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Acquisition of Word Spellings and Meanings during Reading in Nonnative Chinese Speakers

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ACQUISITION OF WORD SPELLINGS AND MEANINGS DURING READING IN
NONNATIVE CHINESE SPEAKERS

A Dissertation
Presented to
The Faculty of the Educational Leadership Doctoral Program
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Doctor of Education

By
Yang Liu

May 2018

ACQUISITION OF WORD SPELLINGS AND MEANINGS DURING READING IN
NONNATIVE CHINESE SPEAKERS

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ACQUISITION OF WORD SPELLINGS AND MEANINGS DURING READING IN
NONNATIVE CHINESE SPEAKERS

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This dissertation explored the acquisition of word spellings (orthographic learning) and word meanings (incidental word learning) during reading in adult nonnative Chinese speakers. Two studies were designed for this dissertation. In Study One, 45 Chinese as a foreign language (CFL) learners at intermediate and advanced proficiency levels participated and completed a character learning experiment in a self-teaching paradigm. Results indicate that CFL learners were able to use the phonetic regularity and semantic transparency of radicals to learn the spellings and pronunciations of new characters after limited exposures to the characters in a story context. In Study Two, 72 CFL learners at novice, intermediate, and advanced proficiency levels were asked to choose the meanings of unfamiliar words presented either in isolation or in sentence context. Results show that CFL learners were more able to infer word meanings in context than in isolation, and such lexical inference ability improved with increasing Chinese proficiency levels. The findings of this dissertation reveal the underlying mechanism of orthographic learning and incidental word learning and yield implications for instruction of Chinese as a foreign language in adult learners.

CHAPTER I: INTRODUCTION

The Importance and Challenge of Learning

Chinese as a Foreign Language

In recognition of the rising international status of China due to its recent rapid growth in aggregate national strength and the growing importance of the U.S.-China relationship, employees who can speak proficient Chinese both in the government and corporations to enhance political, cultural, and economical exchange between China and America are in great demand. Chinese majors and programs in colleges have become a major source to cultivate a competent Chinese-speaking work force, and an increasing number of college students are interested in learning Chinese as a foreign language (CFL) to improve their competitiveness in the global workplace. According to the U.S. Department of Education (2015), Chinese was the second most popular dual-language program implemented by individual states in 2013.

However, the growing number of CFL learners has resulted in increasing awareness of the challenges inherent in learning CFL. The Foreign Service Institute (FSI) ranked a list of different languages into five categories, with an order of increasing difficulty of the languages and approximate time required to reach general professional proficiency in speaking and reading, and Chinese is in Category V. This means that this language is exceptionally difficult for English speakers and needs 2200 hours to achieve general professional proficiency to be able to function in the workplace, whereas to reach the same level of some languages in Category I, such as Spanish, only 575 to 600 hours are needed. This magnitude of difference in difficulty and time for English speakers is attributed primarily to the linguistic features of Chinese that are typologically distant

from those of English, as reported by Everson (1998), who said that learning to read Chinese is one of the greatest challenges faced by CFL learners.

Chinese is considered to be a logographic language in which written forms are square-shaped characters and visually distinct from each other. Characters carry meanings and varying amounts of phonetic information, and their pronunciations are denoted by Pinyin, an alphabetic system providing phonological aid. These linguistic features of Chinese require a different language processing mechanism in CFL learners of English background. However, the importance of word knowledge in language proficiency development is well recognized across different writing systems (Anderson & Freebody, 1981; Beck, Perfetti, & McKeown, 1982; Coady, 1997; Koda, 1989, 2005; Zhang & Li, 2016). Therefore, theories and empirical evidence that guide Chinese orthographic and word learning and inform pedagogical practices in CFL learning are gaining research attention.

Theoretical Frameworks

Theories concerning Chinese orthographic learning have largely relied on the orthographic learning of alphabetic languages. One prevalent orthographic learning theory, the Self-teaching Hypothesis, proposed by Share (1995), states that children of alphabetic language learners apply phonological recoding as a self-teaching device to acquire orthographies independently with limited times of exposure to new orthographies. Compelling evidence from empirical studies confirms Share's (1995) hypothesis that children and adults of both shallow and relatively deep (compared to Hebrew) orthographic learners are able to phonologically recode new orthographies and acquire their phonological and orthographic forms within a couple of word exposures

(Bowey & Muller, 2005; Brooks, 1977; Cunningham, Perry, Stanovich, & Share, 2002; Cunningham, 2006; Kyte & Johnson, 2006; Manis, 1985; Nation, Angell, & Castles, 2007; Reitsma, 1983a; 1983b; Share, 1999, 2004; Tucker, Castles, Laroche, & Deacon, 2016; Wang, Castles, & Nickels, 2012; Wang, Castles, Nickels, & Nation, 2011). The findings suggest that there are fundamentally different learning mechanisms underlying the orthographic learning of typologically different languages based on their orthographic depth (Share, 2004). Context, word familiarity, and word regularity are primary factors that impact learners' orthographic learning (Cunningham, 2006; Cunningham et al., 2002; Tucker et al., 2016; Wang et al., 2012; Wang et al., 2011).

Despite the importance of Chinese orthographic learning, early research on Chinese orthography focused on Chinese orthographic knowledge development and awareness of character subcomponents both in the first language (Anderson, Li, Ku, Shu, & Wu, 2003; Chan & Nunes, 1998; Ho, Ng, & Ng, 2003; Ho & Bryant, 1997; Packard et al., 2006; Shu & Anderson, 1997; Shu, Anderson, & Wu, 2000) and in CFL learners (Shen, 2000; Shen & Ke, 2007; Taft & Chung, 1999; Wang, Liu, & Perfetti, 2004; Wang, Perfetti, & Liu, 2003; Williams, 2013; Zhang, Li, Dong, Xu, & Sholar, 2016). Xiao (2013) and Ho (2013) were among the first empirical studies investigating Chinese orthographic learning in the self-teaching paradigm. Xiao indicated that Chinese children are more able to use the semantic subcomponents of characters to learn the orthographic forms of novel characters, and the semantic subcomponents of characters affect the acquisition of phonological forms of characters. However, Ho showed that Chinese children are more able to use phonetic properties of characters to learn orthographic and phonological forms of characters. A study that investigated CFL learners' orthographic

learning showed that semantic radical knowledge affected their orthographic learning process (Zhang & Li, 2016).

Another theoretical framework that can largely explain individual differences in word knowledge and vocabulary size is incidental word learning, which refers to word acquisition as a by-product of children engaging in communicative activities, such as reading or watching videos (Huckin & Coady, 1999). A body of research documents that young learners of alphabetic languages acquire a large number of words incidentally through leisure reading outside of the classroom, and they are able to infer the meanings of new words while reading (Freebody & Anderson, 1983; Carlisle, Fleming, & Gudbrandsen, 2000; Hulstijn, 2003; Jenkins & Dixon, 1983; Nagy, Anderson, & Herman, 1987; Nagy, Herman, & Anderson, 1985; Thomas & Robinson, 1972). Though children's vocabulary development largely relies on incidental learning during normal reading, there are several factors affecting the learning process. Context support related to the macrostructures (text type and text organization) and microstructures (grammar and syntax use) of text and unfamiliar word coverage in the reading is critical to the success of incidental word learning (Carlisle et al., 2000; Herman, Anderson, Pearson, & Nagy, 1987; Nation, 2000). Another essential factor is word morphology, which refers to the structures of words (Carlisle, 1995, 2000; Deacon & Kirby, 2004; McCutchen, Green, & Abbott, 2008; McCutchen & Logan, 2011; Nagy, Berninger, & Abbott, 2006; Nagy & Herman, 1984; Nunes, Bryant, & Bindman, 1997, 2006). Based on the Interaction Hypothesis proposed by Nagy and Herman (1984), incidental word learning interacts with the morphological structures of unfamiliar words in inferring the meanings of words. Learners' abilities to infer the meanings of new words also depend on their

linguistic abilities (Beck & McKeown, 1991; Bensoussan & Laufer, 1984; Jenkins, Stein, & Wysocki, 1984; Zhang & Shulley, 2017).

Incidental word learning plays an important role in word and literacy development because, through incidental word learning, learners gain a large number of words each year during normal reading. Both first and foreign language learners need to acquire a large amount of words to be able to understand authentic materials. For example, according to the National Survey of Language Situations in China (2005), for both first and CFL learners it is necessary to possess 4,000 Chinese lexical items to understand 80% of authentic materials. Therefore, whether CFL learners are able to infer the meaning of novel words and acquire them incidentally is worth investigating. A cross-cultural study by Shu, Anderson, and Zhang (1995) found that Chinese children in second grade were able to use both morphological structures of words and sentence context to infer the meanings of unfamiliar words. Several later empirical studies also reported similar findings that Chinese children were able to incidentally acquire unfamiliar words during reading (Han, 2015; Ku & Anderson, 2001; McBride-Chang et al., 2005).

The Nature of the Problem

Studies on orthographic learning and incidental word learning in CFL learners of English background are scant. To date, there is no empirical research investigating orthographic learning in CFL learners of English background in the self-teaching paradigm. Additionally, Mori (1996) reported that Japanese as foreign language learners were able to use both context and morphological strategies to learn the meanings of unfamiliar Kanji (a type of traditional Chinese character) words. Recently, Zhang and Li

(2016) documented a study of the incidental word learning paradigm in CFL learners of Thai background, in which learners benefited significantly from morphological knowledge of words embedded in the passages in incidental word learning. However, studies of incidental word learning explored directly in CFL learners of English background are scarce. Therefore, there is an evident research gap in orthographic learning and incidental word learning in CFL learners of English background.

Research Questions and Significance of the Study

To fill the research gap that orthographic and incidental word learning of Chinese in CFL learners of English background has not yet been empirically investigated, the present study aims to investigate: (1) Can CFL learners implicitly learn the orthographic and phonological forms of novel Chinese characters? (2) Can CFL learners infer the meanings of new Chinese words in a reading context? and (3) To what extent do individual differences in linguistic skills predict incidental word learning?

The findings of this dissertation expand the literature of orthographic and incidental word learning into CFL and contribute to an understanding of the mechanism underlying character and word learning that is critical to the success of CFL learners. Additionally, the findings provide insights into native English readers learning a new language system, Chinese, which is typologically distinct from English. Finally, further pedagogical and curriculum suggestions are articulated based on the findings to guide CFL teaching and learning in the classroom.

