, 2005).

*Writing system:* Written language described in terms of linguistic units; for example, morphosyllabic language writing (Chinese), syllabic writing (Japanese Kana), alphabetic-syllabic system (Kannada and Tamil), and alphabetic writing (Italian and Spanish) (Joshi & Aaron, 2006).

**Summary**

Previous studies have demonstrated that three cognitive skills are required in reading. Phonological, orthographic and morphological awareness are the three skills that play important roles in reading acquisition. Yet their relative importance could be different across different languages (Kirby et al, 2008). Chinese is different from majority of world languages in that character, its basic written unit is meaning-based as well as sound-based. In addition, its prominent visual complexity asks for greater effort from the learners to process the orthographic information (Liu, Wang, & Perfetti, 2007). In reading, characters were not processed as a whole but were decomposed into subcharacter components (Feldman & Siok, 1999; Taft & Zhu, 1997). This gives much importance to the radical awareness. However, not much research has been done from the second language or foreign language perspective (Shen & Ke, 2007), so it would be important to explore the significance of radical awareness in word recognition for Chinese language learners whose L1 is English.
CHAPTER TWO
LITERATURE REVIEW

Defining Radicals

In existing literature, “radicals” has different definitions. For example, radicals have been defined as stroke patterns that recur in compound characters and that convey the semantic category of the characters (e.g., Ho & Bryant, 1997; Shu & Anderson, 1997), and elsewhere, radicals have been defined as recurring structural patterns that convey both semantic and phonetic information (e.g., Ho, Ng, & Ng, 2003; Jackson, Everson & Ke, 2003). For the purpose of the present study, the second definition is adopted, and radicals are defined as being “the smallest, meaningful orthographic units that play semantic or phonetic roles in compound characters” (Shen & Ke, 2007, p. 99).

Radicals as Functional Orthographic Units

The basic written units in Chinese are characters (Shu & Anderson, 1997). There are about 3,000 and 4,600 frequently used characters in China and Taiwan, respectively, and these characters make up about 40,000 Chinese words in daily use (Foreign Language Press Beijing, 1989). Research on how Chinese users memorize and process all these characters and words has demonstrated that Chinese users break characters down into radicals, which are represented in memory as sublexical units and that radicals interact with one another in character recognition and character learning (Ding, Peng, & Taft, 2004; Taft & Zhu, 1997).

Radicals are the unique orthographic units of Chinese. Skilled readers use radicals as functional orthographic units in character recognition. Using the priming technique, Feldman and Siok (1999) examined the processing of characters by a group of 64 undergraduates. The reaction latencies of target characters, which are proceeded by four types of primes, were compared. These primes included four types of characters: (1) characters that shared semantic radicals and were semantically related to the target, (2) characters that shared semantic radicals but were not semantically related, (3) characters that did not share semantic radicals but were semantically related, and (4) characters that did not share semantic radical nor were semantically related to the target character. This experiment found an inhibitory effect of prime characters that shared semantic radicals but were not semantically related. Additionally, this study showed
that higher combinability of semantic radicals led to a facilitation of target characters, demonstrating that semantic radicals are functional orthographic units in character recognition.

Using the same paradigm as Feldman and Siok, and also with native undergraduates as the participants, Ding, Peng and Taft (2004) found a significant facilitation effect when the compound characters were preceded by primes that were used as radicals in the compound character. But this effect was only observed for low-frequency targets, not high-frequency targets. They also found a facilitation effect when the prime and the target shared a radical in the same position but not when in the different position. In addition, an inhibitory effect was found when the prime and target shared a radical in different positions. In these experiments, the radicals included both semantic and phonetic radicals.

Taft and Zhu (1999) manipulated the frequencies of the left and right radicals of characters, which could be of high-high, low-high, high-low, and low-low frequency combination. The frequencies of the characters were controlled and comparable. A group of noncharacters were also created and used in the experiment, which included real-real, real-nonsense, nonsense-real, and nonsense-nonsense radical combination. It was hypothesized that if radicals were indeed activated in character recognition, the frequencies of the left and right radicals would affect the reaction time and accuracy of the whole character or noncharacter. The results obtained for the noncharacters were exactly as expected. The reaction time and accuracy for the nonsense-nonsense radical combination was the fastest and the most accurate compared with other radical combinations. The reaction time and accuracy rate for real-real combination noncharacter are the slowest and least accurate. The results for the real characters, however, told a very different story. The frequency of just the right radical had an impact on the character decision responses. Therefore, this study showed that the impact of radical frequency was sensitive to radical position. Taft and Zhu’s explanation for this finding was the processing of the left-hand radical commenced before the processing of the right-hand radical such that frequency manipulations of the left-hand radical were obscured.

In addition to giving evidence that radicals are important processing orthographic units for skilled readers, existing studies have shown that radicals play an important role in reading for children and developing readers as well. Several studies examined children’s performances in character writing. Luan, Shu and Zhang (2001), for example, investigated children’s performance in a dictation task. Sixth-graders were asked to write 2,520 words consisting of two
characters, which appeared in language textbooks from first grade to sixth grade. It was found that most of the written errors were “error characters”. These errors were either homophone characters (characters with the same pronunciation as the correct character), or characters with the correct phonetic radical but different semantic radicals to replace the correct character. A small percentage of errors were noncharacter errors -- 77% of which contained correct radicals. These findings suggested that sixth-grade children decomposed characters into radicals and that radicals were important in character writing. In another study (Pak et al., 2005), 179 primary school students from first, second and fourth grades were administered a character copying task. The characters were divided into five types according to three features: whole character familiarity, radical familiarity, and character structure (single-component character or compound character). Errors in their copying were grouped into random-stroke errors, incorrect-radical errors, and radical-replaced errors. Analyses showed that there was no significant difference in errors made by first graders, but for second and fourth graders, radical-replaced errors (errors that are caused by replacing one radical of the character with another radical) were the most common error pattern.

Aspects of Radical Awareness

As mentioned earlier, radicals are subcharacter components that can be combined together to form compound characters. Different combinations of radicals give rise to various characters. Depending on the function they serve in forming compound characters, radicals are classified as either semantic radicals or phonetic radicals. Semantic radicals serve the function of telling the semantic category of the compound characters, while phonetic radicals give clue to the pronunciations of the compound characters. According to Hossain (1991), there are about 200 semantic radicals and 800 phonetic radicals. And according to Shu and Anderson (1999), there are about 190 semantic radicals and 1,100 phonetic radicals. Characters made up of semantic and phonetic radicals are called standard compound characters (Shu & Anderson, 1999) or compound characters. And they possess more than 80% of modern Chinese characters (Shu & Anderson, 1999; Zhu, 1985).

Radicals are the unique orthographic units of Chinese. They have two major features. The first feature of radicals is that they usually have habitual positions within characters. The second feature is that they function to encode semantic information or phonetic information of
characters. These two special features give rise to two aspects of radical awareness. Accordingly, one aspect of radical awareness is the awareness of radical positional regularity, and the other aspect is the awareness of the functional regularity of radicals.

Awareness of radical positional regularity

The combinations of radicals follow either horizontal or vertical sequence. Instead of appearing randomly within a compound character, radicals have habitual positions. Some radicals only appear on the left side of the compound character, some on the right, some at the top and some at the bottom. For example, radical 只 only appears on the left, as in characters 他, 伯, and 仪. Radical 子 only appears on the right, as in characters 教, 数, and 枚. Examples of radicals that appear at the top include 口, 々, 竹. An example of radicals that only appear at the bottom is 心. It appears at the bottom of characters 思, 想, 念 and many more. Any violation of the positional regularity will lead to an illegal or wrong character (Shu & Anderson, 1997). This is much similar to the orthographic regularity of English, as the letter pattern ck only appear at the end of the word, and learners will be able to reject the word ckiite as a wrong one as it violates the orthographic rule (Venezky, 2006).

The existence of radicals and their positional regularity constraints, outlined earlier, have important implications for the character recognition in Chinese (Chen, Allport, & Marshall, 1996). Just like addressed word superiority effects in English (Chen, Allport, & Marshall, 1996) in which letters are recognized better in word context than in isolation, and letter combination that abide by orthographic regularity have a perceptual advantage over random letter strings, the equivalent character and pseudocharacters (characters that follow the positional regularity constraints) effect has been documented in a few studies (Chan & Nunes, 1998; Shu & Anderson, 1999). Shu and Anderson (1999) examined the issue of character and pseudo-character effect among 143 students who were in the first, second, fourth and sixth grades. The students were asked to decide which of a series of items could be Chinese character. These items included pseudo-characters and ill-formed combinations of radicals and ill-formed components. Ill-formed combinations were those that violate the positional regularity constraint, while the ill-formed components were combinations of non-existing radicals. It was found that the false alarms (false acceptance of any nonexisting characters as real characters) rate was very high with pseudocharacters among students across all four grades.
Awareness of the radical positional regularity is important in that the automatic character recognition depends on a reader having knowledge of this regularity (Ho, Ng, & Ng, 2003). Previous research has demonstrated that skilled readers of Chinese are sensitive to the position of radicals within characters (Chen, Allport, & Marshall, 1996). Children have been reported to gradually acquire knowledge of the positional regularity of radicals over the elementary school years (Ho, Ng, & Ng, 2003; Shu & Anderson, 1999).

Studies that investigated the readers’ knowledge of radical position show that learners are able to acquire this regularity within a short time. Ho, Ng and Ng’s (2003) study examined the positional radical awareness among three groups of Hong Kong children, who differed in years of study at school (first, third and fifth grades). These children were given 64 familiar, rare, pseudo-characters, and noncharacters. They were then asked to determine whether these look like real characters. Several findings were reported. First, children at all three grades judged characters (both familiar and rare characters) as legal ones significantly more than pseudo-characters (unreal characters that conform to the positional regularity) and noncharacters (unreal characters that violate the positional regularity). Second, these children did not differ significantly in their judgment of familiar characters as character-like and noncharacters as not character-like. Significantly more fifth graders judged rare character and pseudo-characters as character-like than the first graders. More fifth graders also judged pseudo-characters as character-like than the third graders but the difference was only marginally significant.

Research on CFL learning showed similar trend. Wang, Perfetti and Liu (2003) explored 15 first-year CFL learners’ knowledge about the structural composition of the character. They found that these first-year CFL learners rejected noncharacter containing illegal radical forms faster and more accurately than those containing legal radicals in illegal positions, which in turn were rejected faster and more accurately than those containing legal radicals in legal positions. This suggested that CFL learners become aware of the radical positional regularity early in their study. This finding was replicated by another study with different 15 CFL learners in the same programs (Wang, Liu & Perfetti, 2004).

Awareness of radical functional regularity

The second aspect of radical awareness concerns with the knowledge that radicals have functional regularities: Semantic radicals encode and specify the meaning of characters, while phonetic radicals cue the pronunciation of characters (Ho, Ng, & Ng, 2003).
Chinese language learners’ awareness of the radical functional regularity (the functional radical awareness) was documented in both L1 and L2 reading research. Shu and Anderson (1997), for instance, investigated semantic radical awareness among a group of 220 elementary students. These children were presented 90 two-character words that were familiar from oral language, yet unseen in print. Each of the 90 words consisted of a written-out character and a blank. The unfinished characters were replaced by 90 pinyin forms. The children were asked to circle a character among four choices to replace the pinyin of each word. The correct choice contained a semantic radical consistent with the meaning of the two-character word. Shu and Anderson found that both third and fifth graders were able to use the semantic radicals to derive the meaning of unfamiliar characters whereas the first graders could not. The performances in familiar character selections, however, were equally good. Therefore, this study suggested that while the first graders treated compound characters as unanalyzable wholes, the third and fifth graders were aware of the meaning-conveying function of semantic radicals and could decompose characters into radicals and use semantic radicals to make inferences about the meanings of unfamiliar characters.

The awareness of function of phonetic radicals by Chinese children was reported by Ho and Bryant (1997). In this study, 45 first graders and 45 second graders in Hong Kong were administered a series of tests that measured IQ, Chinese word reading, compound word reading, pseudo-character reading and phonological awareness. This study revealed that children named phonologically regular Chinese characters (characters whose phonetic radicals have same pronunciations with the whole characters) more accurately than irregular characters (characters whose phonetic radicals have different pronunciations from the whole characters). It also demonstrated that most of the errors in naming were the result of using the phonetic radicals as the pronunciation of the whole characters. Significant correlations among Chinese pseudo-character reading, Chinese real character reading, and rhyme detection for the first graders were also found. Hence, these findings suggested that Chinese first and second graders do rely on phonetic radicals for sound cues in naming Chinese characters.

Using a pseudo-character reading task and pseudo-character spelling task, Ho, Yau and Au (2003) explored the functional radical awareness among 60 students in kindergarten, first and second grade in Hong Kong. It was demonstrated that children’s performance in both tasks differed significantly across the three groups of students. In addition, it was found that pseudo-
character reading was significantly related to Chinese word reading and word spelling after controlling for the effects of age and IQ.

Chan and Nunes’ (1998) study explored the awareness of functional regularities of both semantic and phonetic radicals. In this study, 60 children, aged from 4 to 9, were engaged in a creative writing task and a picture naming task. The children were provided with 12 radicals (both semantic and phonetic radicals) together with six pictures, and asked to form six characters to describe the picture and to name the picture. This creative writing task demanded for the both the positional radical awareness and functional radical awareness. Significant effects of age were found on the correct selection of semantic radicals.

Few studies examined the awareness of radical functional regularity among CFL learners. Shen and Ke (2007) were among the few that did. Their study investigated the developmental trajectory of functional semantic radical awareness. Results showed that awareness of radical functional regularity improved across years of study from 1 to 4 years. They also found that there was a positive relation between radical knowledge and word reading. Participants’ radical knowledge, in this study, was measured by their performances in telling the meaning of 40 characters, which could serve the role of semantic radicals in compound characters.

*Implicit and explicit radical awareness*

As shown in previous sections of this chapter, various tasks have been created to measure the learners’ awareness of radical positional and functional regularities. These tasks included character legality task, picture naming task, word reading task, creative writing task and many more. Although all of them were designed to measure the learners’ radical awareness, they tested two levels of radical awareness. One is the implicit radical awareness and the other is the explicit radical awareness.

For radical positional awareness, the character legality task requires the implicit knowledge, where the participants determine whether a written symbol looks like a character. These written symbols may conform to or violate the positional regularities of radicals (Shu & Anderson, 1997). The radical position judgment task, used in Ho and colleagues’ study (Ho, Ng, & Ng, 2003), on the other hand, measures the explicit knowledge of radical positional regularity, where participants indicate the locations of isolated radicals (not appear in characters) in two grids which were divided into two halves horizontally and vertically.
For radical functional awareness, character-meaning matching task requires the implicit knowledge of function of semantic radicals, where participants choose from several choices of characters the one that matches the meaning given (Li et al., 2002). As all choices differ only in semantic radicals, the attention is drawn to those semantic radicals and participants will be able to use their knowledge about the meaning of semantic radicals to get the answer. Creative writing task adopted in Chan and Nunes (1998), where participants are given both semantic and phonetic radicals to create characters to describe pictures, is to measure the explicit knowledge of radical awareness. To finish the task successfully, the participants need to know the positional and the functional regularities and use this knowledge to create new characters.

**Effect of Radical Awareness Instruction**

Ho, Wong and Chan (1999) reported the effect of training that aimed at improving the radical awareness among 40 first and third graders. A pretest measured their prior knowledge of 12 pairs of clue characters and 48 unfamiliar characters. These unfamiliar characters were classified as characters sharing phonetic radicals in the same position, characters sharing phonetic radicals in the different position, character sharing semantic radicals and control characters. Then both groups of students were taught the pronunciations and meanings of these 12 pairs of clue characters. The two characters in each of the 12 pairs shared the same phonetic radical and same pronunciation. It was designed to help students see the function of phonetic radicals. Then these students were tested on 48 unfamiliar characters with the clue characters in sight. It was shown that both groups of students performed significantly better in naming characters that shared phonetic radicals than control characters. This suggested a possible benefit of improving radical awareness in character reading. This study also examined the effect of semantic radical awareness training. After training, both groups did significantly better in semantic categorization task. The improvement of students in naming and semantic categorization suggested that the role and function of radicals could be taught explicitly in school from an early age to help improve students’ reading skills.

Packard and his colleagues (2006) examined the effects of explicit instruction in radical awareness and word morphology on character production. An experimental group of 144 first graders from two primary schools in Beijing, China were given instruction designed to increase their knowledge of the function of radicals and word morphology. Another 144 first graders
served as the control group. The differences between the two groups of people in various tasks showed the effect of instruction. These tests included 3 word morphology tests (a morpheme discrimination task and a morpheme transfer task), one radical awareness test, one phonological awareness test, an IQ test and two writing tests. The radical awareness was measured in morpheme selection task, where the experimenter read aloud a sentence that was also printed on the answer sheet, except for a blank where one character was missing. The children’s task was to choose the character from among four choices that properly filled in the blank. All of the characters were unfamiliar to the children but they had a hint of the meaning of the best choice from the semantic radical on the left-hand side of the character. The pre-test showed no significant differences in radical awareness, word morphology and two writing tasks between the experimental group and the control group. Yet the post-tests two semesters later showed greater improvement in these tasks among the experimental group. Multiple regression analyses indicated that children’s radical awareness significantly predicted their copy and write character performance after controlling for their IQ and phonological awareness.

A study from the foreign language perspective gave a tentative understanding of radical awareness instruction in foreign language learning. Taft and Chung (1999) conducted a study to determine whether knowledge of the internal character structure helped naïve learners to memorize the character. Four groups of Australians who had never learned any Chinese were asked to learn 24 characters. They were presented three times these 24 characters together with their meanings. And then they were given the characters alone and asked to give the meaning of each character. Before seeing any character, one group of participants were told about the radicals and were given 15 minutes to learn the set of 16 radicals thoroughly. The second group was told about radicals at the first presentation of the characters. The third group was told about radicals at the third presentation of the characters. The fourth group was told nothing about radicals. Their performances in the character recognition task were compared across groups immediately after and one week after the treatment. It was found that the first three groups of participants were doing significantly better than the fourth group in character recognition tasks. So the instruction about radicals greatly helped the learners to learn Chinese characters.

Developmental trajectory of radical awareness

As denoted earlier, there are two aspects of radical awareness. At issue, for the purpose of the present study are questions about when learners develop these aspects of radical awareness
and knowledge of whether learners develop the two aspects of radical awareness with the same pace. Research in this area is scant but informative.

Ho, Ng and Ng (2003) investigated the development of both aspects of radical awareness of 60 first, third and fifth graders (20 for each group) from Hong Kong. It was shown that even the first graders had acquired some knowledge of the position and sound value of phonetic radicals, and this knowledge improved as they advanced in grades. Similarly, these first graders had acquired some knowledge about the position and semantic category of semantic radicals, but they had little idea that semantic radicals serve semantic function. It was not until third grade that the children understood they could rely on the semantic radicals for meaning cues.

Chan and Wang’s (2003) study targeted younger children. Two experiments were conducted to examine the understanding of radical functional regularity among 100 children from Beijing and 100 children from Hong Kong. Their ages ranged from five to nine. First, children were asked to choose from four choices a pseudo-character that was the most appropriate name for some strange objects in five pictures. This picture naming task was used to examine the children’s understanding of the function of semantic radicals. Then they were required to pronounce some pseudo-characters, which was designed to test their understanding of the function of phonetic radicals. The researchers found that eight and nine-year-olds understood the function of both the semantic and phonetic radicals, while younger children yet to develop systematic understanding of the radical functional regularity.

While Ho, Ng and Ng’s experiment showed that awareness of radical positional regularities and pronunciation-cueing function of phonetic radicals developed earlier than the awareness of meaning-cueing function of semantic radicals, other studies showed a different picture. For example, Chan and Nune (1998) examined a group of sixty children, aged 4 to 9 in a creative spelling task. These children were asked to create some words as names for designated objects. A set of selected radicals were provided; half of them were semantic radicals and half were phonetic radicals. Chan and Nune’s study showed that from age six on, the children began to use semantic radicals systematically to represent meanings, which was showed in the percentage increase in correct use of semantic radicals from 43% for the six-year-olds to 86% for the nine-year-olds. However, a more systematic use of phonetic radicals as a clue to pronunciation was observed only among the nine-year-olds (57%). Brote and colleagues’ study (Brote, Chen, Overmars, van der Heijden, 2003) on the radical awareness among good and poor
fourth-grade readers showed good readers were better using pseudo phonetic radicals to read new pseudo-character than poor readers, but at the same time, there was no significant difference in using the semantic radicals to tell the meaning category of pictures. Though this study did not tell the relative developmental pace of the awareness of functions of semantic and phonetic radicals, it suggested that it might be easier to develop the awareness of the function of semantic radicals. Shu and colleagues (2003) study analyzed the characters taught in elementary schools in China and found that only 40% of them were phonetically regular (characters whose phonetic radical has the same pronunciation as the character). This summary led to the expectation that mastery of phonetic radical awareness is hard because the pronunciation cues are less reliable in the characters introduced in early grades, and this expectation was confirmed by other studies (e.g., Ho & Bryant, 1997; Chan & Siegel, 2001).

Some studies have explored the radical awareness developmental trajectory among CFL learners. For example, Jackson, Everson and Ke (2003) examined the development of radical awareness among 15 American college CFL learners in their first year of study. Participants were asked to take part in one semantic-radical-transfer task and one phonetic-radical-transfer task. In the first task, they were asked to choose among four choices the meaning of 12 unfamiliar compound characters (all of them possess familiar semantic radicals). In the second task, they were asked to write in Pinyin the pronunciation of 12 unfamiliar compound characters (all of them possess familiar phonetic radicals). Findings suggested that students had developed some understandings of the function of semantic radicals and phonetic radicals after one year of study in foreign language context. Yet the use of phonetic radicals to get the pronunciation of novel compound characters was difficult as shown in the students’ mean probability of .36 of writing a correct Pinyin answer for phonetic-transfer items, given that they had named the corresponding phonetic radicals correctly.

Shen and Ke (2007) investigated the semantic radical awareness among 105 American college CFL learners. These learners varied from one to four in their years of study in Chinese. They were engaged in three tasks: a radical perception task, a radical knowledge task, and a radical application task. While the radical perception task was designed to test the learners’ skills in chunking characters into radicals and radical knowledge test to measure learners’ knowledge of the meaning of 40 frequent semantic radicals, the radical application task was designed to test learners’ ability to use semantic radicals to figure out meaning of unfamiliar
characters and to memorize familiar characters. It was found that there were significant differences between the one-year and two-year groups as well as the two-year and third-year groups in their semantic radical knowledge. In addition, a significant difference was found between the two-year and three-year groups in semantic radical knowledge task, but no significant difference was found between the one-year and two-year groups.

**Factors influencing the development of radical awareness**

As shown in the previous section, the development of radical awareness may follow different trajectories, but little is yet known about the factors leading to this difference. A few studies do shed some light on this issue. Chan and Wang (2003), for example, posit that vocabulary may be one factor. Their study compared the radical awareness among 5 groups of Chinese children and found around 50% of the eight- and nine-year-olds could choose the meanings of pseudo-characters and over 70% of the eight- and nine-year-olds could generate pronunciations of pseudo-characters while young children (aged from 5 to 7) made random selections for both tasks, showing their lack of ability to use both the semantic and phonetic radicals when they encountered novel characters. They explained this might be because younger children do not possess the knowledge of a large number of characters.

The instruction of character learning may be another factor. Jackson, Everson and Ke (2003) observed the classroom instruction of character learning to CFL learners. They found that classroom teachers incorporated the concept of radicals in their teaching and taught the functions of radicals to the students. In addition, it was found that much more attention was given to semantic radicals and its contribution to the meaning than that given to phonetic radicals. This preoccupation on semantic radical might be the reason for the better performance of these CFL learners in using semantic radicals to get the meaning of novel characters.

The third factor that may contribute to the difference in developmental trajectories is the semantic transparency and phonetic regularity of compound characters (Chung & Leung, 2008). Semantic transparency is defined as “the relationship between the meaning of the semantic radical and that of the character” (Chung & Leung, 2008). The more semantic information a radical provides, the more transparent is the character. Under this definition, characters are divided into transparent, semi-transparent and opaque characters. On the other hand, Chung and Leung defined phonetic regularity as the relationship between the pronunciation of the phonetic radicals and that of the character. Under this definition, characters could be regular and irregular.
characters. The regular characters are those whose phonetic radical has the same pronunciation as the character, while irregular characters are those whose phonetic radical has a different pronunciation from the character. Various studies (e.g., Shu & Anderson, 1997; Tsai & Nunes, 2003) have shown that semantic transparency and phonetic regularity may play a role in radical awareness development. A systematic analysis of characters taught from the first grade to the sixth grade in China by Shu and colleagues (2003) showed an increase in the proportion of semantic transparent and phonetic regular characters across grades. It was also pointed out that high frequency words are less regular while low frequency words are more regular. This gave a possible reason why the learners’ radial awareness improves over years (Chung & Leung, 2008).

In Chan and Siegel (2001) study, the proportion of phonetic-related errors was higher among older and normal achieving readers than younger and poor readers. This gave evidence that older and normal achieving students had a better understanding of the function of phonetic radicals and that they were able to use phonetic radicals in the reading.

**Theoretical categorization of radical awareness**

Radical awareness embraces two aspects of knowledge about the orthographic structure of Chinese characters (Shen & Ke, 2007). Although research on the development of radical awareness in L1 environment and a few studies in L2/FL acquisition context has been carried out, no agreement has been reached concerning its categorization into theoretical construct. Some of researchers label it as a form of orthographic awareness (e.g. Jackson, Everson, & Ke, 2003) whereas others categorized it as morphological awareness (Li et al., 2002). The present study does not intend to take one and thus oppose the other view. Rather we take both perspectives. Radical awareness may be both one form of orthographic awareness and one form of morphological awareness. After all, radicals encode both the orthographic information and morphological information. The combination of radicals reflects both orthographic regularity and the morphological regularity. This special feature of radicals in Chinese may be the reason for the importance of radical awareness in reading and literacy acquisition just as morphological awareness and orthographic awareness are both good predictors of reading development in alphabetic language reading and literacy acquisition (Carlisle, 2001; Cunningham, Perry & Stanovich, 2001). To fit radical awareness into one category may not fully reflect its special features.
Shen and Ke (2007) were among the few researchers that examined the developmental trajectory of the knowledge about positional and functional regularity among CFL learners. They used the term “radical awareness”, which was operationalized as “the functional understanding of the role of radicals in forming Chinese characters and the ability to use this knowledge consciously in learning characters” (Shen & Ke, 2007, p. 100). This study captured three aspects of radical awareness, namely radical perception skill, the radical knowledge, and the radical knowledge application skill. Radical knowledge was defined as the “passive knowledge of semantic radicals”. This knowledge was measured by a task in which the participants told the sounds and meanings of 40 characters. All of these 40 characters could serve as semantic radicals in compound characters. The problem with this design is a lot of semantic radicals could not stand alone as characters (Wang & Yang, 2008).