CHAPTER II: LITERATURE REVIEW

In this chapter, the first part describes the relevant characteristics of the Chinese writing system concerning character formation, Chinese orthography, and Chinese morphology to facilitate an understanding of the present study. Then, the Self-teaching Hypothesis underlying the mechanism of orthographic learning of unfamiliar words in alphabetic languages is systematically reviewed, followed by a review of empirical research on orthographic learning in Chinese. In the next section, incidental word learning of English and Chinese vocabulary is introduced. In the end, the research questions and hypotheses of the present study are stated.

Relevant Characteristics of the Chinese Writing System

The Formation of Chinese Characters

Chinese, in contrast to alphabetic languages, is a morphosyllabic language written in square shaped symbols. These symbols are the basic orthographic units of the Chinese writing system called characters. Each character maps onto one morpheme and corresponds with one syllable. Each Chinese syllable contains one optional onset and one rime. Chinese is also a tonal language and there are four tones, including flat, rising, falling and rising, and falling. Chinese syllables are denoted by an alphabetic script called Pinyin designed to help learners acquire the pronunciations of characters. Every Chinese character is formed by its subcomponents, radicals, and contains one or more radicals.

Some radicals are stand-alone characters with their own pronunciations and meanings, whereas others are only components of characters. According to Shu and Anderson (1999), there are approximately 1,290 radicals in total; however, the Chinese Radical Position Frequency Dictionary (1984) documents 238 radicals that can be used as

the building blocks of characters. Based on the number of radicals within a character, the character can be classified as a simple character or a compound character (Perfetti & Tan, 1999). Simple characters, as its name implies, consist of one radical (e.g., 人), while compound characters are composed of two or more radicals (e.g., 他; Perfetti & Liu, 2006), constituting more than 80% of modern Chinese characters (Shu & Anderson, 1999) and 72% of elementary school characters (Shu, Chen, Anderson, Wu, & Xuan, 2003). Radicals are formed by strokes that are the smallest building materials for characters. There are 24 basic strokes, according to Wang and Yang (2008). These strokes are combined to produce hundreds of patterns, following positional constraints to build characters (Fu, 1994). The next section explains the positional and functional constraints of Chinese radicals.

Positional and Functional Regularities of Semantic and Phonetic Radicals

Radicals play a critical role in the formation of compound characters because the configurations of radicals within compound characters are not arbitrary, including top to bottom (e.g., 昊, 吕), side by side (e.g., 明, 刘), and inside-outside (e.g., 国, 连). Within these configurations, some radicals are also constrained by their positional regularities. For example, some radicals can only appear at the right side of compound characters (e.g., “讠”) or at the left side of compound characters (e.g., “亻”); other radicals can be at the top of compound characters (e.g., “艹”) or at the bottom of compound characters (e.g., “皿”). According to the Chinese Radical Position Frequency Dictionary (1984), about 66% of all radicals comply with positional rules. In addition, some radicals appear in different shapes depending on their positions (e.g., 礻 on the left and 礻 on the right; Taft & Zhu, 1997). When a radical violates its positional constraints, its composed symbol is a

noncharacter or illegal character. When a radical appears at its regular position, the symbol could be a real character or a pseudocharacter that does not exist in reality.

Radicals also function as semantic and phonetic cuing devices within compound characters and such compound characters are semantic-phonetic compounds (Shu et al., 2000). Radicals providing semantic categories of compound characters are called semantic radicals, and radicals cuing phonetic information of compound characters are phonetic radicals. For example, the compound character “洋” is pronounced *yáng* the same as its phonetic radical “羊” *yáng* and means *ocean*, which belongs to its semantic category “氵” *water*. Hoosain (1991) recorded about 200 semantic and 800 phonetic radicals, whereas Shu and Anderson (1999) documented 190 semantic radicals and 1,100 phonetic radicals.

Semantic radicals provide relatively accurate semantic information about compound characters. When the semantic information is accurate, the compound characters are transparent compound characters (e.g., 氵 means *water* and 湖 means *lake*). However, because of the long history of the Chinese writing system, some semantic radicals lost their original meanings and provide misleading semantic information about compound characters. When the semantic information is inaccurate, the compound characters are opaque. For example, the character “錯” means *wrong*, which is not related to the meaning of its semantic radical “钅” meaning *metal*.

Phonetic radicals, on the other hand, offer varying phonetic cues about compound characters. Only 40% of phonetic radicals provide accurate phonetic information about the compound characters called regular compound characters (e.g., phonetic radical 羊

/ yáng / and compound character 洋/yáng /; Shu et al., 2000). The remaining phonetic radicals either provide partial phonetic information about compound characters (e.g., phonetic radical 亢/kàng/ and compound character 杭/háng/) or no phonetic cues about compound characters (e.g., phonetic radical 台/tái/ and compound character 怡/yí). These characters are called semi-regular compound characters and irregular compound characters, respectively.

Chinese Morphology

Morphology refers to word formation rules in a language. Chinese, considered to be an ideographic language, entails two levels (character and word) of morphology. At the character level, the smallest Chinese morpheme is the semantic radical, a subcomponent of compound characters, which cues the semantic category of the characters. As previously mentioned, the majority of semantic radicals provide accurate semantic categories about the compound characters. Take the semantic radical 足 foot as an example; it hints at the meaning of the compound character 跳 *jump*, which relates to *foot*. Additionally, the meanings of the compound characters sharing the same semantic radical relate to each other. For instance, the meanings of the compound characters 海, 河, and 湖 are *sea*, *river*, and *lake* and all mean a body of water in different forms.

At the word level, Chinese words are divided into single words (e.g., 我) and compound words (e.g., 钱包) that consist of two or more morphemes. Two-character words occupy 74% of high-frequency words (Modern Chinese Frequency Dictionary, 1986). According to Packard (2000) and Xing (2006), compound words occupy 75% to 80% of modern Chinese words. Morphemes in compound words can either be

independent morphemes or bound morphemes and bring independent meanings to the words (e.g., 牛 means *cattle*; 奶 means *milk*; 牛奶 means *cattle milk*; Zhou, Marslen-Wilson, Taft, & Shu, 1999). Therefore, the meaning of a morphologically complex compound word can be inferred by interpreting each sublexical meaningful unit, each morpheme. For example, the compound word 高血压 *high blood pressure* means *hypertension*. The meaning of the word can be inferred by interpreting the three morphemes 高 *high*, 血 *blood*, and 压 *pressure* and combining the meanings of each constituent morpheme *high blood pressure*. Moreover, the meanings of compound words sharing the same morpheme are related. For example, the meanings of 电话 (*electricity-speech, telephone*), 电脑 (*electricity brain, computer*), and 电视 (*electricity view, television*) are all related to the meaning of 电 (*electricity*). Semantically transparent compound words can be easily interpreted by combining the meanings of their component characters. However, the meanings of some compound words are metaphorical or figurative, and these compound words are semantically opaque. For instance, the word 东西 means *thing*; however, 东 means *east* and 西 means *west*. The meaning of the word derives from a historical story and cannot be easily figured out by interpreting the constituent morphemes.

Orthographic Learning and Self-teaching Hypothesis

Orthographic learning refers to the process of transitioning from mapping printed words with their oral forms to recognizing the words as individual lexical units (Castles & Nation, 2006). Orthographic learning of Chinese characters has gained much attention in literature due to the complexity of Chinese orthography and the features distinct from English. However, research on Chinese orthographic learning has largely relied on the

theoretical framework from English orthographic learning. The next section explains how the prevalent theory of orthographic learning, the Self-teaching Hypothesis, in alphabetic languages was developed. Then, the literature of orthographic learning in Chinese is reviewed.

Early Research on Phonological and Orthographic Learning in English

English is an alphabetic writing system in which written English words represent pronunciation. Relatively speaking (compared to Chinese orthography), the orthography of English encodes direct and consistent phonological information and adheres to orthography-phonology correspondence rules (e.g., *made* or *like*); therefore, words can be pronounced accurately at the first sight (Venezky, 1970). Nevertheless, there is a smaller proportion of irregular words that are spelled regularly but violate spelling-sound correspondence rules (e.g., *have*, or *give*; Glushko, 1979) and another small proportion of uncommon words that are both spelled irregularly and violate spelling-sound correspondence rules (e.g., *ache*; Waters, Seidenberg, & Bruck, 1984). Though irregular and uncommon words occupy a small proportion, the number of these words is considerable. Over the past few decades, the investigations on whether and how learners of English employ grapheme-phoneme correspondence rules in both phonological and orthographic learning of English words drew much attention from linguistic, psycholinguistic, and educational researchers and practitioners because effective reading pedagogies to enhance literacy were in great demand.

However, the early research findings on English orthographic learning did not reach consensus (Baron & Strawson, 1976; Coltheart, Davelaar, Jonasson, & Besner, 1977; Glushko, 1979; Gough & Cosky, 1977; Stanovich & Bauer, 1978). In simple

pronunciation tasks, research has indicated that regular words are performed better by adult subjects than irregular words, suggesting an employment of spelling and sound corresponding rules (Baron & Strawson, 1976; Glushko, 1979; Gough & Cosky, 1977; Stanovich & Bauer, 1978). However, Coltheart and her colleagues (1979) found that adult subjects were affected by spelling-sound correspondence rules more in reading words aloud tasks than in lexical decision tasks, suggesting that using correspondence rules is a more effective strategy specific for phonological learning rather than orthographic learning.

Later, Seidenberg, Waters, Barnes, and Tanenhaus (1984) found the critical factor that contributed to the inconsistency of the results in the earlier experiments was word frequency. The studies that used more stimuli of lower frequency irregular words or words of uncommon spelling patterns (e.g., *ache*) tended to produce a greater effect of orthography-phonology correspondence rules than those that only included both more high-frequency regular and irregular words (Seidenberg et al., 1984). Therefore, to balance the frequency of stimuli, Seidenberg et al. (1984) carried out experiments to include all high- and low- frequency regular, irregular, and uncommon words and compared them for naming and lexical decision latencies. They found that there were no effects across different types of words for high-frequency stimuli in both pronunciation and lexical decision tasks, indicating that the word recognition of familiar words was not influenced by spelling-sound correspondence rules regardless of regular or irregular words, and familiar words were recognized visually. On the other hand, for low-frequency words, it took subjects longer to recognize both irregular words and uncommon spelling words in pronunciation tasks and only uncommon words in lexical

decision tasks than regular words, suggesting that phonological recoding was applied in the process of accessing unfamiliar words including both irregular words and orthographically uncommon words.