Another issue that was raised by Shen and Ke’s (2007) study is the possibility of differentiating radical awareness into implicit and explicit radical awareness. Shen and Ke did not explicitly use “implicit” or “explicit” to define radical awareness, and instead used “consciously” and “passive” to differentiate radical awareness. This might be because of the difficulty in distinguishing implicit from explicit knowledge (Ellis, 2005).

Given the inconsistent interpretations and definitions of knowledge about positional and functional regularities of radicals in L1 and L2 reading acquisition, and the scant research in L2 reading context, further research needs to be done to have a better understanding of the acquisition of this knowledge and its role in reading acquisition among CFL learners.
CHAPTER THREE

METHOD

The aim of the present study is three-pronged: to explore the CFL learners’ radical awareness, to find out the relationship between radical awareness and word recognition among Chinese-as-a-foreign-language learners and to discover among four aspects of radical awareness the unique predictor of word recognition.

Prior to the present study, a pilot study had been done to test the validity and reliability of the instruments that were then used to measure radical awareness among CFL learners, therefore, this chapter begins with a description of the pilot study. Then it proceeds to the design of the present study, including: the research methods and procedures, setting and participants, study materials, data collection and analysis.

The Pilot Study

Quite unlike the native speakers, CFL learners have limited exposure to the target language, so the number of Chinese characters they acquire usually is limited compared to native speakers. This limited command of Chinese characters could affect their radical awareness (Chan & Wang, 2003). The instructional materials they have and the instructional methods they undergo are also factors that influence the development of their radical awareness (Jackson, Everson, & Ke, 2003). To investigate the radical awareness level of CFL learners, a pilot study was implemented in April 2009. Also, because the instruments selected for use in the present study were either used in experiments with native Chinese speakers and not CFL learners or were created by myself, a pilot study was needed to test the internal reliability of each measure. Additionally, the pilot study helped me identify the limitations of the research design and minimize them in the design of the present study.

Pilot study participants

Twenty-five CFL learners were recruited for the pilot study. All of them enrolled in Chinese classes at a southeastern pubic research university. Eight students were enrolled in Chinese Grammar & Composition, while the other seventeen were enrolled in Elementary Chinese II. Students enrolled in Chinese Grammar & Composition had learned Chinese for three or four semesters in this university while those enrolled in Elementary Chinese II had learned
Chinese for two semesters. The ages of these 25 participants varied from 18 to 24, and their
etnicities included White, Black, Latino and Asian.

All participants with the exception of four spoke English as their L1. Two of these four
students were able to read and write in Chinese before they enrolled in the class, so they were
eliminated from the study. For the other two participants, one spoke Portuguese and the other
Cantonese (a dialect of Chinese) as their L1. These two students were fluent English speakers
and received their education in the US.

Cantonese is a dialect of Chinese, and it is quite different in speaking from Mandarin that
is taught in the Chinese class offered at this university. In addition, Cantonese-speaking Chinese
immigrants adopted a writing system (the traditional Chinese, or complicated Chinese) that is
significantly different from the simplified Chinese offered in the class (Cheung & Ng, 2003).
The simplified Chinese was created in the 1950s in mainland China to increase the Chinese
literacy level. It was based on the old writing system, the traditional Chinese, which is still used
by people in Taiwan and Hong Kong. Therefore, though it seemed ideal to exclude this
Cantonese-speaking student from the study, due to the difference between the two writing
systems, the small sample size and no significant differences in all tasks between this student and
the other participants in the pilot study, this CFL learner remained in the study. In the end, 23
students participated in the pilot study.

Pilot study method

A questionnaire consisting of a background information survey and three tasks was
administered with the intention of shedding some light on radical awareness levels among a
group of CFL learners.

To measure radical awareness, three tasks were designed. The first one was the character
legality decision task, where the participants decided the legality of 40 made-up characters. The
second one was a character-meaning matching task, where participants identified the character
that matched the meaning provided. The third one was the radical writing task, where the
participants added the missing radicals to unfinished characters. Each test is described in detail
later in this section.

Consent form

The participants were given a consent form (see Appendix A) at the beginning of the
questionnaire. This consent form explained the purpose of the study, the possible benefits to the
participants, and the rights to withdraw at any time of the study. Contact information of the researcher and the supervisor was also provided. All 25 participants signed the form and proceeded to the following sections of the pilot study.

*Participant background information questionnaire*

The participant background information questionnaire (see Appendix B) was designed for the pilot study to collect participants’ background information, such as age, gender, first language, and year of Chinese learning. The purpose of collecting this data was to achieve a basic understanding of the participants’ general background information and then use this understanding for further analysis. For example, based on the information on the Background Information Questionnaire, two students who were able to read and write before their Chinese study at this university were eliminated from the study. The semester in the Chinese study was used as an independent variable to see whether there was any difference in radical awareness level between students with differing amounts of Chinese language experience.

*Instruments*

The instruments used to measure radical awareness in the pilot study included three tasks. All directions were written in English to make it understood by every participant.

*Character legality decision task.* The character legality decision task is similar to a lexical decision task utilized in English reading research. It was used to test the learner’s implicit awareness of the positional regularities (constraints) of the radicals. The character legality decision task (see Appendix C) administered as part of the pilot study was adopted from Lu’s research (1992, 1994), which focused on children studying Chinese as their L1. Since the participants recruited in Lu’s two studies were from Taiwan and learned traditional characters, the character legality decision task used in those studies was not suitable for the pilot study and the present study. Therefore, Lu’s character legality decision task was adapted to a version of simplified characters for the pilot study.

In this task, the participants were given 40 unreal characters and asked to make decisions as to whether they were written correctly. These unreal characters included pseudo-characters and illegal characters. Pseudo-characters are unreal characters that conform to character positional regularity, while illegal characters are those that violate the Chinese character positional regularities. These 40 unreal characters were of a left-right or top-bottom structure. As compound Chinese characters are made up of two radicals and most of the radicals have
habitual positions of their own within a character, this task was to measure the participants’ awareness of the rules that certain radicals can only appear in certain position within a character. Since participants were foreign language learners with a limited command of characters, all radicals involved were covered in the textbook and were of high combinability. Combinability is defined as the semantic radical’s ability to combine with phonetic radicals in forming a compound (Feldman & Siok, 1999). All 40 items were unreal characters instead of real ones to avoid familiarity effect. In Lu’s early study (Lu, 1992) that involved children from kindergarten to sixth grade, the Cronbach’s alpha was reported as .91. In a later study (Lu, 1994) involving children in fifth grade, the Cronbach’s alpha was reported as .81 with the sample size of 247. An example of the character legality decision task is provided in Figure 2.1:

**Direction:** The following characters were written by a Chinese language learner, but not all of them were written correctly. Please mark T if it is right and F if it is wrong in the parenthesis given.

1. 庾 ( ) 2. 劜 ( )

Figure 2.1: Sample pilot test character legality decision task

**Character-meaning matching task.** In the character-meaning matching task (see Appendix D), the participants were given fifteen sets of characters with fifteen meanings. For each set, there were three choices of characters. The participants were asked to decide which of the three choices of characters matched the meaning given. All three choices of characters shared the right part or the phonetic radicals and only differed in their left parts, or semantic radicals.

This task demands the knowledge about the meaning-cueing function of semantic radicals and the knowledge about the meanings of the targeted semantic radicals. Semantic radicals were targeted instead of phonetic radicals for two reasons. First, semantic radicals are more reliable for cueing meanings than phonetic radicals for cueing pronunciations of characters (Shu, 2003). Second, the number of semantic radicals is much less than that of phonetic radicals.
According to Hossain (1991), there are about 200 semantic radicals and 800 phonetic radicals. Because of limited language proficiency, these CFL learners were much more familiar with semantic radicals than phonetic radicals.

The character-meaning matching task was used by Shen and Ke (2007). It was intended to test learners’ “passive” (She & Ke, 2007) knowledge about the function of semantic radicals. Participants were not explicitly asked to utilize their knowledge about the semantic radicals to figure out the meaning of unfamiliar Chinese characters. Instead, they were administered a form-meaning matching task. Therefore, the task was to measure the implicit knowledge about the function of semantic radicals. In Shen and Ke’s study, however, only five items were included. These five items were not listed in their published paper and were therefore unknown to the researcher. In the pilot study, after reviewing the textbooks used by the participants, 15 semantic radicals of high combinability were chosen. The relationship between the meaning of the character and that of the semantic radical of each 15 items is transparent. That is, the meaning of semantic radical is closely related to that of the character (Shu, 2003). This task tests the implicit knowledge of function of semantic radicals (Shen & Ke, 2007). An example of the character-meaning matching task is provided in Figure 2.2:

<table>
<thead>
<tr>
<th>Meaning</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 To mix</td>
<td>伴 拌 绊</td>
</tr>
</tbody>
</table>

*Figure 2.2: Sample pilot test character-meaning matching task*

**Character writing task.** In the character writing task (see Appendix E), the participants were required to complete the characters that missed the semantic radicals. Fifteen unfinished characters were presented together with the meaning and pinyin form of two-character words. In order to succeed the task, the participants need to know about the meaning of the semantic radicals, and they also needed to put the semantic radicals in the right places.

This character writing task is based on the one used in Shen and Ke’s (2007) study. Reportedly, their instrument had five items, but this test was not released publicly and so was
unavailable to the researcher. For use in the pilot study, the researcher selected fifteen Chinese words from the textbooks used in the two Chinese classes in which the participants were enrolled. The pinyin forms were given in order to ease the difficulties of the task. All fifteen words were high frequency words and appeared repeatedly in their textbooks. According to Shen and Ke (2007), this task tests the explicit knowledge of the functions of semantic radicals, as the learners should acquire the knowledge about the meanings as well as the functions and positions of semantic radicals and apply this knowledge to finish the character spelling. An example of character writing task is given in Figure 2.3:

![Figure 2.3: Sample pilot test character writing task](image)

**Direction:** Each of the following **characters or underlined character** is missing a component.

**Please add this component according to the meaning and pronunciation given.**

<table>
<thead>
<tr>
<th>Pinyin</th>
<th>Meaning</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>chàng gē</td>
<td>to sing</td>
<td>昌 歌</td>
</tr>
</tbody>
</table>

Figure 2.3: Sample pilot test character writing task

**Pilot study procedure**

Data was collected in April 2009 from eight students enrolled in Chinese Grammar & Composition and 17 enrolled in Elementary Chinese II. Students took the test during thirty minutes of a regular class period. All 25 students signed a consent form before they took part in the test. Next, they finished a background information questionnaire, in which their age, race, native language, prior Chinese learning experience and years of Chinese learning were reported. Then, the three radical awareness tasks were group administered. After participants finished the tests, they returned the test papers to the researcher. After the researcher screened the questionnaires, two students from Elementary II were eliminated from the next-round study because they reported in their background information questionnaire that they could write and read in Chinese before they took the class. So, finally, data from 8 students from Grammar & Composition and 15 from Elementary II was documented for analysis.
Pilot study scoring

The researcher graded all the tests. Only one correct answer was possible for each item. If participants gave a right answer, they received one point, and, if not, they received a zero. SPSS 15 was used to analyze the test results.

Pilot study results and analyses

Based on the analysis of data from eight students enrolled in Grammar & Composition, the internal reliabilities are reported as follows (see Table 3.1). The Cronbach’s alphas were .84, .70, and .83 for character legality task, character-meaning matching task, and character writing task, respectively. Deletion of any item for any one task would not greatly increase the alpha.

The results for the fifteen second-semester CFL learners are as follows. The Cronbach’s alphas were .78, .82, and .83 for the character legality decision task, character-meaning task, and character writing task respectively. Deletion of any item for any one task would not greatly increase the alpha.

The internal reliabilities of all three radical awareness tasks reached or were higher than .7, the acceptable level of internal reliability for preliminary study (Nunnally, 1978).

Table 3.1: Internal reliabilities of instruments used in the pilot study

<table>
<thead>
<tr>
<th>Study Level</th>
<th>Character Legality Decision</th>
<th>Character-meaning Matching</th>
<th>Character Writing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd and 4th semester</td>
<td>.84</td>
<td>.70</td>
<td>.83</td>
</tr>
<tr>
<td>2nd semester</td>
<td>.78</td>
<td>.82</td>
<td>.83</td>
</tr>
</tbody>
</table>

The descriptive statistics are shown in Table 3.2. The mean scores for the third or fourth-semester CFL learners were 33.63, 10.38 and 7.37 in character legality decision, character-meaning matching and character writing task, respectively. The mean scores for the second-semester CFL learners were 30.27, 9.4 and 6.8, respectively. So the mean scores for the third/fourth-semester CFL learners were higher than those of the second-semester CFL learners.
Yet the one-way ANOVA test did not show any significant differences between the two groups in any of the three tests.

Table 3.2: *Descriptive statistics of three radical awareness tasks used in pilot study*

<table>
<thead>
<tr>
<th>Level</th>
<th>Character Legality Decision Task</th>
<th>Character-Meaning Matching Task</th>
<th>Character Writing Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd and 4th semester</td>
<td>33.63 (4.84)</td>
<td>10.38 (3.74)</td>
<td>7.37 (3.62)</td>
</tr>
<tr>
<td>2nd semester</td>
<td>30.27 (5.75)</td>
<td>9.4 (2.80)</td>
<td>6.8 (3.86)</td>
</tr>
</tbody>
</table>

**Discussion**

The pilot study suggested that it may take less time for the CFL learners to become aware of the radical positional regularity than to be aware of the semantic radical functional regularity. This is demonstrated by the mean scores of both groups in the character legality decision task. The accuracy rates in the character legality decision task are 84% and 76% respectively for the third/fourth-semester students and second-semester students. The accuracy rates in the Character-meaning Matching task were 69.2% and 62.7% for the third/fourth -semester CFL learners and second-semester CFL learners. The accuracy rates in the Character Writing task were 49.1% and 45.3% for the third/fourth-semester CFL learners and second-semester CFL learners.

The above data gave evidence that, after two semesters of study, the CFL learners were able to acquire the positional regularity of radicals. These results suggested that the positional regularity seem easier for these CFL learners to acquire than functional regularity as demonstrated by the high correct percentages in Character Legality Decision task. In addition, the implicit knowledge of the function of radicals is easier to acquire than the explicit knowledge. In sum, findings of the development of radical awareness among CFL learners suggested a similar pace of development with those Chinese-as-native-language learners (Ho, Yau & Au, 2003).
Limitations of pilot study

The pilot study tested the internal reliabilities of the measures and showed that all three measures had good internal reliabilities. Yet, some limitations surfaced in the pilot study. First, the sample size was rather small. Second, the way of categorizing participants into two groups may be problematic. In the pilot study, participants were categorized into one of two groups according to semesters of Chinese study they were enrolled in the program at this college. This was in line with Shen and Ke’s (2007) study, where participants were classified as first-year, second-year, third-year or fourth-year CFL learners. But in the pilot study, some participants had learned Chinese prior to their study in college. For example, some students had 2 years of high school Chinese learning experience prior to their Chinese study in college. In addition, the Grammar & Composition group included students with two or three semester of prior Chinese learning experience in college. As their total number was only eight, it was unwise for further grouping. This sacrifice may have caused the nonsignificant mean difference in all three radical awareness tasks. Therefore, categorizing students according to the semester of Chinese study in college may not serve as a good independent variable for ANOVA analysis. The nonsignificant mean differences in the three radical awareness tasks between the two groups of CFL learners might also have been the result of this categorization and the small sample size. The design of the primary study has been modified as a result.

The Primary Study

Drawing on the strength and trying to minimize the weakness of the pilot study, the present study furthered the understanding about the radical awareness among CFL learners as well as the relation between radical awareness and word recognition among CFL learners.

Research Methods

The same form of questionnaire used in pilot study was used for the primary study. In order to find the differences in radical awareness between advanced and beginning CFL learners and to determine whether there is a significant difference in the relation between radical awareness and word recognition as a function of language proficiency, the present study recruited 97 participants.

To answer the first research question “Do advanced CFL learners have higher levels of radical awareness than beginning CFL learners”, a one-way ANOVA test was conducted and the
effect size and statistical power were calculated. To answer the second question “Is radical awareness significantly related to word recognition for CFL learners? Does the relationship between word recognition and radical awareness differ between advanced and beginning CFL learners”, four multiple regression analyses were conducted and the statistical power were calculated.

Procedure

Prior to the start of the present study, the IRB approval was secured in December 2009. Data for the present study was collected in several regular classes in the fourth and fifth week of spring semester of 2010. The reason to choose this period was for practical considerations. Enrollment in the first month of the semester is usually higher and students usually are less stressed by other classes. Also the teachers at this university are more willing to spare time in class for the students to take the test because the teaching load in the beginning of the semester is usually lighter than that of the latter portion of the semester (Researcher’s personal correspondence with the Chinese teachers).

First, a consent form (see Appendix A) was given before the administration of the experiment. This consent form includes information about the purpose of the study, the researcher’s contact information of the researcher, the confidentiality issue and the record keeping and the possibility to withdraw from the study. Any question concerning the present study was answered before the test. The following parts of the study were only administered to those students who signed the consent form.

A background questionnaire (see Appendix B) was then given, which included questions about participants’ native language, years of Chinese study, grades they had received in Chinese classes, and self-rated Chinese skills. The questionnaire was followed by three radical awareness tasks and a word recognition test.

Setting

The participants of the primary study were college students enrolled in ten Chinese classes at a public research university in the southeastern part of the United States. The reasons to choose this university were as follow. First, this university has a Chinese program and offers Chinese as a major to CFL learners. The enrollment in the Chinese program has been increasing steadily in the past several years. This program offers various Chinese classes to meet the needs of students who are at different levels of language proficiency. Second, the researcher herself is
studying at this university and is familiar with the setting, the instructors of the Chinese classes and thus has better access to the participants.

According to the description of the student body at the university’s website, the university has wide student diversity. Students come from all 50 states of the US and dozens of countries. Twenty-five percent of students are minority students and fifty-seven percent are women. The university policy requires all students planning to obtain a bachelor of arts (BA) degree to complete a classical or modern foreign language through the 2000 level (2220 or equivalent) as is stated in its 2007-2008 General Bulletin Undergraduate Edition (p. 66). For students who have no previous experience with the selected language, the course work will include 1120 (first semester language course), 1121 (second semester language course) and 2220 (third semester language course).

This university offers the students many different foreign language programs. These foreign languages include Arabic, Chinese, French, German, Hebrew, Italian, Japanese, Latin, Portuguese, Slavic, and Spanish.

At this university, the Chinese program is under the division of East Asian Languages, which is a part of the modern language department. According to the program website, Chinese has ranked in the second place in “the Foreign Language I Want to Choose as the Major” survey. Because of the fast expansion of the Chinese program, Chinese has been offered as an undergraduate major since 2008. The Chinese program at this university offers the following courses: Elementary Chinese I, Elementary Chinese II, Intermediate Chinese, Chinese Grammar & Composition, Business Chinese I, Business Chinese II, Chinese Short Story & Essay, News Media Chinese, and Chinese Calligraphy & Poetry.

In the school year of 2009-2010, the Chinese program had seven teachers. They were all native speakers of Chinese, and among them, one was an associate professor and program chair, one was an assistant professor, one was a visiting scholar, one was an instructor, and the other three were teaching assistants, all of whom were enrolled in university graduate programs.

Stories & Essays, Advanced Grammar & Writing are language related and lectured in Chinese. The other two courses are lectured in English.

According to the curriculum and academic map from the program chair, Elementary Chinese I, Elementary Chinese II, and Intermediate Chinese are offered to undergraduate students to meet the minimum foreign language requirement. Those who seek to minor in Chinese need to complete another 12-18 credit hours of Chinese-related coursework above Intermediate Chinese. Those who seek to major in Chinese need to complete another 30 hours of coursework above Intermediate Chinese.

Students in Elementary Chinese I and II meet Monday through Thursday, weekly, for a 50-minute class. On Friday, they take the course online, which often involved reading and writing tasks. Except for the introductory class on pronunciation and character-writing, approximately seven class periods are spent on each lesson chapter. Students finish learning the pinyin and radicals in the first two weeks and then proceed to the learning of dialogues in the following chapters. The dialogues in the first textbook are written both in the pinyin and characters, yet instructors encourage the students to read the dialogues in characters without referring to the pinyin.

Students in Intermediate Chinese also meet Monday through Thursday, weekly. There is no online class on Fridays. Every other Thursday, an additional online class is offered, which involves reading and writing tasks. Besides dialogues and reading passages, short stories are introduced in Intermediate Chinese. Chinese Grammar & Composition is offered to students who have finished two or three semesters of study. This course on Chinese Grammar and Composition aims to improve students' aural-oral proficiency. In addition, increased emphasis is put on developing students' reading and writing skills in Chinese. Students in this class also meet for 50 minutes from Monday to Thursday.

Business Chinese II is offered to students who will want to use Chinese in business and professional environments. It aims to develop students’ Chinese proficiency in the context of business activities. Students meet weekly for 50 minutes on Monday, Wednesday and Friday. Chinese Short Story & Essays is designed for students who have had two years of Chinese at the college level or equivalent preparations. While this course continues to put emphasis on consolidating students’ language skills in listening and speaking, it aims to help students to bring their mastery of written Chinese to a more advanced level of proficiency by further developing
their knowledge of Chinese grammar and increasing their grasp of vocabulary used in professional and social contexts. Students enrolled in this course also meet weekly for 50 minutes on Monday, Wednesday and Friday. Advanced Grammar & Writing emphasizes reading and writing skills in Chinese, and it is designed for students who have had five or six semesters of Chinese at the college level or equivalent preparations. Students meet three times a week for a 50-minute class.

Participants

Ninety-seven college students (49 male, 48 female) who studied Chinese as a foreign language participated in the study. Their ages ranged from 18 to 28, with the mean of 20.59. All of them had studied Chinese as a foreign language for more than one semester before they participated in the study. Ninety-one of them learned English as the L1, two had Spanish, one had German and two had Vietnamese as the native language. Some of them learned a language other than Chinese as the L2, and these second languages were Spanish, Dutch, Creole, Urdu, Tagalog and Vietnamese.

These students came from 10 Chinese classes at this university. These ten classes included three Elementary II classes, two Intermediate Chinese classes, one Chinese Grammar & Composition class, one Business Chinese II class, one Chinese Short Story & Essay class, and one Advanced Grammar & Writing class.

Study material

A background information questionnaire (see Appendix B) and four tests were administered. All participants were tested on three radical awareness tasks: a character legality decision task, a character-meaning matching task and a character writing task (which was then broken down into a semantic radical position task and a semantic radical supplement task). They were also administered a word recognition test. This test included 20 two-character Chinese words, taken all from their textbooks Integrated Chinese (Yao et al., 2007).

Character legality decision task

Character legality decision task (See Appendix C) was designed to measure the learners’ implicit knowledge about the radical positional regularity. It is similar to lexical decision task, which is widely used research paradigm in studying various basic processes in word identification (Wang, Perfetti, & Liu, 2003).
Altogether 40 unreal characters were presented to the learners. All the radicals involved in the legality decision task were those that had already been covered in their Chinese classes. Radicals examined by the primary study are of different combinabilities. Combinability is defined as the ability to combine with phonetic radicals in forming a compound character (Feldman & Siok, 1999). Some are of high combinability, like 亻, 木 and 人, some are of low combinability, like 亻, 干 and 人. It has been used in Lu (1992, 1994) twice aiming at K-6 graders and 5th graders. The Cronbach’s alpha was .91 and .81 respectively. It was also used in a pilot study (participated by 23 second and fourth semester CFL learners) conducted ten months prior to the primary study and the Cronbach’s alpha was .84 for the second-semester college CFL learners and .78 for fourth-semester participants.

**Character-meaning matching task**

Character-Meaning Matching task (see Appendix D) aims at measuring the learners’ implicit knowledge about semantic radicals. Fifteen meanings in English together with three choices of characters for each meaning were presented to the participants. The three characters shared the same phonetic radical yet differed from each other in their semantic radicals. The format was used in Shen and Ke (2007), which aimed at measuring the learners’ ability to make use of the semantic radicals to match the meanings. As all of them share the phonetic radicals, it is believed to measure the implicit knowledge of the semantic function of semantic radicals. The pilot study showed that the internal reliability of the character-meaning matching task was .70 for the second-semester CFL learners and .82 for the fourth-semester CFL learners.

**Character writing task**

The character writing task (See Appendix E) aims at measuring the participants’ explicit knowledge about radical positional regularity and meaning-cueing function of semantic radicals. It was then broken down into a semantic radical position task and a semantic radical supplement task. Fifteen unfinished characters with their meanings in English were presented to the participants. As there are many cases of synonyms (characters with similar meanings) in Chinese, the pinyin forms of the target characters were given to ensure that there were no multiple choices. The first component of character writing task was the semantic radical position task. A point was awarded if the participants put a radical in the correct place. The second component of character writing task was the semantic radical supplement task. A point was awarded if the participants provided the correct semantic radicals, no matter the position.
**Word recognition task**

In this word recognition task, the learners were asked to provide the pinyin forms of 20 words. These words consisted of one character or two characters. These 20 words were from 21 lessons covered in their classes at this university. Participants got a zero if they were not able to provide in Pinyin the right onset and rhyme of the word. The tones were not assessed because tones posed extreme difficulties to CFL learners.

**Scoring and analysis**

The present study examined the radical awareness levels among CFL learners at two proficiency levels, namely the beginning and advanced levels. Latent Class Analysis (LCA) was used to determine the learners’ Chinese language proficiency. LCA is a statistical method for finding subtypes of related cases (latent classes) from multivariate categorical data (McCutcheon, 1987). In this case, the language proficiency (either advanced or beginning Chinese level) was the latent class, which was drawn from four self-rated Chinese language skill scores and the number of semesters in the Chinese study. The self-rated scores ran on one to six Likert scale. The statistics software, Mplus 5 was used to do the LCA.

In order to answer the question “Do advanced CFL learners have higher levels of radical awareness than beginning CFL learners”, four ANOVA tests were conducted. To answer the question “Is there a significant relation between radical awareness and word recognition among CFL learners” and “Is the relationship between radical awareness and word recognition differ for beginning and advanced CFL learners”, four multiple regression analyses were conducted. In these multiple regression analyses, the outcome variable was Word Recognition and the predictors were Chinese language proficiency (advanced or beginning), each of the radical awareness tasks (Character Legality Decision task, Semantic Radical Position task, Character-Meaning Matching task, Semantic Radical Supplement task), and the interaction between Chinese proficiency and each of the four radical awareness tasks. The significant tests in the four interaction tests were to determine whether the relationship between radical awareness and word recognition differ between advanced and beginning CFL learners.