These results suggested the lack of consistency of the findings in previous experiments was not due to specific reading tasks but due to the inclusion of different types of words, namely familiar and unfamiliar words. The findings of Waters and Seidenberg (1984) further confirmed an effect of low-frequent irregular words and uncommon words in both naming and lexical decision tasks, validating that the grapheme-phoneme correspondence rules play a critical role in both phonological and orthographic learning. Waters, Seidenberg, and Bruck (1984) further argued that the grapheme-phoneme correspondence rules contribute more significantly to young children than to adult readers because children encounter a great number of unfamiliar words in reading every day, and the correspondence rules become a valuable and effective learning tool, allowing them to recode unfamiliar letter strings into familiar phonological codes, which in turn later allows a direct visual access similar to more experienced readers.

A large body of empirical studies on children's application of spelling-sound correspondence rules to pronounce unfamiliar words yields a few consistent findings (Backman, Bruck, Hebert, & Seidenberg, 1984; Calfee, Venezky, & Chapman, 1969; Perfetti & Hogaboam, 1975; Shankweiler & Liberman, 1972; Venezky & Johnson, 1972; Waters et al., 1984). The convergent findings were: (1) children are able to abstract the relation between grapheme and phoneme in English in the course of learning to read, (2) more complex correspondence rules are acquired after simple rules are mastered, and (3)

good readers develop the corresponding knowledge faster than poor readers and are able to reach the level of the knowledge of adult skilled readers by fourth grade.

As empirical evidence of both visual access and phonological recoding using the association between the spelling-sound correspondence rules and printed letter strings on English orthographic learning has accumulated, McCusker, Hillinger, and Bias (1981) reviewed the relevant literature and concluded with a dual access model of word recognition in which visual access and phonological recoding function in parallel. Frequency of word items determines which of the two strategies is employed in the process of orthographic learning. High frequency words are accessed rapidly via visual representation, whereas all other words that are low frequency are more slowly processed through phonological recoding. Researchers have confirmed their hypothesis by demonstrating that detection rates and naming latencies were longer for low frequency words and longer words (Cosky, 1976; Healy, 1976; Warm & McCray, 1969), as longer words tend to be low frequency words.

The dual access model of word recognition lays the foundation of orthographic learning and reading acquisition and recognizes the significance of phonological recoding in the development of literacy. All low frequency words that are accessed via phonological recoding can become sight words after certain times of recoding and restored in long-term memory, which is probably the process of orthographic learning. A few studies have found that subjects performed faster on recognizing words in the second trial than in the first, and the repetition effect was larger on low frequency words (Hillinger, 1979; Scarborough, Cortese, & Scarborough, 1977). These findings suggest that every phonological recoding provides learners the opportunity to learn unfamiliar

words by acquiring the orthographic forms of the words in memory and recognizing those words as sight words later.

The Self-teaching Hypothesis and Empirical Research in Alphabetic Languages

Based on the function of phonological recoding and its association with word recognition, Jorm and Share (1983) proposed in the Self-teaching Hypothesis that phonological recoding enables learners to self-teach and acquire orthographic representations of unfamiliar words by using spelling-sound correspondence rules. Phonological recoding plays a vital role in the acquisition of a considerable number of unfamiliar words and reading development of less experienced learners. A number of studies have indicated that young children are able to use partial decoding skills as a self-teaching mechanism at the very beginning stage of their learning to read by being able to pronounce simple pseudowords, which is arguably the beginning of self-teaching (Ehri & Sweet, 1991; Ehri & Wilce, 1985, 1987a, 1987b; Morris, 1992; Scott & Ehri, 1990; Stuart & Coltheart, 1988). The findings demonstrate that once young children have rudimentary knowledge of letter names and their sounds, they are capable of making associations between print letters and sounds to pronounce novel words and to acquire their orthographic representations. Share (1995) further elaborated that every time a learner encounters an unfamiliar word and phonologically recodes the word, it is an opportunity for the learner to acquire the detailed orthographic features of that word; and the successful self-teaching process of phonological recoding can be achieved within a small number of exposures of words. Phonological recoding offers developmental

reading opportunities not only for novice readers (Manis, 1985; Reitsma, 1983a; 1983b) but also for adult readers (Brooks, 1977).

The first study carried out to test the Self-teaching Hypothesis in a natural reading environment was Share (1999). In experiment 1, Hebrew-speaking second graders read 10 stories containing 10 pseudowords (e.g., *Yait is the hottest town in the world*) presented either four or six times in the stories in the reading phase. They then completed an orthographic choice task, a naming task, and a spelling task immediately, followed by an orthographic choice task retest three days later. Four alternatives in orthographic choice included target pseudowords, homophonic foils of target pseudowords (e.g., *yate*), and two other spellings with either substituted or transposed letters. The assumption was that if no orthographic learning occurred, the chances that every choice was selected should be about the same. However, the results of all three tasks indicated the chances that target pseudowords were selected, named, and spelled were three times higher than the chances of any other choices being selected, named, and spelled either with target words being presented four or six times in the stories, suggesting that orthographic learning was happening. Additionally, there was not a noticeable difference between four times and six times of target word exposure, indicating that children were able to acquire novel orthographic representations rapidly with only limited exposures. In order to test that the results of experiment 1 were not due to visual exposure, another three experiments designed for minimizing and interrupting phonological recoding process showed that the target words were still selected higher than chance level would predict, and visual exposure only produced a small contribution to the orthographic learning observed in experiment 1. Share (1999) compared the results of the four experiments,

empirically confirming the Self-teaching Hypothesis that children phonologically recode novel letter strings and use grapheme and phoneme correspondences to acquire novel orthographic representations.

Building upon the findings of Share (1999), Share (2004) addressed the issues in the Self-teaching Hypothesis of how many exposures would allow children to establish orthographic representations from printed words and how long the established orthographic representations would be retained in children's memory in an experiment. Results revealed a high decoding accuracy and a significant orthographic learning even with presenting one exposure of target words. Little gain in orthographic learning was added to additional exposures (two and four). Additionally, all three posttest intervals (three days, seven days, and 30 days) showed a significant effect on orthographic learning that was retained up to one month and was slightly diminished compared to the three-day interval. These findings suggested orthographic representations of unfamiliar words were established rapidly and robustly, and children acquired orthographic information of unfamiliar words rapidly at first encounter and gradually developed the information into memory-based representations with more practice, consistent with the findings of Share (1999).

Share (2004) went on to examine the beginning self-teaching of Hebrew-speaking children by asking first graders to complete a short version of experiment 1 with only two exposure types (two and four exposures) and two posttest intervals (three days and seven days). In contrast to the orthographic learning of experiment 1, there was no orthographic learning effect of target pseudowords and real words across three posttests with two different exposures at two posttest intervals. This result suggests that there was no early-

onset self-teaching in Hebrew and word meaning did not affect the orthographic learning of Hebrew.

Hebrew is an alphabetic language and encodes direct, consistent, and regular grapheme-phoneme correspondences between its printed forms and their sounds, which is considered shallow orthography. The findings of Share (2004) indicate that beginning readers of Hebrew pay little attention to the details of words because of the shallow Hebrew orthography that requires little effort for young children to pronounce Hebrew words, which is contrary to the findings of less regular orthographies such as English in which novice readers of English are able to self-teach at the onset of reading. These results suggest that orthographic regularity affects orthographic learning, and there are different orthographic learning processes between shallow and deep orthographies. More studies investigated orthographic learning of a deep orthography, English rapidly accumulated in the past decade (Bowey & Muller, 2005; Cunningham et al., 2002; Cunningham, 2006; Kyte & Johnson, 2006; Nation et al., 2007). The results were robust that target words were selected more favorably than their alternative distractors, directly supporting orthographic learning that successful decoding is considerably correlated with and predicted orthographic learning. Building upon the previous findings, the factors influencing orthographic learning were systematically investigated.

Kyte and Johnson (2006) investigated the interaction between phonological recoding and word familiarity, as proposed by the Self-teaching Hypothesis that word familiarity is one of the critical factors influencing learners' orthographic learning. However, the finding did not support the significant interaction between phonological recoding and word familiarity proposed by the Self-teaching Hypothesis. Kyte and

Johnson believed the non-significant result was because the estimate of word familiarity was used as a printed word frequency. The second experiment overcoming this research limitation used precise control of word familiarity (i.e., low, medium, and high) to reassess the interaction between phonology and familiarity. Results yielded an effect of phonological recoding on word familiarity that the naming accuracy decreased with the increase of word familiarity, though this interaction was weak.

To fill the research gap left by the previous studies that used reading materials with pseudowords and had difficulty generalizing their findings in real reading situations, Cunningham (2006) employed real words that were orally known but orthographically unknown to subjects to test whether context had an impact on children's self-teaching new orthographic forms of unfamiliar real words. The self-teaching task adapted from Cunningham et al. (2002) and Share (1999) with real words and their pseudohomophonic alternatives counterbalanced in two versions, of which one was redesigned to present scrambled passages to eliminate contextual support. First graders were randomly assigned to read one version and completed an orthographic choice task, spelling task, and other cognitive measures, including prior orthographic knowledge tasks and rapid automatic naming. A higher decoding accuracy of target words was found under this cohesive reading condition, and the difference was statistically significant, inferring that semantic information and syntactic structure embedded in context plays a critical role in children's phonological recoding and successful word recognition. Nonetheless, there was no significant difference in orthographic learning between the two text conditions. Results also indicated a strong correlation between orthographic learning and decoding

accuracy, as was found by Cunningham et al. (2002). The findings suggest that context plays a critical role in decoding accuracy, which in turn facilitates orthographic learning.