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1 Following Shen & Ke’s (2007) study, originally this word recognition task asked participants to give both the pinyin forms and meanings of all 20 words. In the present study, I report results from using scores on students’ pinyin forms. It should be noted, however, when analysis was conducted incorporating both pinyin forms and meanings, the results were essentially the same as those reported in the present paper.
To answer the last research question “Which aspects of radical awareness are shared and unique predictors of word recognition after accounting for the effects of others,” a multiple regression analysis was conducted in which all the four radical awareness tasks were included as predictors simultaneously. All data were input into computer and SPSS 17 was used to analyze the results. Table 3.3 shows the questions, data sources and way of analysis for the proposed study.

Table 3.3: An overview of research questions, data sources and analysis tools

<table>
<thead>
<tr>
<th>Question</th>
<th>Data Source</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Do advanced CFL learners have higher levels of radical awareness than beginning CFL learners?</td>
<td>Background Information Survey, Character Legality Decision Task, Character-Meaning Matching Task, Character Writing Task</td>
<td>ANOVA</td>
</tr>
<tr>
<td>2. Is there a significant relation between radical awareness and word recognition among CFL learners? Does this relationship differ for beginning and advanced CFL learners?</td>
<td>Background Information Survey, Character Legality Decision Task, Character-Meaning Matching Task, Character Writing Task, Word Recognition Test</td>
<td>Regression</td>
</tr>
<tr>
<td>3. What are shared and unique relations of radical awareness with word recognition in Chinese?</td>
<td>Background Information Survey, Character Legality Decision Task, Character-Meaning Matching Task, Character Writing Task, Word Recognition Test</td>
<td>Regression</td>
</tr>
</tbody>
</table>

Validity issues

The scope of validity issues to be considered in this study concerns the validity of the instruments and data collection procedure. In this case, validity is used to refer to the ability of
an instrument and measurement procedures to accurately obtain data needed to answer a research question (Perry, 2005).

Construct validity reflects how accurately the instrument measures the construct or the concept under investigation. The present study examined radical awareness level among CFL learners, which is defined as the knowledge about the positional constraints and functions of radicals in forming Chinese characters and the ability to use this knowledge consciously in learning characters. Previous research has shown that awareness of the functions of radicals includes the awareness of semantic radicals and that of phonetic radicals (Ho et al., 2003). It has also been shown that the awareness of the function of phonetic radicals is slowly formed (Chan & Nunes, 1998; Ho, Yau, & Au, 2003) before of the low reliability of the cueing function of the phonetic radicals (Shu, 2003). Therefore, the present study only focused on the awareness of the function of semantic radicals among Chinese as foreign language learners. Hence, this aspect of construct validity was met.

Another aspect of construct validity is to see whether the measures will be used for the right purpose, in other words, whether the measures are used for what originally are intended for. In the present study, the character legality decision task was used to test learners’ awareness of the positional constraints of radicals in forming compound characters and the character-meaning matching and character writing task were used to test learners’ awareness of the functions of semantic radicals in compound characters. So this aspect of construct validity was also met.

Content validity, the extent to which the test appropriately samples from the domain of knowledge and skills relevant to performance in the criterion (McNamara, 2000) was also considered for the present study. Based on the literature review, the knowledge about radicals includes knowledge about the radical position regularities and the function of radicals (Ho et al, 2003). Knowledge of function of radicals includes knowledge of both semantic radicals and phonetic radicals, and it is easier for learners to acquire the function of semantic radicals as the number of semantic radicals is far lesser than that of phonetic radicals, its cueing function is more reliable than the cueing function of phonetic radicals (Ho & Bryant, 1997; Shu, 2003). Given the limited language proficiency of these CFL learners, only the awareness of the function of semantic radicals was investigated. Thus, content validity was satisfactory.
Summary

The present study examined the radical awareness level among CFL learners and the relation between radical awareness and word recognition. Three tasks (character legality decision task, character-meaning matching task and character writing task) were administered to 97 CFL learners to measure their fours aspects of radical awareness. A word recognition test was given to test the participants’ word recognition skills. Four ANOVA tests were used to determine if significant differences existed in radical awareness across learners of different language proficiency levels. The relation between radical awareness and word recognition was examined to determine whether the relations varied across learners of different language proficiency levels. It was further examined which aspects of radical awareness were significant, unique predictors of word recognition after accounting for the effect of other aspects of radical awareness.
CHAPTER FOUR
RESULTS

Compared to the substantial amount of research interest given to radical awareness in L1 literacy acquisition, research on radical awareness in L2 or FL context is scant. Wang and colleagues (Wang et al., 2003; 2004) were among a few that looked at the development of radical awareness in CFL learners. They found that alphabetic readers quickly became aware of the positional regularities of Chinese characters (Wang et al., 2003; 2004). Shen and Ke (2007), on the other hand, examined the developmental trend of radical awareness and its relation with word recognition among CFL learners. The relation between exposure time and radical awareness has been acknowledged by these studies, yet none of the L2 study examined the relation between language proficiency and radical awareness. The present study, therefore, started to explore the relation between Chinese language proficiency and radical awareness among CFL learners.

Descriptive statistics of participants

The descriptive information about the 97 participants was presented in Table 4.1. The mean score for semester of Chinese study was 3.46; the mean score they received in Chinese classes was 3.7. The mean self-rated score in writing is the highest among the four reported self-rated scores while the mean self-rated score in speaking is the lowest.

Correlations among Semester of Chinese study, Grades received in Chinese classes, self-rated reading, speaking, listening and writing skills, the four radical awareness tasks and word recognition were presented in Table 4.2. As shown in this table, the relations among all four radical awareness tasks were significant, and the relations between word recognition and each of the four radical awareness tasks were also significant.

Internal consistency of instruments

As is shown in Table 4.1, all four radical awareness tasks had higher internal consistency (Cronbach’s $\alpha s \geq 0.75$). Since Cronbach’s Alphas for all five measures used for the present study are above .70, they have met the internal reliability requirement.
Table 4.1: *Descriptive Statistics of the full sample*

<table>
<thead>
<tr>
<th></th>
<th>( \alpha )</th>
<th>Mean (SD)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td>N/A</td>
<td>3.70 (.41)</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Semester of study</td>
<td>N/A</td>
<td>3.46 (1.66)</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Chinese Reading Self-rating</td>
<td>N/A</td>
<td>3.22 (1.11)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Chinese Speaking Self-rating</td>
<td>N/A</td>
<td>3.08 (1.18)</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Chinese Listening Self-rating</td>
<td>N/A</td>
<td>3.37 (1.28)</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Chinese Writing Self-rating</td>
<td>N/A</td>
<td>3.78 (1.12)</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Legality</td>
<td>.85</td>
<td>30.16 (6.17)</td>
<td>16</td>
<td>40</td>
</tr>
<tr>
<td>Position</td>
<td>.86</td>
<td>8.55 (4.24)</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Matching</td>
<td>.75</td>
<td>10.52 (3.07)</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>SR</td>
<td>.85</td>
<td>7.02 (4.03)</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Word Recognition</td>
<td>.88</td>
<td>8.44 (4.48)</td>
<td>.0</td>
<td>18</td>
</tr>
</tbody>
</table>

Note. GPA = Grades received in Chinese classes; Legality = Character Legality Decision task; Position = Semantic Radical Position task; Matching = Character-Meaning Matching task; SR = Semantic Radical Supplement task
Table 4.2: Correlations between variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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</thead>
<tbody>
<tr>
<td>1. Sem</td>
<td>_</td>
<td>.04</td>
<td>-.03</td>
<td>.24*</td>
<td>.39**</td>
<td>.04</td>
<td>.46**</td>
<td>.51**</td>
<td>.48**</td>
<td>.49**</td>
<td>.52**</td>
</tr>
<tr>
<td>2. GPA</td>
<td>_</td>
<td>.41**</td>
<td>.28**</td>
<td>.29**</td>
<td>.38**</td>
<td>.27**</td>
<td>.30**</td>
<td>.21*</td>
<td>.34**</td>
<td>.36**</td>
<td></td>
</tr>
<tr>
<td>3. Rdg</td>
<td>_</td>
<td>.47**</td>
<td>.42**</td>
<td>.72**</td>
<td>.27**</td>
<td>.34**</td>
<td>.21*</td>
<td>.37**</td>
<td>.37**</td>
<td></td>
<td></td>
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<tr>
<td>4. Spk</td>
<td>_</td>
<td>.71**</td>
<td>.51**</td>
<td>.28**</td>
<td>.26*</td>
<td>.26*</td>
<td>.25*</td>
<td>.35**</td>
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<td></td>
<td></td>
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<tr>
<td>5. Lis</td>
<td>_</td>
<td>.42**</td>
<td>.34**</td>
<td>.35**</td>
<td>.38**</td>
<td>.36**</td>
<td>.41**</td>
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<tr>
<td>6. Wrtg</td>
<td>_</td>
<td>.35**</td>
<td>.38**</td>
<td>.23*</td>
<td>.39**</td>
<td>.36**</td>
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<tr>
<td>7. Leg</td>
<td>_</td>
<td>.70**</td>
<td>.52**</td>
<td>.67**</td>
<td>.62**</td>
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<td>8. Po</td>
<td>_</td>
<td>.58**</td>
<td>.89**</td>
<td>.77**</td>
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<tr>
<td>9. Mat</td>
<td>_</td>
<td>.60**</td>
<td>.57**</td>
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<tr>
<td>10. SR</td>
<td>_</td>
<td>.82**</td>
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<td></td>
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<tr>
<td>11. WR</td>
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</tr>
</tbody>
</table>

*Note.* Sem = Semester of Chinese study; GPA = Grades in Chinese classes; Rdg = Chinese reading self-rating; Spk = Chinese speaking self-rating; Lis = Chinese listening self-rating; Wrtg = Chinese writing self-rating; Leg = Character legality decision task; Po = Semantic Radical Position task; Mat = Character-meaning matching task; SR = Semantic radical supplement task; WR = Word recognition

* * p < .05, ** p < .01

Creating Groups

In order to answer the two research questions, the participants were divided into different groups according to their Chinese language proficiency level. As there are no standardized tests available to determine one’s Chinese language proficiency level, a Latent Class Analysis (LCA) was conducted to determine the Chinese language proficiency of the 97 participants.
LCA is a statistical method that enables characterization of multidimensional discrete latent variable from a cross-classification of two or more observed categorical variables (McCutcheon, 1987). LCA is frequently used when the researcher is interested in classifying study participants based on a set of interrelated categorical measures (McCutcheon, 2002).

For this study, the latent class variable was the Chinese language proficiency, and the observed variables used were Semester of Chinese study, Chinese reading self-rating, Chinese speaking self-rating, Chinese listening self-rating and Chinese writing self-rating. In order to determine number of classes that these CFL learners should be classified into, model fit statistics AIC, BIC for different models were compared. BIC and AIC are the most common relative model fit statistics for nonnested model (Henson, Reise & Kim, 2007). According to McCutcheon (2002), a model with lower BIC and AIC is preferred to a model with higher BIC and AIC. In addition, Vuong-Lo-Mendell-Rubin likelihood ratio test provides a standard of comparison for ascertaining the numbers of classes in the model (Duncan, Duncan, & Strycker, 2006). The Mplus 5 output showed that the 3-class model had the lowest BIC and AIC, while the 1-class model had the highest BIC and AIC. Yet the Vuong-Lo-Mendell-Rubin likelihood ratio test for 2 versus 3 classes turned out to be non-significant \( (p > .05) \), which indicated that the more parsimonious 2-class model should be preferred. Based on this model fit information, the 2-class model was adopted.

This two-class latent class model classified 46 participants into the first class and 51 into the second class. The correlation matrix among the latent variable (Chinese language proficiency level) and the observed variables is demonstrated in Table 4.3. The mean scores for the first class in semesters of study, reading self-rating, speaking self-rating, listening self-rating and writing self-rating were 2.98, 3.22, 2.33, 2.17 and 2.67; the mean scores for the second class in semester of study, reading self-rating, speaking self-rating, listening self-rating and writing self-rating were 3.9, 4.29, 4.02, 3.9 and 4, respectively. The second class had higher mean scores in all five observed variables. The first class was designated as the beginning level and the second class was designated as the advanced level.
Table 4.3: Correlations between LCA proficiency level and four self-ratings

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. LCA proficiency</td>
<td>---</td>
<td>.28**</td>
<td>.48**</td>
<td>.77**</td>
<td>.74**</td>
<td>.52**</td>
</tr>
<tr>
<td>2. Sem</td>
<td>---</td>
<td>- .02</td>
<td>.24*</td>
<td>.39**</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>3. Rdg</td>
<td>--</td>
<td>.47**</td>
<td>.42**</td>
<td>.72**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Spk</td>
<td>----</td>
<td>.71**</td>
<td>.51**</td>
<td></td>
<td></td>
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<tr>
<td>5. Lis</td>
<td>-----</td>
<td>.42**</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6. Wrtg</td>
<td>---</td>
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</tr>
</tbody>
</table>

Note. LCA proficiency = Chinese proficiency level based on Latent Class Analysis; Sem = Semester of Chinese study; Rdg = Chinese reading self-rating; Spk = Chinese speaking self-rating; Lis = Chinese listening self-rating; Wrtg = Chinese writing self-rating.