Building upon the results of Cunningham (2006) on the effect of context on orthographic learning, Wang and her colleagues (2011) further explored the interactions between word regularity in English and context conditions on orthographic learning in the self-teaching environment in two experiments. When decoding, it is challenging for children to find oral equivalents of irregular words to retrieve semantic meanings of the irregular words; therefore, it is easy to test the effect of context in orthographic learning. For the first study, participants were 19 second graders who participated in a pre-exposure phase after which a picture-naming task was administered immediately and 10 days later. An orthographic exposure phase was conducted with target words presented either in connected texts or isolated word lists four different times. Children were asked to read aloud the target items under both conditions. An orthographic test phase including spelling, orthographic choice, and orthographic decision tasks was completed immediately and 10 days later after the orthographic exposure phase. Results of the pre-exposure phase showed no effect of context and time. A significant main effect of exposure times was found, and a marginal main effect of context conditions was also found without interaction between context conditions and exposure times, suggesting a context facilitation effect on orthographic learning. Children tended to read novel words more accurately in the context condition than in the decontextualized condition at the first exposure. These results converged with the findings of the previous studies (Landi, Perfetti, Bolger, Dunlap, & Foorman, 2006; Nation & Snowling, 1998), supporting Share's (1995) Self-teaching Hypothesis that contextual information plays a critical role

on successful phonological recoding. However, there was no effect of context across all three orthographic learning measures both immediately and with the delayed tasks, and there was a favorable trend of target words learned under decontextualized conditions, though there was successful orthographic learning. This result confirmed the finding from Landi and her colleagues (2006), arguing that learners might need to pay additional attention to context and thus reduce the amount of attention spent on target items while reading. In order to investigate the effect of word regularity, in the second experiment irregular pronunciations were given to target items, and design and procedures were adjusted accordingly. Results indicated no context effect on decoding accuracy across different times but yielded a significant context effect on orthographic learning of irregular items across all times. Further analysis on orthographic learning tasks showed that children had high acceptance rates of both target irregular items and their regularized phonological foils, suggesting novel words were easier to be acquired in context.

Besides word regularity, Tucker and her colleagues (2016) investigated the effect of other word features such as morpheme and orthographic similarity on orthographic learning in the self-teaching paradigm. Specifically, they examined whether prior orthographic learning of novel words influenced children's learning of words that are morphologically and orthographically related to novel words and whether children's phonological decoding and orthographic learning experience affected their processing of novel orthographic forms. About 141 children in Grade 3 and Grade 5 were randomly assigned to three different groups to read eight stories, each with an embedded pseudoword. The pseudowords in each group were manipulated by three conditions, including base forms, morphologically complex forms, and orthographically complex

forms (e.g., *feap*, *feaper*, and *feaple*, respectively). After the reading phase, participants completed an orthographic choice task with the same pseudoword items in the stories immediately and two or three days later and another two orthographic choice tasks with the pseudoword items that were not in their stories to evaluate whether there was a transfer effect of orthographic learning. The results indicated children performed significantly better on target pseudowords than their morphological and orthographical counterparts, and there was no performance difference on morphological transfer and orthographical transfer, suggesting there is a similar effect of orthographic learning on morphologically and orthographically complex words. Furthermore, analysis on comparing the items that were at least successfully decoded once and never unsuccessfully decoded indicated a similar effect that children chose correct orthographic representations across all conditions significantly above chance. However, there was a facilitation effect of successful decoding on orthographic learning and transfer, and this facilitation effect was well supported by the analogous mechanism of the Self-teaching Theory proposed by Share (1995).

Based on the previously mentioned empirical research, it can be concluded that (1) there are fundamental differences of orthographic learning between deep and shallow orthographies for beginning learners, and novice learners of shallow orthography do not pay attention to specific word details compared to novice learners of deep orthography; (2) though context has little direct impact on orthographic learning, it benefits learners' phonological decoding and, therefore, indirectly contributes to orthographic learning; and (3) learners are more able to acquire regular words than irregular words because regular words are easier to decode. It is also sufficient to summarize that the learners of

alphabetic languages use phonology-based skills because the successful orthographic learning largely relies on phonological decoding accuracy by using grapheme-phoneme correspondence rule. However, Chinese is a deep orthography that encodes indirect phonological information. How Chinese orthographic features affect orthographic learning of its learners should be systematically investigated; however, in the past two decades, research has been centered on Chinese learners' orthographic development. Therefore, in the next session orthographic knowledge development in Chinese children is reviewed, since research on orthographic learning of Chinese young children is scant.

Orthographic Knowledge Development in Chinese Children

At the turn of the new century, because of the rapid growth of the Chinese economy and China's increasing influence on international trade, more foreigners started to learn Chinese as a foreign language to enhance their market competitiveness, which has promoted a significant demand on orthographic learning in Chinese for pedagogical purposes. To date, most previous research has focused on orthographic knowledge development in Chinese as first (L1) and second language (L2) learners, and limited research on orthographic learning is available for Chinese learners.

One of the first studies was conducted by Ho and Bryant (1997) examining how first- and second- grade students processed familiar semantic-phonetic compound characters with different phonetic regularity. It was found that children read significantly better with regular compound characters than with tone-different characters, which in turn are read significantly better than irregular characters, suggesting that phonetic regularity of compound characters affects word recognition. The same year, there was a study conducted by Shu and Anderson (1997) investigating when Chinese children start

to develop radical and orthographic knowledge and are able to use them in orthographic learning. It was found that children in third grade were able to replace the Pinyin with characters containing correct radicals, suggesting children as early as third grade develop awareness of function of semantic radicals and are able to use that knowledge in character identification.

A study conducted by Chan and Nunes (1998) found children as young as six developed the understanding of constraints of orthographic patterns and developed orthographic knowledge. Reaching age nine, children were able to accept pseudowords and reject nonwords, providing the evidence that children develop orthographic knowledge as early as age six. Children at age six selected correct semantic radicals and formed acceptable pseudocharacters significantly higher than chance level and reached ceiling effect by age nine, suggesting they were able to use orthographic and functional knowledge of radicals to create pseudocharacters. To further investigate children's understanding of the pronunciation cuing function of phonetic radicals, participants were asked to pronounce the words that they invented. By analyzing whether children were able to use phonetic strategy (pronounce phonetic radical) or semantic strategy (pronounce semantic radical), the findings suggested there was an increasing awareness that phonetic radicals provide the phonological cues for characters. These findings were later confirmed by a body of empirical studies that investigated children's orthographic knowledge development and radical awareness (Anderson et al., 2003; Ho et al., 2003; Packard et al., 2006; Shu et al., 2000).

Early research examined Chinese young children's orthographic knowledge development and radical awareness related to positional constraints and functional

regularity of radicals. Results consistently showed that Chinese children as early as first grade start to develop internal structures of characters and radical awareness and are able to apply this knowledge in naming, discriminating, and forming characters. This knowledge also continues to grow throughout elementary school years.

Orthographic Knowledge Development in Chinese as L2 Learners

Recently, there has been a growing interest in orthographic knowledge development and radical awareness in CFL learners. Whether CFL learners adopt a similar developmental trajectory in Chinese orthographic knowledge as Chinese children was investigated by a number of researchers. Though most researchers have confidently assumed that CFL learners would benefit from the function of semantic radicals in learning compound characters because of their relatively consistent reliability (Shen, 2000; Shen & Ke, 2007; Shu et al., 2000; Taft & Chung, 1999), they did not reach consensus on whether phonetic radicals would facilitate or distract character learning due to their varying reliabilities of phonological information provided (Taft & Chung, 1999).

Taft and Chung (1999) speculated that phonetic radicals might distract CFL learners because of the varying reliability of phonological information provided by phonetic radicals about compound characters. On the other hand, Taft and his colleague believed that semantic radicals might have a facilitation effect on acquiring the meanings of compound characters due to the small number of semantic radicals and their relatively reliable semantic information. After testing their hypothesis in an empirical study, it was found that semantic radicals of compound characters facilitated character learning in novice CFL learners. This finding was further supported by a body of studies that concluded semantic radical knowledge has a facilitation effect on compound character

learning across different proficiency levels of CFL learners, and their knowledge of character internal structures and radical awareness increases linearly with proficiency levels and reaches a plateau at intermediate level (Shen, 2000; Shen & Ke, 2007; Su, 2010; Wang et al., 2004, Williams, 2013). Additionally, CFL learners are aware of the complexity of character internal structures at an early stage of learning. Character structural complexity affects the acquisition of low-frequency characters regardless of simple or compound characters, conferring a similar word learning pattern in both English and Chinese (Wang et al., 2004; Wang et al., 2003). Wang and her colleagues (2003) also found a significant main effect of radical frequency on character recognition that CFL learners were able to infer more meanings of characters from high-frequency radicals than low-frequency radicals; and after explicit instruction, students were able to extract significantly more meanings from semantic radicals of both high-frequency and low-frequency characters.

Studies investigating phonetic radical knowledge are prevalent; however, only a weak correlational linkage has been found between phonetic radical knowledge and characters identification. Williams (2013) found intermediate proficiency level students named character homonyms under four conditions, including same pronunciation with same phonetic component (e.g., 安氨); different pronunciation with same phonetic component (e.g., 位泣); same pronunciation with different phonetic component (e.g., 瓷词); and negative control (e.g., 往根). Results showed no significant facilitation effect of accurate phonetic components on character recognition, though students tried to apply phonological decoding skills, suggesting that CFL learners have not developed phonological pathways to character recognition at intermediate proficiency level.

However, one limitation of the experiment was that all the characters were low-frequency and might have been unknown or unfamiliar to CFL learners, even though frequencies of the characters were carefully matched. In experiment 3, in a lexical decision task, subjects were required to judge whether a list of 30 pseudocharacters and 30 real characters were true or false characters. Half of the characters had their semantic radicals blurred or phonetic radicals blurred. Students reacted slower on pseudocharacters with blurred phonetic radicals, indicating a phonological analysis to character recognition. However, the author argued that phonetic radicals might be used more for orthographic recognition than for phonological analysis.

Zhang and Li (2016) reported a study in which beginning CFL learners were invited to learn a list of novel compound characters in a pair-associated paradigm. The regularity and transparency of compound characters were manipulated. The study concluded that beginning CFL learners tried to apply phonetic cues provided by phonetic properties to learn novel characters, though this application was not statistically significant in enhancing learners' character acquisition. They used transparent semantic cues to learn the meaning of novel characters, suggesting that beginning CFL learners understood the function of semantic radicals and were able to apply this knowledge in character learning. However, a limitation of the study was that the phonetic radicals composing the novel characters were of quite low frequency and might have been unfamiliar to beginning CFL learners. Therefore, they were not able to use that knowledge in the experiment.

The evidence provided by the previous empirical research suggests that CFL learners develop orthographic knowledge and radical awareness at the beginning stage of

their character learning, and radical frequency and character internal structural complexity affect students' character identification. Additionally, semantic radicals facilitate the character acquisition of CFL learners. However, there was an exception that CFL learners develop phonetic knowledge of compound characters slower than Chinese children, thus further confirming that orthographic learning in Chinese is a more orthography/semantic-based strategy rather than a phonetic-based strategy adopted by alphabetic learners.

Orthographic Learning in Chinese

The first study conducted in the self-teaching paradigm on Chinese was Xiao (2013), who investigated both the effect of semantic radical transparency and phonetic radical regularity within compound characters and the effect of character type (simple or compound) and radical familiarity on phonological and orthographic learning of Chinese novel characters with Chinese children from second grade. The study also examined whether different target character exposures influenced children's performance and whether the new orthographic and phonological representations could be retained after three days. The materials for experiment 1 were adapted from Share (1999), with more appropriate Chinese stories in which semantic radical transparency (transparent, opaque) and phonetic radical regularity (regular, semi-regular, irregular) within the inserted compound pseudocharacters were manipulated to create six pairs of pseudocharacters (e.g., 劬, 勑) and counterbalanced into six different versions. All the characters in the stories were denoted by Pinyin to help students with reading. After participants were randomly assigned to one version and read the stories, they completed orthographic choice, naming, and spelling tasks immediately and three days later. The orthographic

choices included two target pseudocharacters and two orthographically similar pseudocharacters (e.g., 魴, 勑, 魴, 夥). Results indicated a significant effect of semantic radical transparency that children performed better on transparent compound characters than opaque compound characters, but no effect was found of phonetic radical regularity on orthographic learning of compound characters as well as interaction between semantic radical transparency and phonetic radical regularity. This might be attributed to the fact that all the characters in the stories were presented with Pinyin that has shallow orthography and reduced children's attention on phonologically decoding the pseudocharacters, diverting their attention away from the orthographic details of the pseudocharacters. This speculation was further confirmed by another similar empirical study conducted by Ho (2013), that indicated the phonological aid system prohibited phonological decoding of characters from the orthographic learning of the characters.

Surprisingly, in Xiao's (2013) study, there was a significant effect of semantic radical transparency on the immediate naming test, suggesting that transparent semantic radicals also facilitate phonological learning of compound characters. The results indicate that semantic radicals play a critical role in not only orthographic learning but also phonological acquisition. A significant effect of phonetic radical regularity was also found on the naming test, and multiple comparisons showed that children performed better on regular compound characters than on irregular compound characters, which in turn performed better than semi-regular compound characters. Three days later, results yielded a significant effect of both semantic radical transparency and phonetic radical regularity on the naming test. For spelling tasks, the results on two different test dates showed similar patterns of significant semantic radical transparency. Children recalled

more compound characters with transparent semantic radicals than those with opaque semantic radicals. There was no effect of phonetic radical regularity and interaction.

In experiment 2, by manipulating character type (simple, compound) and exposure (three times, six times), three types of characters were created, including simple characters, compound characters with familiar radicals, and compound characters with unfamiliar radicals. A different group of second graders read the stories and completed orthographic choice, naming, and spelling tasks immediately after the experiment and three days later. Results showed that different exposure times did not influence orthographic learning of Chinese characters, consistent with orthographic learning of alphabetic languages. However, different character types had a significant impact on orthographic learning, suggesting an effect of character internal structural complexity. Children performed well on simple characters and compound characters with two familiar radicals, both of which were better than they did on compound characters with one familiar radical and one unfamiliar radical. There was no interaction between exposure and character type on the immediate orthographic choice task, but there emerged an interaction after three days. For simple character learning, exposure had an effect on orthographic learning; however, for the other two types of compound characters, exposure did not influence the learning. For the naming task, there was no effect of either exposure or character type as well as no interaction between them. For the spelling task, only an effect of character type was found. Compound characters with both familiar radicals were performed better than compound characters with one unfamiliar radical and one familiar radical. However, this effect disappeared after three days.

Based on the findings from Xiao (2013), it can be assumed that Chinese children

use a fundamentally different learning strategy in orthographic learning of a deep orthography like Chinese than those children learning a shallow orthography, such as English. Studies have reported there is a strong correlation between phonological decoding accuracy and orthographic learning of English, and phonological recoding plays a vital role in the acquisition of words, which suggests a phonological strategy in orthographic learning of alphabetic languages. For a deep morphosyllabic orthography like Chinese, each character carries a meaning or encodes a semantic cuing component; thus, the orthographic learning of Chinese might entail semantic-based strategies, which aid the acquisition of both phonological and orthographic forms of Chinese characters.

To reduce the diversion from the denotation of the pronunciations of the characters in the experimental stories, Ho (2013) conducted another study to examine whether phonetic and semantic radicals facilitate phonological recoding and thus enhance orthographic learning of compound characters by manipulating the availability of phonetic radicals in the stimuli in the stories within the self-teaching paradigm. Children acquired significantly more orthographic representations inserted with phonetic cuing radicals than those without phonetic radicals, suggesting that children phonologically decode Chinese characters by applying phonetic knowledge, and phonetic radicals play a facilitation role in the orthographic learning of children. Interested in whether semantic transparency affects orthographic learning of compound characters, Ho (2013) further investigated and found that children learned significantly more characters with semantic cuing radicals than with non-cueing semantic radicals, consistent with the findings of Xiao (2013). However, Ho did not find an interaction between semantic transparency and

phonetic regularity, since all the characters were pronounced regularly in her last experiment.

Although research has consistently reported that children develop orthographic knowledge regarding phonetic regularity and semantic transparency, and employ such knowledge to facilitate their character acquisition, it stands to reason that orthographic learning in Chinese, different from that in English, is a more orthography/semantic-based strategy. In Zhang and Li's (2016) study, a test investigating CFL learners of Thai background's character recognition through reading found that CFL learners of Thai background were able to use transparent semantic radicals to acquire orthographic forms of new characters, confirming the researcher's hypothesis. The hypothesis was supported by compelling evidence that both Chinese native children and CFL learners develop orthographic knowledge at the beginning phase of their learning, which plays a critical role in character processing and learning; and semantic transparency not only affects the learning of the meanings of characters but also interacts with the acquisition of the phonological forms of characters.

Incidental Word Learning

Another theoretical construct that guides the present study is incidental word learning. Incidental word learning, in contrast to intentional learning, refers to a word learning process during which students acquire words through focusing on understanding the meaning of written and spoken language in communicative activities rather than directly paying attention to the orthographic forms of language (Huckin & Coady, 1999). According to Nagy and Herman (1984), it was estimated that there are 88,533 distinct word families with upwards of 100,000 distinct meanings in printed school English from

Grade 3 through Grade 9. Anderson and Freebody (1983) found that an average fifth grader would encounter approximately 10,000 different unknown words, even with limited reading. Nagy et al. (1987) further confirmed the estimate that an average high school graduate should have about 40,000 words and, therefore, an average student should acquire about 3,000 new words each year from Grade 3 to Grade 12. The volume of vocabulary growth by children each year is astonishing and contradicts the number of words intentionally learned from school. It was claimed that only 200 to 300 new words are attributed to direct vocabulary instruction in classrooms (Jenkins & Dixon, 1983; Nagy et al., 1987).

The discrepancy between the actual rate of children's vocabulary growth and the number of school vocabulary words learned induced a "default" assumption that children incidentally acquire a large amount of vocabulary from context during normal reading outside of classrooms (Jenkins & Dixon, 1983). This incidental word learning has been the major source of word acquisition since children begin to read (Thomas & Robinson, 1972). This hypothesis has been supported by a considerable number of studies that the rapid growth of children's vocabulary during school years is largely attributed to incidental word learning through extensive reading (Carlisle et al., 2000; Hulstijn, 2003; Merriam, Caffarella, & Baumgartner, 2007; Nagy et al., 1985).

Incidental Word Learning in English

To test this hypothesis, a growing body of research has been conducted on the mechanism of incidental word learning (e.g., Carlisle et al., 2000; Deacon & Kirby, 2004; Herman et al., 1987; Jenkins et al., 1984; McCutchen et al., 2008; McCutchen & Logan, 2011; Nagy et al., 1987; Nagy et al., 1985; Nagy et al., 2006).

Jenkins et al. (1984) were among the first empirical researchers investigating incidental word learning from context and factors impacting that learning process. Three factors that were considered in the study included word exposure times, prior experience with unfamiliar words, and reading abilities. The experimental condition was designed to closely resemble normal reading. A total of 112 fifth graders were asked to read informative texts that were centered on concepts (e.g., an altercation, a provocative event, incarcerating someone, eradicating something) two, six, and ten times, followed by several post-measures on vocabulary learning. It was found that fifth graders were able to infer the meanings of unfamiliar words without explicit instruction, and better readers were more able to acquire meanings from context with more word exposure times. These results suggest better readers pay more attention to unfamiliar words and are able to extract the meanings of unfamiliar words from context. Additionally, results indicated that increasing context presentation led to more word learning; and two context exposures were sufficient for effective word acquisition, although the growing rate of learning with each exposure was not in large quantities.

Nagy, Herman, and Anderson (1985) hypothesized that learners only gain small increments of word knowledge in context with one encounter; however, word learning from context is relatively more effective than any other source, and word knowledge can be accumulated to a sufficient amount with substantial exposure of written language. To test their hypothesis, about 70 eighth graders with average or above average reading skills were randomly assigned to read a 1,000-word expository or narrative passage in which the 15 most difficult words from each text were selected as target words assessed at different difficulty levels. This was followed by a checklist vocabulary test to measure

their word knowledge before reading the experimental texts. Immediately after reading the passage, each student was interviewed on the meanings of the target words, followed by a multiple-choice task. Each multiple-choice item contained the correct answer, four distractors, and a “don’t know” option. Results showed that participants who read the passages performed significantly better on target words than those who did not read the passages, even taking the levels of word difficulties into consideration. It was also found that subjects who read the passages learned more words that were not previously known to them than their counterparts on the multiple-choice task, but not on the interview results. The findings confirmed the effect of word learning from context across different text type and word difficulty.