* p < .05, ** p < .01

Descriptive statistics by groups

Based on the LCA, 46 participants were classified as beginning CFL learners and 51 were classified as advanced CFL learners.
Table 4.4: *Descriptive statistics by groups*

<table>
<thead>
<tr>
<th></th>
<th>Beginning (N = 46)</th>
<th>Advanced (N = 51)</th>
<th>F (df)</th>
<th>Effect Size (Cohen's d)</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean (SD)</strong></td>
<td><strong>Mean (SD)</strong></td>
<td><strong>Min-Max</strong></td>
<td><strong>Min-Max</strong></td>
<td>F(1, 95) =</td>
<td>.46</td>
</tr>
<tr>
<td><strong>Sem</strong></td>
<td>2.98 (1.06)</td>
<td>3.90 (1.96)</td>
<td>2-7</td>
<td>3.90 (1.96)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>GP A</strong></td>
<td>3.58 (.49)</td>
<td>3.80 (.29)</td>
<td>2-4</td>
<td>3.80 (.29)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Rdg</strong></td>
<td>3.22 (1.01)</td>
<td>4.29 (.97)</td>
<td>1-5</td>
<td>4.29 (.97)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Spk</strong></td>
<td>2.33 (.76)</td>
<td>4.02 (.68)</td>
<td>1-3</td>
<td>4.02 (.68)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Lis</strong></td>
<td>2.17 (.88)</td>
<td>3.90 (.73)</td>
<td>1-4</td>
<td>3.90 (.73)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Wrt g</strong></td>
<td>2.67 (1.08)</td>
<td>4.00 (1.11)</td>
<td>1-6</td>
<td>4.00 (1.11)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Leg</strong></td>
<td>28.72 (6.33)</td>
<td>31.47 (5.79)</td>
<td>17-39</td>
<td>31.47 (5.79)</td>
<td>F(1, 95) = 5.01*</td>
</tr>
<tr>
<td><strong>Po</strong></td>
<td>7.46 (4.11)</td>
<td>9.53 (4.15)</td>
<td>0-14</td>
<td>9.53 (4.15)</td>
<td>F(1,95) = 6.08*</td>
</tr>
<tr>
<td><strong>Mat</strong></td>
<td>9.57 (3.11)</td>
<td>11.37 (2.79)</td>
<td>2-15</td>
<td>11.37 (2.79)</td>
<td>F(1, 95) = 9.12**</td>
</tr>
<tr>
<td><strong>SR</strong></td>
<td>5.83 (3.74)</td>
<td>8.10 (4.02)</td>
<td>0-14</td>
<td>8.10 (4.02)</td>
<td>F(1,95) = 8.26**</td>
</tr>
<tr>
<td><strong>WR</strong></td>
<td>6.85 (4.38)</td>
<td>9.88 (4.10)</td>
<td>0-16</td>
<td>9.88 (4.10)</td>
<td>F(1, 95) = 12.41**</td>
</tr>
</tbody>
</table>

*Note. WR = Word recognition; Leg = Character legality decision; Po = Semantic Radical Position task; Mat = Character-meaning matching; SR = Semantic Radical Supplement task.*

*p < .05, **p < .01*
Research Question 1: Do advanced CFL learners have a higher level of radical awareness than beginning CFL learners?

Before the one-way ANOVA was conducted, the assumptions of ANOVA were first checked. The Levene’s test was done to ensure that homogeneity of variance was met. None of the four Levene’s tests was statistically significant ($p_s \geq .30$). This means that the error variances of the dependent variables were equal across groups.

Second, a one-way ANOVA was run to determine if the advanced CFL learners had a higher level of radical awareness than beginning CFL learners. As shown in Table 4.4, the ANOVA tests for all the four radical awareness tasks were statistically significant ($F_s \geq 5.01$, $p_s \leq .03$).

All four significance tests suggested that the advanced CFL learners had higher level of radical awareness than beginning CFL learners. However, as significance tests are greatly influenced by the sample size (Neil, 2008) and may not used to determine whether there is a meaningful difference (Cohen, 1995), the effect sizes indicated by Cohen’s d for the four tasks were computed and shown in Table 4.4. The Character Legality Decision task had the effect size of .46, the Semantic Radical Position task had an effect size of .51; the Character-meaning Matching task had an effect size of .62 and the Semantic Radical Supplement task had an effect size of .59. According to Cohen’s d criteria (Cohen, 1988), these indicate medium size effects.

Post-hoc power analyses were done to determine the statistical power of detecting the mean differences in four radical awareness tasks between the two groups. An online calculator provided by DSS research (2010, retrieved at http://www.dssresearch.com/toolkit/spcalc/power_a2.asp) was used to calculate the power and the statistical power for detecting the differences in the four radical awareness tasks were .60, .69, .85 and .82 for legality decision task, semantic radical position task, character-meaning matching task and semantic radical supplement task, respectively. This means that the chances of detecting differences between advanced and beginning level students in implicit positional radical awareness, explicit positional radical awareness, implicit functional semantic radical awareness and explicit semantic radical awareness tasks were 60%, 69%, 85% and 82%, respectively.
Research Question 2: Is radical awareness related to word recognition for CFL learners? Does the relation between radical awareness and word recognition differ between advanced and beginning CFL learners?”

To answer this research question, four multiple fix-order regression analyses were conducted. In these four multiple regression models, word recognition was the dependent variable. The language proficiency level was entered to the model first, followed by one of four radical awareness tasks, and the interaction between each of the four radical awareness tasks and language proficiency level. The interaction effect between language proficiency level and radical awareness tasks was to determine whether the relation between radical awareness and word recognition differs for beginning and advanced CFL learners.

Before the multiple regression models were run, the assumption of linearity was checked. The scatterplots showed that the relations between word recognition and each of the four radical awareness tasks were linear, thus the assumption of linearity was satisfied. The results of the four multiple regression analyses are presented in Table 4.5.

When the independent variables were Character Legality Decision tasks, Chinese language proficiency level, and the interaction between Character Legality decision and Chinese language proficiency level, the main effect of the Character Legality Decision task was statistically significant ($p = .006$). This means that for one unit difference in character legality decision task, there is a .98 unit difference in word recognition, holding the Chinese proficiency level and the interaction between character legality decision and Chinese proficiency level constant. The nonsignificant interaction between character legality decision and Chinese proficiency level ($p = .64$) suggested that the relation between implicit positional radical awareness does not differ significantly between advanced and beginning CFL learners.

When the independent variables were Semantic Radical Position task, Chinese proficiency level and the interaction between semantic radical position and Chinese proficiency level, the main effect of semantic radical position task was significant ($p < .01$). In other words, one unit difference in semantic radical position task is associated with to 2.09 unit of difference in word recognition, holding Chinese proficiency level and the interaction between semantic radical position task and proficiency level constant. The interaction effect was not significant ($p = .16$), which suggested that the explicit positional radical awareness does not differ significantly between beginning and advanced CFL learners.
When the independent variables were Character-meaning Matching task, Chinese proficiency level and the interaction between Character-meaning Matching task and Chinese proficiency level, the main effect of neither character-meaning matching nor Chinese proficiency level were significant. The interaction effect is non-significant ($p = .64$), suggesting that the relation between implicit functional radical awareness and word recognition does not differ between advanced and beginning CFL learners.

When the independent variables were Semantic Radical Supplement task, Chinese proficiency level and the interaction between Semantic Radical Supplement task and Chinese proficiency level, the main effects of both semantic radical supplement and Chinese proficiency level are significant ($ps < .05$). The interaction effect is non-significant ($p = .11$), suggesting that the relation between explicit functional semantic radical awareness does not differ between advanced and beginning CFL learners.

Post-hoc power analyses were conducted by using an online calculator (Danielsoper.com, 2010, retrieved at http://www.danielsoper.com/statcalc(calc09.aspx), and all yielded power of 1.0. This means that the chance of seeing a significant relationship between implicit positional radical awareness, explicit positional radical awareness, and explicit functional semantic radical awareness and word recognition is 100%. 
Table 4.5: *Multiple Regression Results (N = 97)*

<table>
<thead>
<tr>
<th>Character legality decision task as a main predictor</th>
<th>B (s.e)</th>
<th>$\beta$</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-8.85 (5.49)</td>
<td>NA</td>
<td>-1.6</td>
</tr>
<tr>
<td>Legality decision task</td>
<td>.48 (.18)</td>
<td>.66</td>
<td>2.61*</td>
</tr>
<tr>
<td>Proficiency level</td>
<td>3.21 (3.61)</td>
<td>.36</td>
<td>.89</td>
</tr>
<tr>
<td>Legality * Proficiency level</td>
<td>-.04 (.12)</td>
<td>-.19</td>
<td>-.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semantic radical position task as a main predictor</th>
<th>B (s.e)</th>
<th>$\beta$</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-2.45 (2.00)</td>
<td>NA</td>
<td>-1.23</td>
</tr>
<tr>
<td>Semantic radical position task</td>
<td>1.03 (.23)</td>
<td>.98</td>
<td>4.57***</td>
</tr>
<tr>
<td>Proficiency level</td>
<td>2.90 (1.32)</td>
<td>.32</td>
<td>2.19*</td>
</tr>
<tr>
<td>SR position * Proficiency level</td>
<td>-.17 (.14)</td>
<td>-.34</td>
<td>-1.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Character-meaning matching task as a main predictor</th>
<th>B (s.e)</th>
<th>$\beta$</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-.39 (4.12)</td>
<td>NA</td>
<td>-.10</td>
</tr>
<tr>
<td>Matching task</td>
<td>.59 (.40)</td>
<td>.41</td>
<td>1.51</td>
</tr>
<tr>
<td>Proficiency level</td>
<td>.49 (2.78)</td>
<td>.06</td>
<td>.18</td>
</tr>
<tr>
<td>Matching * Proficiency level</td>
<td>.11 (.25)</td>
<td>.20</td>
<td>.44</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semantic radical supplement task as a main predictor</th>
<th>B (s.e)</th>
<th>$\beta$</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.50 (1.61)</td>
<td>NA</td>
<td>-.93</td>
</tr>
<tr>
<td>SR supplement task</td>
<td>1.21 (.22)</td>
<td>1.09</td>
<td>5.48***</td>
</tr>
<tr>
<td>Proficiency level</td>
<td>2.55 (1.07)</td>
<td>.29</td>
<td>2.39*</td>
</tr>
<tr>
<td>SR supplement * Prof. level</td>
<td>-.22 (.14)</td>
<td>-.40</td>
<td>-1.62</td>
</tr>
</tbody>
</table>

*Note.* $^* p <.05$, $^{***} p <.001$.

**Research Question 3:** What are shared and unique relations of radical awareness with word recognition in Chinese?

All the four radical awareness tasks (i.e., character legality decision task, positional semantic radical awareness task, character-meaning matching task and semantic radical supplement task) were entered to the model simultaneously. As shown in Table 4.6, semantic radical supplement task remained positively related to word recognition after accounting for the
effects of the other three tasks. None of the other three radical awareness tasks remained to be significantly related to word recognition after accounting for the effects of other radical awareness tasks. As semantic radical supplement task was aimed at measuring the explicit semantic radical awareness, this finding suggested that explicit semantic radical awareness was the unique predictor of word recognition among CFL learners even after accounting for the effect of other aspects of radical awareness.

Table 4.6 *Summary of Regression Analyses for Predicting Word Recognition*

<table>
<thead>
<tr>
<th>Variables</th>
<th>B (s.e.)</th>
<th>β</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character legality decision task</td>
<td>.06 (.06)</td>
<td>.08</td>
<td>.94</td>
</tr>
<tr>
<td>Semantic radical position task</td>
<td>.14 (.14)</td>
<td>.13</td>
<td>.99</td>
</tr>
<tr>
<td>Character-meaning matching task</td>
<td>.15 (.11)</td>
<td>.11</td>
<td>1.41</td>
</tr>
<tr>
<td>Semantic radical supplement task</td>
<td>.65 (.14)</td>
<td>.59</td>
<td>4.52***</td>
</tr>
</tbody>
</table>

Note: *** p < .001

**Summary**

The present study has the following findings. First, advanced CFL learners had a higher level of radical awareness than beginning CFL learners. Second, there was a significant relationship between radical awareness and word recognition for both advanced and beginning CFL learners after accounting for the effect of Chinese proficiency and the interaction between Chinese proficiency and radical awareness, and this significant relationship does not vary for advanced and beginning CFL learners. Third, explicit functional semantic radical awareness is a unique predictor of word recognition after accounting for the effect of implicit functional semantic radical awareness, implicit positional radical awareness, and explicit positional radical awareness.
CHAPTER 5
DISCUSSION AND CONCLUSIONS

Overview

Radical awareness has been widely studied in L1 literacy acquisition in Chinese. A substantial amount of research has shown that knowledge about the positional and functional regularities of radicals is related to word recognition and writing in Chinese (e.g., Ho et al, 2003; Packard et al, 2006). Despite the wide research interests in radical awareness in L1 literacy acquisition, radical awareness is hardly explored in L2/FL literacy acquisition.

Wang and colleagues’ studies (Wang et al., 2003; 2004) were among a few that investigated radical awareness among CFL learners, yet their studies only explored the positional radical awareness with a limited number (N=15) of first-year CFL learners. Shen and Ke’s study (2007) involved a larger number of participants (N=140), who varied in years of Chinese study. However, this study only explored the semantic radical awareness and the relation between radical knowledge (knowledge about the meaning of 40 radicals, which could stand alone as characters) and word recognition. None of the previous studies in the L2/FL context examined both the positional and functional radical awareness at the same time. In addition, these studies assumed the importance of exposure time (i.e., number of semesters students have studied in Chinese classes) to the target language in the development of radical awareness and none considered the possible effect of language proficiency on radical awareness. The present study used the proficiency level to distinguish 97 CFL learners. To my best knowledge, this is the only study that examined the relation between Chinese language proficiency level and radical awareness to date.

Unlike the previous studies in L2/FL reading research, the present study explored both the positional and functional radical awareness (the meaning-cueing function of semantic radicals) among CFL learners, who differed in their Chinese proficiency levels. In addition, the present study differs from previous studies in that it further differentiates the two aspects of radical awareness (positional and functional radical awareness) into explicit and implicit awareness, thus examining four aspects of radical awareness.

The primary purpose of this study was to determine radical awareness levels among CFL learners who differ in Chinese proficiency, to explore shared and unique relation between radical
awareness and word recognition among CFL learners. In order to meet these goals, three tasks aimed at measuring radical awareness and one word recognition test were created and pilot-tested. Then they were administered to 97 CFL learners. These CFL learners were classified as either beginning or advanced CFL learners based on results from a Latent Class Analysis.

Three major findings have been discovered for the present study. First, advanced CFL learners had higher levels of radical awareness than beginning CFL learners. Second, there was a significant relationship between radical awareness and word recognition for both advanced and beginning CFL learners after accounting for the effect of Chinese proficiency and the interaction between Chinese proficiency and radical awareness, and this significant relationship does not vary for advanced and beginning CFL learners. Third, explicit functional semantic radical awareness is a unique predictor of word recognition after accounting for the effect of implicit functional semantic radical awareness, implicit positional radical awareness, and explicit positional radical awareness. This chapter offers interpretations and discussions for these findings. Limitations of the present study and directions for future studies are also discussed.

Radical Awareness among CFL Learners

The first research question of the present study aimed at examining the relation between language proficiency and radical awareness. As stated in Chapter four, the one-way ANOVA analysis showed that advanced CFL learners had higher levels of radical awareness than beginning CFL learners. This higher level of radical awareness was demonstrated in better performance in character legality decision task, semantic radical position task, character-meaning matching task, and semantic radical supplement task. These tasks were aimed at measuring the implicit positional radical awareness, explicit positional radical awareness, implicit semantic radical awareness and explicit semantic radical awareness, respectively.

No previous studies directly investigated the relation between language proficiency and radical awareness. Although it has been shown in L1 literacy acquisition studies that older students have higher levels of radical awareness than younger students (e.g., Chan & Nunes, 1998; Ho, Ng, & Ng, 2003; Shu & Anderson, 1997), this positive relationship between age and radical awareness shown in L1 literacy acquisition is not comparable to the significant relationship between Chinese language proficiency and radical awareness drawn from the present study. Unlike children who were yet to reach cognitive maturity, all of the 97
participants involved in the present study were college students. They brought to the classroom the conceptual sophistication of adults and they already were literate in their L1. For the present study, these college CFL learners were designated as either advanced or beginning CFL learners based on latent class analysis, where the observed variables were semester of study in Chinese classes, self-rated scores in Chinese listening, speaking, reading, and writing skills.

The finding that students of higher Chinese proficiency levels is associated with higher levels of positional radical awareness gives evidence that students of higher Chinese proficiency levels have a better understanding of the positional constraints of radicals and were more able to apply this understanding to judge the legality of unknown Chinese configurations. The positive relation between Chinese proficiency and implicit functional semantic radical awareness means that students of higher Chinese proficiency levels had a better understanding of the meaning-cueing functions of semantic radicals and were more able to make use of this knowledge to infer the meaning of unfamiliar characters. The significant relationship between explicit functional semantic radical awareness and Chinese language proficiency suggested that CFL learners with a higher Chinese proficiency level are better at decomposing characters into radicals and that semantic radicals may have a clearer representation in their memory. This last inference is based on Ke’s (1998, reported in Jackosn, Everson, & Ke, 2003) three-stage model of learning character for CFL learners. According to Ke, the first stage sees CFL learners learn characters as wholes and unable to decompose characters into radicals, while the second stage witnesses CFL learners treat characters are decomposable Chinese configuration.

As previously indicated, radicals usually have fixed positions within a character and serve either a meaning-cueing or pronunciation-cueing function. Accordingly, previous studies differentiated two aspects of radical awareness: the positional radical awareness and the functional radical awareness (Chan & Nunes, 1998; Ho et al., 2003). Although it was stated in the previous studies that the knowledge about positional and functional regularity in radicals could be implicit or explicit, the present study is the first one to include in an empirical study, examining four aspects of radical awareness: implicit/explicit positional radical awareness and implicit/explicit functional radical awareness.

The descriptive analyses showed that these CFL learners have a better understanding of the positional regularities of radicals than the functional regularities as the mean percent correct was higher for the positional radical awareness tasks (both implicit and explicit) than for the
semantic radical awareness tasks. This was true regardless of students’ proficiency level. These results converge with previous studies of CFL reading acquisition (Wang et al., 2003) and Chinese L1 literacy acquisition (Ho, Ng, & Ng, 2003), supporting the argument that the acquisition of functional radical awareness and positional radical awareness do not follow the same pace.

**Relationship between Radical Awareness and Word Recognition**

The second research question of the present study explored the relationship between radical awareness and word recognition among CFL learners and whether the relationship differs for advanced and beginning CFL learners. As shown in chapter four, the multiple regression analyses yielded a significant relation between word recognition and implicit positional radical awareness, a significant relation between word recognition and explicit positional radical awareness, and a significant relation between word recognition and explicit functional semantic radical awareness after accounting for the effect of Chinese proficiency and the interaction between Chinese proficiency and radical awareness. In addition, the present study showed that this strong association does not vary between advanced and beginning CFL learners. This significant relation between radical awareness and word recognition has also been documented in L1 literacy acquisition (e.g., Ho, Ng, & Ng, 2003; Packard et al., 2006).

This significant relationship holds for both L1 and L2 learners may be attributed to the importance of radicals in character formation and character processing. As indicated earlier, radicals carry orthographic and morphological information. They follow positional constraints and they have meaning-cueing or pronunciation-cueing functions. Empirical studies on character recognition among skilled readers (e.g., Ding, Peng, & Taft, 2004; Taft, Zhu, & Peng, 1999; Zhu & Marslen-Wilson, 1999) have demonstrated that the frequency of radicals affected the reaction time and accuracy of the whole characters and thus given evidence that radicals are indeed activated in character recognition. Additionally, it has been documented that knowledge about radicals has a significant relation with reading and writing acquisition among developing L1 readers (Ho et al., 2003; Packard et al., 2006). Error analyses that targeted CFL learners also suggested that learners were gradually able to decompose characters into radicals and began to generate characters (wrong characters) by combining semantic radicals with phonetic radicals (Jiang & Liu, 2004; Ma, 2007).
Shen and Ke’s (2007) study was one of the few that examined the relation between radical knowledge application skill and vocabulary among 140 US college CFL learners, who were in their first, second, third or fourth year of Chinese study. A moderate positive correlation was reported between semantic radical knowledge and word recognition ($r = .46, p < .001$) for both the one-year group and two-year group CFL learners. The present study, however, found a much stronger relationship between radical awareness and word recognition ($rs = .59 & .84, ps < .01$). This might be because a different operationalization of radical awareness was adopted in the two studies. In Shen and Ke’s study, the knowledge of semantic radicals (knowing their sound, shape, and meaning) was classified as one of the three “levels” of radical awareness whereas a much more strict definition was adopted for the present study in that semantic radical awareness was referred as the learners’ knowledge about the meaning-cueing function of semantic radicals and the skill to make use of the knowledge in literacy acquisition.

As stated earlier, no previous study systematically examined four aspects of radical awareness. A widely adopted practice was to distinguish two aspects of radical awareness, namely, the positional radical awareness and functional radical awareness (e.g., Ho et al., 2003; Shen & Ke, 2007). In the present study, explicit semantic radical awareness (measured by semantic radical supplement task) is the only significant predictor of wording reading in Chinese after accounting for the effects of other radical awareness measures. This result suggests that although radical awareness is related to word recognition in Chinese, various radical awareness tasks require different levels of control and type of knowledge to be analyzed, and these variations may matter in the extent of relation with word recognition. Explicit semantic radical awareness requires one to know the meaning and meaning-cueing function of semantic radicals, to retrieve correct radicals, and to apply this knowledge in character writing. Thus, this task may tap into a higher level of semantic radical awareness than does implicit semantic radical awareness. According to Gombert (1992), explicit metalinguistic awareness emerges from implicit metalinguistic awareness and while implicit metalinguistic awareness involves the declarative knowledge, the explicit metalinguistic awareness involves the procedural knowledge, which is used during language production or comprehension. This distinction could help to explain why explicit functional semantic radical awareness is the unique predictor of word recognition.
Limitations and Directions for Future Study

The first limitation of the present study is concerned with the validity of the instrument used for the present study. For the purpose of the present study, I created two of the three radical awareness tasks and the word recognition test. Although statistical analysis yielded good internal consistency (Cronbach’s $\alpha \geq .75$) for all instruments, their validities need to be tested. However, it should be noted that the significant correlations among the radical awareness tasks and between radical awareness tasks and the word recognition task provided some validity evidence. Additionally, all the characters in the character-meaning matching task were of left-right structure, and no top-bottom structured characters were included. Thus, future studies need to incorporate characters of both left-right and top-bottom structure.

The second limitation of the present study is the exclusion of phonetic radical awareness. Although previous studies have shown that learners’ awareness of the sound-cueing function of phonetic radicals develops much slower than the awareness of the meaning-cueing function of semantic radicals (Ho et al., 2003; Jackson, Everson, & Ke, 2003) due to the high inconsistency between the pronunciation of the phonetic radicals and that of the character (Shu, 2003), it would have been ideal to include this aspect of radical awareness in the present study.

The third limitation of the present study is its generalizability. Only a limited number of radicals were included in the four radical awareness tasks. These radicals were included in the present study, as they were of high frequency and had high combinability based on the textbook they used in their Chinese studies. However, this high frequency and high combinability may not be true to other groups of CFL learners, who use different textbooks. Therefore, the result of the present study may not be easily generalized to other CFL learners.

The findings and limitations of the present study give rise to recommendations for future study. First, future studies should replicate the present study in order to examine the validity and reliability of the instruments and generalizability of the findings. Second, although the present study showed that there is a significant relation between radical awareness and word recognition, it is only a correlational and cross-sectional study. Longitudinal studies are needed to see whether radical awareness is a strong predictor of later reading.
Pedagogical Implications

The present study showed that higher levels of radical awareness are linked to higher Chinese proficiency levels and that implicit positional radical awareness, explicit positional radical awareness, and explicit functional semantic radical awareness are significantly related to word recognition among CFL learners. These findings give evidence of the importance of radical awareness in L2/FL reading acquisition and call for more instructional attention.

Instructional methods are believed to influence character learning (Cheung & Ng, 2003; Jackson, Everson & Ke, 2003). Although radicals and the meaning-cueing function were introduced in the eighth week of these participants’ study (personal correspondence with all the teachers involved in the present study), teachers of these participants admitted that this concept had not been emphasized in their later teaching due to time constraints. This may explain the low percentages of correct answers in the four radical awareness tasks. Yet previous studies have shown that using semantic radicals to establish link between familiar characters and new characters is beneficial to character recognition (e.g., Zhao & Jiang, 2002) and that intervention on radical awareness could lead to significantly better performance in both reading and writing in Chinese (Li, 2010; Packard et al., 2006). Li’s (2010) study reported the effect of a teaching method on the word recognition among a group of intermediate and advanced Chinese learners, who came to study in Beijing. This teaching method emphasized the meaning-cueing and pronunciation-cueing function of radicals. After a semester of study, the intermediate and advanced level Chinese learners had an average increase of 600 characters. Although this study did not include a control group, this big increase within a short period of time provided evidence that instructions that emphasize raising the learners’ radical awareness could be very helpful to CFL learners. Zhao and Jiang’s (2002) demonstrated that there was a significant relation between word identification and semantic radical application strategy and that semantic radical application strategy was one of the strategies that were believed to be most effective in character learning among CFL learners. At the same time, Jackson and colleagues (Jackson, Everson & Ke, 2003) indicated that though semantic radical application strategy may indeed be valued by CFL learners, this strategy may be difficult to use as CFL learners have not accumulated enough characters in their mental lexicons to abstract the radicals (Jackson et al., 2003).

The significant relation between word recognition and radical awareness and the difficulty for the beginning CFL learners to make use of the semantic radical application strategy...
(Zhao & Jiang, 2002) suggest that it would be advisable for the instructors to postpone the introduction of semantic radicals in their teaching, and that systematically classifying characters and teaching characters according to shared semantic radicals may be helpful for character learning. The findings of the present study also have implications for textbook writers. It suggests that they could highlight, bold semantic radicals when introducing characters in vocabulary list as visual input enhancement (e.g., bolding, underlying, or highlighting) has proved to be effective in second language acquisition (Doughty, 1991; Williams, 1999). Additionally, it is advisable that textbooks could incorporate activities that help CFL learners to strengthen their understanding of the meaning-cueing function of semantic radicals.