Herman et al. (1987) investigated how expositions with varied text features impact incidental acquisition of word meaning in children. The first text feature taken into account was the features related to the macrostructure of text. The second feature was the characteristics pertinent to logical and temporal associations in the microstructure. The last feature considered was the aspect related to concept explanation and relations between them. Two expositions were revised into four versions of each text, and the most difficult words were identified as target words. A total of 309 eighth-grade students read one text version and completed a multiple-choice task. It was found that participants gained the most on word meanings from the text versions in which concepts and the relations between them had been thoroughly explained compared to any other versions regardless of students’ reading abilities.

Carlisle et al. (2000) investigated incidental word learning in science classes where context for topical words is rich in discussion, guided projects, and hands-on

experiences. Word acquisition of topical words and nontopical words after such contextually rich activities was compared to determine whether children gained word knowledge. Results indicated students showed a significant gain on topical words and even were able to define them a month later but did not show a gain on nontopical words, suggesting the level of contextual support is a critical factor influencing incidental word learning.

The occurrence of incidental word learning has been empirically proven, notwithstanding that word acquisition from context with each encounter is only a small increment, as hypothesized by Jenkins et al. (1984) and Nagy et al. (1985). Along with the significant evidence of incidental word learning, the factors affecting successful incidental word learning were also emergent from the previous studies. It can be concluded that one of the critical factors is context in two aspects, contextual support of text (Herman et al., 1987) and unfamiliar word coverage in text (Nation, 2000). In Herman et al. (1987), the text versions in which concepts were thoroughly explained and the relations among concepts were cohesive led to more gains in word learning during reading by students because these texts had high context support for the target words. The hands-on projects and group discussions in science classes naturally provided more contextual information for unfamiliar words (Carlisle et al., 2000).

In regard to unfamiliar word coverage in text, it has been suggested the coverage of unfamiliar words should range from 3% to 5%, contingent upon text-specific factors, to result in best optimal incidental word learning in reading. This argument has been confirmed by a few studies that direct instructions on contextual strategies improved word acquisition and reading comprehension.

Another confounding factor that has consistently shown a significant impact on incidental word learning is the morphological structure of words. A body of research has documented that awareness of the morphological structure of words improves learners' word acquisition from context during reading and is also a significant unique predictor of both word identification and reading comprehension (Carlisle, 1995, 2000; Deacon & Kirby, 2004; McCutchen et al., 2008; McCutchen & Logan, 2011; Nagy et al., 2006; Nunes et al., 1997, 2006).

Morphological skill has been proven to facilitate word acquisition and reading comprehension, which in turn facilitates incidental word learning. The most direct influence of morphological skill is, as Nagy and Herman (1984) extrapolated in their interaction hypothesis, that incidental word learning interacts with morphological transparency of words in inferring the meanings of unfamiliar words in context, and children might be able to infer an additional one to three derivative words based on their morphologically related words. A few studies have documented that familiar prefixes and suffixes in English can facilitate analysis of meanings and syntactic functions of unfamiliar words during reading (Bowers, Kirby, & Deacon, 2010; Carlisle, 2007; Tyler & Nagy, 1990). For example, in English, the familiar prefix and suffix (in- and -ly) can help children guess the meaning of the word *incompletely* based on their knowledge of the two affixes with the stem *complete* and also suggest the adjective function of the word, facilitating the understanding of words and at the same time further supporting the comprehension of its composed sentence. This theoretical construct is supported by the significant correlation between morphological skills and vocabulary reading and knowledge (Deacon & Kirby, 2004; Fowler & Liberman, 1995; Singson, Mahony, &

Mann, 2000), which in turn further contributes to reading comprehension by increasing vocabulary (Nagy et al. 2006; Tong, McBride-Chang, Shu, & Wong, 2009).

McCutchen and Logan (2011) hypothesized that morphological analysis might be a determinant strategy children use to infer the meanings of unfamiliar words during reading. The researchers carried out a study by asking fifth and eighth graders to select definitions for morphologically accessible unfamiliar words or their morphologically inaccessible synonyms in the same sentence context. Participants also defined nonwords that were morphologically accessible or inaccessible to determine children's morphological analysis. It was found that both grade students chose more accurately for both words and nonwords that were more morphologically accessible than for those lacking morphological access, confirming that children can apply morphological analysis to infer the meanings of unfamiliar words.

As reported by Nagy et al. (1985), though the effect of incidental word learning was significant but rather small, it was argued that morphological skills promote higher quality lexical representations and a more extensive vocabulary by higher exposure to morphologically related words (e.g., *complete*, *completely*, *incompletely*, and *incompletely*; Perfetti, 2007; Perfetti & Hart, 2001; Reichle & Perfetti, 2003). This argument was supported by the empirical study conducted by Anglin, Miller, and Wakefield (1993) that children's morphological knowledge grew dramatically from Grade 1 to Grade 5 and contributed significantly to their vocabulary growth.

Another factor influencing incidental word learning is student linguistic ability. More skilled learners seem more able to gain from incidental word learning during reading (Jenkins et al., 1984). It is more challenging for less able students to use

contextual information to derive meanings of unfamiliar words (Beck & McKeown, 1991). Bensoussan and Laufer (1984) reported that English as a foreign language learners were not able to infer the meaning of words from context because they either retained the meaning of a word in the context they learned in new context or directly conducted a wild guess, lacking the ability to confirm the meaning of the word against the context. Therefore, it was concluded by the authors that context is not useful for less experienced learners. Another reason that prevents less skilled learners in greater incidental word learning from context is weaker morphological knowledge possessed by them (Zhang & Shulley, 2017). Zhang and her colleague (2017) assessed incidental word learning, vocabulary, morphological awareness, working memory, and short-term memory in learners of both English as a native language and a foreign language in fourth and fifth grades. Results showed that students with weaker morphological knowledge were less able to use morphological structure of words to infer the meanings of unfamiliar words during reading, confirming that student linguistic ability affects incidental word learning from context.

Incidental Word Learning in Chinese both as L1 and L2 Learners

Language typology in terms of phonological transparency also interacts with incidental word learning. A cross-cultural study conducted by Shu et al. (1995) comparing incidental word learning from context in American and Chinese children from third and fifth grade found that children from both cultures and both grades performed better on the words in the story they read than on those they did not read, indicating incidental word learning occurs in two typologically different languages. However, a noteworthy finding of the study was that there was a significant interaction between

morphological transparency and context among Chinese fifth graders, but not among American children in either grade. Since children were from same grade levels, it suffices to argue these different learning patterns were due to linguistic features of the two languages. English is an alphabetic writing system that requires learners to acquire grapheme-phoneme correspondence and develop phonemic awareness. In contrast, Chinese is a morphographic writing system entailing learning grapheme-morpheme correspondence. This distinct feature of Chinese, therefore, might allow Chinese children to develop and apply morphological knowledge of Chinese characters and words earlier in reading (Nagy et al., 2000). According to a cross-cultural study conducted by McBride-Chang et al. (2005) examining relations among phonological awareness, morphological structure awareness, vocabulary, and word recognition, it was found that phonological awareness was a more critical linguistic skill for reading alphabetic languages such as English, whereas morphological structure awareness was more important for reading in Chinese.

Further investigating the effect of the internal structure of Chinese characters on incidental word learning, Ku and Anderson (2001) asked a total of 241 Taiwanese fourth graders to read one of two texts and then infer the meanings of unfamiliar words from both texts. Radical transparency and contextual support were also analyzed to examine how they interacted with incidental word learning. Results indicated that children incidentally acquire the meanings of unfamiliar words during reading, confirming the findings of Shu et al. (1995). Children are able to learn more characters with more transparent radicals within strong contextual support texts.

Han (2015) investigated whether fourth graders were able to infer the meanings of words that are semi-transparent two-character compound words by applying different inferential strategies of word meanings, including morphological structures of words, contextual clues, and integrated strategies from both. A list of semi-transparent words was either presented in isolation, in sentence context, or omitted from the sentence, counterbalanced into three versions. Participants were randomly assigned to complete one version. Results showed that children from fourth grade were able to integrate information from morphological knowledge of words and contextual clues to derive the meanings of unfamiliar words, and better readers relied more on contextual clues and integrated strategy to infer the meanings of words but not on morphological knowledge.

In Mori's (1996) study, a total of 56 intermediate and advanced learners of Japanese as a foreign language of English background completed a multiple-choice task to investigate whether they could use morphological information, context clues, or integrated strategies to infer the meanings of compound Kanji words. Four choices in the multiple-choice task included target word, Kanji distractor, context distractor, and random choice. There were three conditions in the task. In one condition, words were shown in isolation; in another condition, words were present in sentences. In the third condition, only the sentences in the last condition were shown without target words. Three conditions were counterbalanced in three versions. Students were randomly assigned to one version and completed the task. Results showed that students at both proficiency levels were able to use integrated strategies from morphology and context to infer the meanings of new words. When context information was available, they were able to rule out the Kanji distractors, which confused students when the target words

were presented in isolation. What was more intriguing was that learners' overuse of contextual clues was positively correlated with their language proficiency, whereas the ability to use morphology was not associated with their language proficiency. The findings of the study empirically confirmed that Kanji foreign language learners of English background are able to derive the meanings of unfamiliar words integrating both morphological knowledge of Kanji words and contextual information.

Zhang and Li (2016) explored how adult CFL learners of Thai background's morphological awareness influenced their incidental word learning. About 10 students each from intermediate and advanced levels completed two tests. One test included morphological discrimination (e.g., 商量, 商店, 商业, and 商标); morpheme meaning selection where 亲密: (a) relative, (b) kiss, (c) intimate, and (d) by oneself; radical form recognition as in 飘, which part cues meaning? (a) 西, (b) 示, (c) 风, and (d) 票; and radical explanation as 病字旁 in 痛: (a) sad, (b) disease, (c) angry, and (d) hungry. In the other test, students were asked to read five 5-minute passages with embedded pseudocharacters, followed by a character recognition task (select pseudocharacters), a character meaning inference task as 女每: (a) girl, (b) beautiful, (c) lucky, and (d) expensive; and a syntactic function inference task to measure the success of incidental word learning. It was found that a higher level of morphological awareness contributed to more successful incidental word learning. This morphological facilitation effect was more obvious in intermediate proficiency level students than in advanced proficiency level students who showed less reliance on characters' internal structures in character acquisition. These results were consistent with the previous findings that the more

proficient the students are, the less they rely on the morphological structure of characters and words to infer the meanings of vocabulary (Mori, 1996).