**Concluding Remarks**

The present study explored the development of radical awareness and the relation between radical awareness and word recognition among a group of 97 CFL learners. Radical awareness was captured by four tasks for the study, namely, a character legality decision task, a character-meaning matching task, and a semantic radical position task and a semantic radical supplement task. These four tasks measured CFL learners’ implicit positional radical awareness, explicit positional radical awareness, implicit functional semantic radical awareness and explicit functional semantic radical awareness. The present study extended the previous studies by exploring the relation between language proficiency and radical awareness. It provided evidence that a higher level of radical awareness is linked to a higher Chinese proficiency level, and that significant relations existed between radical awareness and word recognition, and that this relationship does not vary for advanced and beginning CFL learners. The pedagogical implications include: (1) Instructors need to be aware of the importance of radical awareness in reading acquisition among CFL learners; (2) More instruction time may be needed to increase the learners’ radical awareness and categorizing characters that share the same radical may be beneficial to the learners.
APPENDIX A

HUMAN SUBJECT INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL LETTER
AND CONSENT FORM

Office of the Vice President For Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673 · FAX (850) 644-4392

RE-APPROVAL MEMORANDUM

Date: 12/4/2009

To: Xiaoxiang Su

Address: 308 Pennell Circle Apt:4
Dept.: EDUCATION

From: Thomas L. Jacobson, Chair

Re: Re-approval of Use of Human subjects in Research
radical awareness and phonological awareness among Chinese as a Foreign language Learners

Your request to continue the research project listed above involving human subjects has been approved by the Human Subjects Committee. If your project has not been completed by 12/3/2010, you are must request renewed approval by the Committee.

If you submitted a proposed consent form with your renewal request, the approved stamped consent form is attached to this re-approval notice. Only the stamped version of the consent form may be used in recruiting of research subjects. You are reminded that any change in protocol for this project must be reviewed and approved by the Committee prior to
implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report in writing, any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the Chair of your department and/or your major professor are reminded of their responsibility for being informed concerning research projects involving human subjects in their department. They are advised to review the protocols as often as necessary to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

Cc: Susan Wood, Advisor
HSC No. 2009.2988
CONSENT FORM

Dear Students:

I am a graduate student under the direction of Professor Susan Wood (at 850-644-1909) in the program of Multilingual/Multicultural Education, School of Teacher Education, College of Education at the Florida State University. I am conducting a study for the doctoral dissertation. This study aims at exploring the development of radical awareness and phonological awareness among college students who study Chinese as a foreign language. The research will be conducted for six months starting from October 1, 2009 to October 1, 2010.

Your participation will involve finishing four tests and one background information questionnaire, which will take approximately 30 minutes during a regular class period. Your chapter dictation scores and final exam score will be collected from your instructors at the end of the semester. Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. It will not affect your grade.

All the records will remain confidential, to the extent allowed by law. These records will be kept in a locked cabinet in the researcher’s office. Only the researcher herself has access to the collected data and will not be revealed to others for any other purpose.

Although there may be no direct benefit to you, the possible benefit of your participation is to give insights to the Chinese instruction, which will eventually help improve your language skills.

If you have any questions concerning this study, please call me at Office: (850) 245-3805 or email me at xs05c@fsu.edu or contact my major professor Susan Wood at (850) 644-1909

Sincerely,
Xiaoxiang Su

I have read the above consent form. I understand that I may withdraw my consent and discontinue participation at any time without penalty. I understand that the data will be kept in safe and confidential place and only the researcher will have access to it. Thereby, I give my consent to participate in this study.

Name ___________________________ Date ____________

If you have any questions about your rights as a participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subject Committee, Institutional Review Board, through the Vice President for the Office of Research at (850) 644-8633.

APPENDIX B
PARTICIPANTS BACKGROUND INFORMATION

The following test is for educational research. Before you take this test, please provide all the following information. This information is for research purpose only and will remain confidential.

1. Name (Chinese name): _______________
2. Age: ____________
3. Gender: Male ______ Female__________
4. Ethnicity: White________ Black__________ Asian _________ Latino ________
   Other (Please specify) __________
5. Native language: _______________
6. Second language: _______________ Other languages: _______________
7. Major: ________________
8. Year in college: ________________
9. Do your parents (does any of them) speak Chinese Mandarin as their native language?
   Yes________  No_________
10. Were you able to read or write in Chinese before you took the Chinese class?
    Yes_________ No_________
11. Circle all Chinese courses you have taken:
    1120 (Elementary Chinese I)        1121 (Elementary Chinese II)
    2220 (Intermediate Chinese)        2300 (Chinese Grammar & Composition)
    3440a (Business Chinese I)         3440b (Business Chinese II)
    3502 (Chinese Short Story & Essay) 4930 (Advanced Grammar & Writing)
    3391 (War & Action Films)         3930 (Pre-Modern Chinese Lit/Trans)
12. What Chinese course(s) are you taking now?
    _______________________________________________________________
13. How long have you studied Chinese (including this semester and your high school experience):
    _______________ semester(s) at college    _______________ semester in high school
14. Did you study in the oversea program in Tianjin or similar intensive Chinese study program in China?
   Yes ______________       No_______________

15. What grades have you received in your Chinese classes at FSU?
   1st semester______       2nd semester_______       3rd semester______       4th semester_______
   5th semester______       6th semester_______       7th semester______       8th semester_______

16. How do you grade yourself in Chinese (Please circle the number, 6 stands for “excellent” while 1 stands for “poor”, 5, 4, 3, 2 are grades in between )?

   Excellent          Poor
   6  5  4  3  2  1 in Speaking
   6  5  4  3  2  1 in Listening
   6  5  4  3  2  1 in Reading
   6  5  4  3  2  1 in Writing

17. How do you grade yourself in English?

   Excellent          Poor
   6  5  4  3  2  1 in Speaking
   6  5  4  3  2  1 in Listening
   6  5  4  3  2  1 in Reading
   6  5  4  3  2  1 in Writing
APPENDIX C
CHARACTER LEGALITY DECISION TASK

Below you will see some handwritten characters that you may have never seen before. Please use your knowledge about character structures and decide whether they are written correctly. If yes, write a T in the parenthesis, if no, write a F in it.

<table>
<thead>
<tr>
<th>1. 魔 ( )</th>
<th>2. 矇 ( )</th>
<th>3. 悫 ( )</th>
<th>4. 孙 ( )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. 塾 ( )</td>
<td>6. 侻 ( )</td>
<td>7. 客 ( )</td>
<td>8. 鳥 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>9. 繷 ( )</td>
<td>10. 恬 ( )</td>
<td>11. 讶 ( )</td>
<td>12. 帥 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>13. 麥 ( )</td>
<td>14. 耆 ( )</td>
<td>15. 雩 ( )</td>
<td>16. 鎚 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>17. 倉 ( )</td>
<td>18. 拏 ( )</td>
<td>19. 場 ( )</td>
<td>20. 拆 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>21. 邋 ( )</td>
<td>22. 傲 ( )</td>
<td>23. 毛 ( )</td>
<td>24. 脷 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>25. 汐 ( )</td>
<td>26. 梥 ( )</td>
<td>27. 犠 ( )</td>
<td>28. 腉 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>29. 腍 ( )</td>
<td>30. 驮 ( )</td>
<td>31. 萬 ( )</td>
<td>32. 螟 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>33. 頞 ( )</td>
<td>34. 勤 ( )</td>
<td>35. 騁 ( )</td>
<td>36. 嵶 ( )</td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>37. 榆 ( )</td>
<td>38. 崎 ( )</td>
<td>39. 嵊 ( )</td>
<td>40. 帆 ( )</td>
</tr>
</tbody>
</table>
**APPENDIX D**

**CHARACTER-MEANING MATCHING TASK**

*Below you will see some unfamiliar characters. Use your radical knowledge to figure out the one that matches the meaning given to the left and circle it.*

<table>
<thead>
<tr>
<th>Meaning</th>
<th>Character</th>
<th>Character</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To see</td>
<td>堵</td>
<td>睹</td>
<td>赌</td>
</tr>
<tr>
<td>2. To mix</td>
<td>伴</td>
<td>拌</td>
<td>绊</td>
</tr>
<tr>
<td>3. emotion</td>
<td>蜻</td>
<td>晴</td>
<td>情</td>
</tr>
<tr>
<td>4. Peak</td>
<td>峰</td>
<td>锋</td>
<td>烽</td>
</tr>
<tr>
<td>5. Oak</td>
<td>像</td>
<td>橡</td>
<td>蟹</td>
</tr>
<tr>
<td>6. To translate</td>
<td>译</td>
<td>峰</td>
<td>驿</td>
</tr>
<tr>
<td>7. To bite</td>
<td>钉</td>
<td>叮</td>
<td>叮</td>
</tr>
<tr>
<td>8. Sunshine</td>
<td>浑</td>
<td>挥</td>
<td>晖</td>
</tr>
<tr>
<td>9. Sleeve</td>
<td>姑</td>
<td>抽</td>
<td>袖</td>
</tr>
<tr>
<td>10. To grill</td>
<td>烤</td>
<td>拷</td>
<td>拷</td>
</tr>
<tr>
<td>11. Pan</td>
<td>蜗</td>
<td>蜗</td>
<td>锅</td>
</tr>
<tr>
<td>12. Grave</td>
<td>纹</td>
<td>坟</td>
<td>汶</td>
</tr>
<tr>
<td>13. To irrigate</td>
<td>绕</td>
<td>浇</td>
<td>娆</td>
</tr>
<tr>
<td>14. To spring, to jump</td>
<td>跃</td>
<td>沃</td>
<td>祎</td>
</tr>
<tr>
<td>15. To cry</td>
<td>鸡</td>
<td>鸡</td>
<td>鸡</td>
</tr>
</tbody>
</table>
APPENDIX E
CHARACTER WRITING TASK

Below each of the following **bold** characters is **missing** a radical. Add this missing radical according to the meaning and pronunciation given.

<table>
<thead>
<tr>
<th>Pinyin</th>
<th>Meaning</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>mèi mei</td>
<td>younger sister</td>
<td>未 未</td>
</tr>
<tr>
<td>chàng gē</td>
<td>to sing</td>
<td>昌 歌</td>
</tr>
<tr>
<td>xué xiào</td>
<td>school</td>
<td>学 交</td>
</tr>
<tr>
<td>kù zi</td>
<td>pants</td>
<td>库 子</td>
</tr>
<tr>
<td>shuō</td>
<td>to say; to speak</td>
<td>兑</td>
</tr>
<tr>
<td>sān diǎn zhōng</td>
<td>three o’clock</td>
<td>三点 中</td>
</tr>
<tr>
<td>xiāng</td>
<td>to think, to want</td>
<td>相</td>
</tr>
<tr>
<td>No.</td>
<td>Chinese</td>
<td>Pinyin</td>
</tr>
<tr>
<td>-----</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>8.</td>
<td>dǎ</td>
<td>dǎ</td>
</tr>
<tr>
<td>9.</td>
<td>chī fàn</td>
<td>chī fàn</td>
</tr>
<tr>
<td>10.</td>
<td>shuǐ jiào</td>
<td>shuǐ jiào</td>
</tr>
<tr>
<td>11.</td>
<td>tiào wǔ</td>
<td>tiào wǔ</td>
</tr>
<tr>
<td>12.</td>
<td>dōng</td>
<td>dōng</td>
</tr>
<tr>
<td>13.</td>
<td>rè</td>
<td>rè</td>
</tr>
<tr>
<td>14.</td>
<td>pí jiǔ</td>
<td>pí jiǔ</td>
</tr>
<tr>
<td>15.</td>
<td>shí jiān</td>
<td>shí jiān</td>
</tr>
</tbody>
</table>
APPENDIX F
WORD RECOGNITION

*Please give the Pinyin and Meaning of the following 20 words.*

<table>
<thead>
<tr>
<th>Pinyin</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>晚上</td>
<td></td>
</tr>
<tr>
<td>球</td>
<td></td>
</tr>
<tr>
<td>漂亮</td>
<td></td>
</tr>
<tr>
<td>念</td>
<td></td>
</tr>
<tr>
<td>妈妈</td>
<td></td>
</tr>
<tr>
<td>椅子</td>
<td></td>
</tr>
<tr>
<td>踢</td>
<td></td>
</tr>
<tr>
<td>衬衫</td>
<td></td>
</tr>
<tr>
<td>眼睛</td>
<td></td>
</tr>
<tr>
<td>星期</td>
<td></td>
</tr>
<tr>
<td>茶</td>
<td></td>
</tr>
<tr>
<td>洗澡</td>
<td></td>
</tr>
<tr>
<td>抱</td>
<td></td>
</tr>
<tr>
<td>喝</td>
<td></td>
</tr>
<tr>
<td>卧室</td>
<td></td>
</tr>
<tr>
<td>这个</td>
<td></td>
</tr>
<tr>
<td>饿</td>
<td></td>
</tr>
<tr>
<td>认识</td>
<td></td>
</tr>
<tr>
<td>钱</td>
<td></td>
</tr>
<tr>
<td>城市</td>
<td></td>
</tr>
</tbody>
</table>


Schneider, W. & Sheffrin, R. (1977). Controlled and Automatic Human Information Processing:


Xiaoxiang Su is a native of Changsha, Hunan, China. In spring 1997, she got her Bachelor’s degree in English Language and Linguistics at Hunan Normal University. She got her Master’s degree in Linguistics also at Hunan Normal University in spring 2003. She enrolled in the doctoral program of Multicultural/Multilingual Education at Florida State University in 2005.

Xiaoxiang’s research interests include psycholinguistics and second language acquisition.