To fill the research gap in orthographic learning of Chinese in CFL learners, the present study examined how the internal properties of compound characters would affect the orthographic learning of CFL learners. There are several limitations in previous studies on incidental Chinese word learning of foreign language learners. First, the first study investigating incidental word learning of the Chinese writing system was Japanese Kanji, which is a traditional Chinese writing system and entails different linguistic features from modern Chinese. Second, the language background of the participants in Zhang and Li (2016) was Thai, which is typologically remote from Chinese. Therefore, going beyond the previous studies and, to address the limitations of the previous research, the current study aims to investigate: (1) whether CFL learners can implicitly learn the orthographic forms and phonological forms of new characters, (2) whether CFL learners can infer the meanings of new Chinese words in a reading context, and (3) the extent to which individual differences in linguistic skills predict incidental learning of new vocabulary in CFL learners.

It was hypothesized that CFL learners would acquire more phonological and orthographic forms of characters with regular phonetic radicals and transparent semantic radicals than those with irregular phonetic radicals and opaque semantic radicals in the self-teaching paradigm. The acquisition of orthographic and phonological forms of characters requires more semantically related strategies. Furthermore, students would be more able to infer the meanings of words presented in sentence context condition than in

decontextualized condition, and such lexical inference ability would improve with increasing proficiency levels.

CHAPTER III: METHOD

Study One

Participants

After IRB approval was granted through the Institutional Review Board of Western Kentucky University (see Appendix A for IRB approval letter and informed consent document), participants were recruited from the Chinese program at WKU, a university in southern United States. A total number of 45 adult college students participated in this experiment. All participants attend an intensive Chinese program at the university. According to a survey they filled out, there were 41 European Americans (91%), 1 Hispanic American (2%), and 3 Asian Americans (6%). There were 26 males and 19 females. The average age was 19.84 and standard deviation was 1.30. Participants were divided into two proficiency levels based on their years of learning Chinese characters. Thirty students enrolled in the second and third year were in intermediate proficiency level, and 15 students who were enrolled in fourth year were in advanced proficiency level. Student proficiency levels were also verified by the distribution of principle factor analysis of all the background measures. Due to the difficulty of the experimental materials, novice CFL learners were not included in the current study.

Context

It is important to understand the goal and the curriculum of the intensive Chinese program. This program aims to cultivate undergraduates to speak superior proficiency level Chinese in their undergraduate studies so that they can increase American competitiveness in social, cultural, and commercial exchanges with China. The curriculum is intensive and rigorous. From first to third year, students in this program

attend Chinese classes five days a week, including three 55-minute drill sessions on Monday, Wednesday, and Friday and two 80-minute lecture sessions on Tuesday and Thursday. Both first- and second-year students have one additional mandatory tutorial session each week, and third-year students have two additional mandatory tutorial sessions each week. Each semester students are supposed to complete the content that should be covered in one year in a regular college Chinese program. All classes from first year to third year regardless of formats are language classes that aim to help students improve their linguistic knowledge and skills. At the end of the first, second, and third years, students are expected to reach novice-mid, intermediate-low, and intermediate-high Chinese proficiency levels, respectively, as defined by the American Council of Teaching Foreign Languages (ACTFL Guidelines, 2012).

Fourth-year students attend one three-hour content-based class each semester in the hope of improving students' knowledge of Chinese culture and society. The content-based classes include Chinese history, Chinese media, Chinese culture, and Classical Chinese; and students enroll in different classes based on their instructors' recommendation. Ideally, the four content-based classes should be completed in four semesters (two years), with Classical Chinese being completed in the last semester since it is the most difficult class among the four. However, some students enroll in two classes simultaneously to graduate early. Fourth-year students also have two hours of mandatory tutorial sessions each week. After completing four content-based courses, students should reach advanced-mid Chinese proficiency level. All the classes and tutorial sessions in the program are instructed in Chinese, except the first semester when students are taught both in Chinese and English. Before each semester ends, students are required to complete a

Stamp Test (a standardized Chinese proficiency test) to monitor their proficiency levels. Throughout each regular semester, the program holds a variety of cultural and social events for students to practice Chinese and learn Chinese culture. All students are encouraged to study abroad in Chinese speaking countries during summer and winter breaks, and there are scholarships available for them.

Design and Materials

Orthographic learning experiment. Following Share's (1995) self-teaching paradigm, an orthographic learning experiment was newly designed to explore English-speaking CFL learners' ability to acquire orthographic and phonological forms of novel characters during reading. In this experiment, participants were asked to read a list of 16 short stories while listening to the audio recordings of the stories. Then they were asked to recall the pronunciations and spellings of compound pseudocharacters appearing in each story. Regularity of phonetic radicals and transparency of semantic radicals of the pseudocharacters were manipulated, which will be explained in detail later.

A total of 16 stories were designed for the orthographic learning experiment. The themes of the stories were daily topics related to a Chinese young adult's (李文文) life, including shopping, eating, and other daily activities (e.g., 李文文很喜欢运动, 尤其喜欢游泳。夏天天气很热的时候, 她常常和朋友一起去海边, 河边或者湖边游泳。她认为这真是一种享受啊! i.e., *Wenwen Li likes sports very much, especially swimming. In the hot summer, she often goes to sea, lake or another body of water to swim with her friends. She thinks this is a kind of enjoyment!*) Daily topics were used because they are more cognitively suitable for adult CFL learners due to the communicative foreign language teaching approach in the United States. The length of

the stories ranged from 44 characters to 59 characters. The coverage of unknown pseudocharacters ranged from 1.7% to 2.3% to ensure the success of incidental character learning, according to the less than 5% rule proposed by Hu and Nation (2000).

Two compound pseudocharacters were created for each story (e.g., 泠 and 吟), manipulating the regularity of phonetic radicals (regular vs. irregular) and the transparency of semantic radicals (transparency vs. opaque) within the compound characters. To create an equal degree of difficulty of pseudocharacters, the two pseudocharacters of each story shared the same phonetic radical (e.g., in 泠 and 吟, 今 is the phonetic radical). The two pseudocharacters of each story had one transparent semantic radical and one opaque semantic radical (e.g., in 泠 and 吟, 冫 is a transparent semantic radical and 彳 is an opaque semantic radical). Each of the two pseudocharacters had a regular pronunciation (e.g., /jīn / and /jīn /) and an irregular pronunciation (e.g., /tiān/ and /tiān/). The irregular pronunciation was the same as the pronunciation of the phonetic radical within the pseudocharacter distractor. The tones of irregular pseudocharacters were kept the same as those of regular pseudocharacters to eliminate the distraction of tone differences. Therefore, four pseudocharacters were created for each story (e.g., /jīn/, /jīn/, /tiān/, and /tiān/). The 16 sets of four pseudocharacters were counterbalanced by character conditions (i.e., transparent/regular, opaque/regular, transparent/irregular, and opaque/irregular) and embedded into the stories, creating four versions of 16 stories. Each pseudocharacter only appeared once in its story. Four sets of PowerPoint slides were created for the four versions of the stories. The corresponding audio recordings of each story were also recorded by the researcher

using PowerPoint and inserted in the corresponding slide of each story. Therefore, four versions of orthographic learning experiment materials were created.

Measures

To assess students' understanding of the stories, two true or false reading comprehension questions were designed for each story (e.g., *Wenwen Li often swims with her parents in the summer*). For each story, there were also two multiple-choice tasks: spelling recall, pronunciation recall, and a semantic production task (see Appendix B).

Spelling recall task. Four choices for the orthographic form questions included transparent/target pseudocharacter, opaque/target pseudocharacter, transparent/pseudocharacter distractor, and opaque/pseudocharacter distractor (e.g., 泠, 泠, 沃, and 饭). Selected phonetic radicals of pseudocharacter distractors were orthographically similar to the phonetic radicals of target pseudocharacters to keep similar character visual complexity. The stem question for the orthographic form task was, "Which of the following characters did you see in Story # 1?" Cronbach's Alpha for orthographic choice across all three learning trials was .92.

Pronunciation recall task. Regarding the phonological choice task, four choices were created: regular pronunciation, irregular pronunciation, semi-regular pronunciation of regular pronunciation, and semi-regular pronunciation of irregular pronunciation (e.g., xīn, tiān, xiān, and jīn) to ensure the equal degree of difficulty among the four versions of materials. The stem for the phonological form task was, "What is the pronunciation of the character that you saw in Story #1?" referring to the character that participants just chose from the orthographic form task. Cronbach's Alpha for phonological choice across all three learning trials was .86.

Semantic production task. Students were asked to write down the meanings of the target characters by answering the question: “What is the meaning of the character that you saw in story#1?” The semantic production task was not reported in the Results section because of the floor effect. Students were not able to produce meaningful answers based on the researcher’s observation. This result might be due to the heavy loads on students’ working memory and the challenges of the production task.

Procedure

The orthographic learning experiment took about 50 minutes. Each participant scheduled a 50-minute individual appointment with the researcher in classrooms where the participants had their Chinese classes. Each participant was randomly assigned to complete one of the four versions. Before the experiment, the instruction given to the students was: *“You will read a list of 16 short stories on PowerPoint while listening to their audio recording. You are encouraged to read aloud while following the audio. After each story, you will answer two true or false reading comprehension questions. After reading eight stories, you will take some quizzes. You will repeat this procedure three times. Please pay attention when you read.”* After reading and listening to each story, participants completed the true or false reading comprehension questions for that story. Then, after they read and listened to eight stories, they completed the first eight sets of tasks. After they read and listened to the other eight stories, they completed the other eight sets of tasks for the other eight stories of the versions they were assigned. After participants completed the 16 sets of tasks, answer sheets were collected by the researcher. The procedure was repeated three times. After each trial, sets of answer sheets were collected by the researcher and a new answer sheet was given to participants. The

orthographic learning experiment was completed after the researcher collected all three sets of answer sheets. One point was given for each correct answer, and the total maximum score was 48 points.

Background Measures

All participants were given the following background tasks, including phonetic radical knowledge, semantic radical knowledge, word reading and word semantic knowledge. All the tasks were completed in group tests and took approximately half an hour.

Phonetic radical knowledge task. A phonetic radical knowledge task was assigned to examine their explicit phonetic radical knowledge. The phonetic radical knowledge task contained a list of 48 common phonetic radicals within which the 16 phonetic radicals (e.g., 今) were used to create the pseudocharacters in experiment 1. The rest of the phonetic radicals (e.g., 去) were high-frequency phonetic radicals that are familiar to CFL learners. Students were asked to write Pinyin with tone for the 48 phonetic radicals. If Pinyin and tone were right, one point was given; if tone was not correct, a partial point was given. Otherwise, no points were given. The maximum score was 48 points. Cronbach's Alpha was .98 (see Appendix C).

Semantic radical knowledge task. A semantic radical knowledge task was given to investigate their explicit semantic radical knowledge. Students were asked to articulate the meanings of 30 semantic radicals, including the 16 semantic radicals (e.g., 讠) that were used to design the pseudocharacters in Study One. The rest of the semantic radicals were high-frequency semantic radicals (e.g., 广) that are familiar to CFL learners. Students were asked to write the meanings of the semantic radicals in English translation.

If the answer was correct, one point was given. If the meaning of a radical was close to the right answer, a partial point was given. Otherwise, no point was given. The maximum score was 30 points. Cronbach's Alpha was .93 (see Appendix D).

Word reading and semantic knowledge task. A word reading task was given to all participants to examine their word reading ability and semantic knowledge. There were 60 words (e.g., 跳舞) selected from some popular CFL textbooks with increasing difficulty. Students were required to provide both pronunciations with tones and meanings for the words. They were asked to skip if they did not know the words and stop if they had about 10 consecutive words that they did not know. Word reading and word semantic knowledge were scored separately. For word reading, one point was given to each correct Pinyin and tone of a character; a partial point was given if the tone was not correct. The maximum score was 120 points. Cronbach's alpha of this task was .98. For semantic knowledge, one point was given to each correct meaning, and a partial point was given to the answer that was close to the right answer. The maximum score was 60 points. Cronbach's alpha of this task was .97 (see Appendix E).

Data Analysis

To answer research questions for Study One, two four-way repeated measures analyses of variance (ANOVA) were conducted. For the first ANOVA, the dependent variable was the proportion of correctly answered orthographic choices. The independent variables were three within-subjects factors: phonetic regularity (regular and irregular); semantic transparency (transparent and opaque); and learning trial (learning trial one, learning trial two, and learning trial three); and one between-subjects factor: student proficiency level (intermediate and advanced). For the second ANOVA, the dependent

variable was the proportion of correctly answered phonological choices. The independent variables were three within-subject factors: phonetic regularity, semantic transparency, and learning trial, and one between-subject factor: student proficiency level (intermediate and advanced).

Study Two

Participants

A total of 72 students were recruited for this study. All 45 participants in Study One completed Study Two. Forty-seven participants were recruited from the same program as the participants in Study One, and another 25 participants were recruited from another Chinese program in the same university as the participants of Study One. In total, there were 39 males and 33 females. The average age was 19.42 and standard deviation was 1.20. About 25 students who only learned Chinese characters for half year were in novice proficiency level. Thirty-one students who were enrolled in the second and third year were in intermediate proficiency level, and 16 students who were enrolled in fourth year were in advanced proficiency level. Student proficiency levels were also verified by the distribution of principle factor analyses of all the background measures.

Context

The goals of the other Chinese program serve the purpose of general education at the university and provide a major or a minor study for students. Students start with three-hour basic language classes in their first two years. In the first semester, only Pinyin is introduced and used as script, and character learning is delayed to the second semester. The classes are instructed partially in English. Students in the Chinese minor or major move on to more advanced language classes and content-based classes in their third and

fourth year. The content-based classes include Business Chinese, Chinese Stylistics, Chinese Culture and Civilization, and Chinese Conversation and Composition. All courses are instructed in both English and Chinese. A one-hour tutorial session is provided to Chinese major and minor students. Various cultural and social events and activities are also held to help students learn Chinese and Chinese culture. Study abroad is encouraged as well.

Design and Materials

Incidental word learning experiment. An incidental word learning experiment was given in groups to investigate whether CFL learners were able to use morphological knowledge of Chinese characters and context clues to infer the meanings of new words. In this experiment, participants were asked to complete a multiple-choice task to infer the meanings of 44 unfamiliar compound words. The presentation method (decontextualized condition vs. context condition) of the 44 compound words was manipulated.

The incidental learning experiment materials were modified based on the experiment materials from Mori's (1996) study and Han's (2012) study to better suit CFL learners. There were 22 compound words that are more commonly used in Chinese selected from Mori's study and 22 compound words that are easier for CFL learners chosen from Han's study to form 44 compound words that are common in Chinese but novel to CFL learners. The 44 words were equally distributed in two conditions, decontextualized condition (i.e., word only) and context condition, counterbalanced in two versions. Under the word only condition, compound words were shown without context (e.g., 月食). Under the context condition, the compound words were displayed in a sentence context that provided neutral semantic cues about the target compound words

(e.g., 今天晚上有月食, 我们一起去山上看吧). The four choices included integrated answer (*a lunar eclipse*), character distractor (*a monthly meal ticket*), context distractor (*fireworks*), and anomalous (*a traffic light*) and presented in English translation. The 44 words were counterbalanced into two conditions in two versions of the task. One point was given to each correct answer, and the maximum score was 44 points. Cronbach's alpha of this task was .87 (see Appendix F).

The proportion of correctly answered choices was used to represent student incidental word learning abilities. In addition, selection rates of different inferential strategies were calculated as well. When students selected integrated answers, this meant they used both morphology and context cues to infer the meanings of words; therefore, they used integrated strategy. The average selection rates on integrated answers were used to represent the use of integrated strategy. When students chose character distractors, they attempted to use only morphology strategy to infer the meanings of words. Therefore, the average selection rates on character distractors were used to represent the use of morphology strategy. Context strategy was defined as the average selection rates on context distractors, when students used only context cues to infer the meanings of words.

Procedure

Students participated in the incidental word learning experiment in small groups based on their availability during their Chinese lesson times. Each student completed a version of the incidental word learning task randomly assigned by the researcher. The task took approximately 20 minutes.

Background Measures

The background measures were the same as in Study One.

Data Analysis

To answer the research questions for Study Two, two two-way repeated ANOVAs were conducted. The first ANOVA was conducted to answer whether CFL learners were able to infer the meanings of words in a reading context. The dependent variable was the proportion of correctly answered target word meaning choices. The independent variable was one within-subjects factor: condition (context condition and decontextualized condition) and one between-subjects factor: student proficiency level (novice, intermediate, and advanced). The second ANOVA was conducted to answer whether CFL learners from different proficiency levels use different lexical inferential strategies. The dependent variable was the proportion of students' selection rates on three types of lexical inferential strategies (integrated strategy, morphology strategy, and context strategy). The independent variables were one within-subjects factor: condition (context condition and decontextualized condition) and one between-subjects factor: student proficiency level (novice, intermediate, and advanced). A Multiple Linear Regression was also run to find the predictors to student incidental word learning abilities. The independent variables were word reading, word semantic knowledge, semantic radical knowledge, and phonetic radical knowledge.

CHAPTER IV: RESULTS

Findings for Study One

To answer Research Question One, whether CFL learners can learn orthographic and phonological forms of novel Chinese characters via self-teaching, two four-way repeated measures analyses of variance (ANOVA) were conducted.

The first ANOVA was conducted to assess whether CFL learners can learn orthographic forms of new characters via self-teaching. The dependent variable was proportions of correctness of orthographic choice. The independent variables were three within-subject factors: phonetic regularity (regular and irregular); semantic transparency (transparent and opaque); and learning trial (one, two, and three), as well as one between-subject factor: student proficiency level (intermediate, advanced). Based on the number of years students had learned Chinese, students were divided into two proficiency levels. Students who had studied Chinese characters for two to three years were in the intermediate level, and students who learned characters for more than three years were in the advanced level. Table 1 presents the descriptive statistics of student correctness on orthographic choice by proficiency level over three trials.

Table 1

*Descriptive Statistics of Proportions of Correctness on Orthographic Choice by**Proficiency Level over Three Trials*

			Intermediate (<i>n</i> = 30)		Advanced (<i>n</i> = 15)	
			<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Regular	Transparent	T1	0.38	0.28	0.57	0.33
		T2	0.62	0.35	0.88	0.13
		T3	0.72	0.33	0.88	0.16
	Opaque	T1	0.31	0.22	0.50	0.33
		T2	0.51	0.30	0.82	0.18
		T3	0.62	0.35	0.85	0.18
Irregular	Transparent	T1	0.29	0.25	0.52	0.31
		T2	0.61	0.28	0.58	0.35
		T3	0.68	0.34	0.85	0.21
	Opaque	T1	0.28	0.18	0.30	0.25
		T2	0.44	0.31	0.65	0.28
		T3	0.64	0.31	0.83	0.15

Note. T1 = Trial1; T2 = Trial 2; T3= Trial 3.

The ANOVA results indicate significant main effects of both phonetic regularity and semantic transparency, $F(1, 43) = 19.54, p < .01, \eta_p^2 = .31$ and $F(1,43) = 13.52, p < .01, \eta_p^2 = .24$, respectively, indicating that students were more able to use regular phonetic radicals and transparent semantic radicals than irregular phonetic radicals and opaque semantic radicals to learn the orthographic forms of the new characters. There were also significant main effects of trial and proficiency level, $F(2, 86) = 72.08, p < .01, \eta_p^2 = .63$ and $F(1, 43) = 7.88, p < .05, \eta_p^2 = .16$, showing that students performed significantly better on the orthographic forms over the trials, and advanced students performed significantly better than intermediate students.

A significant interaction between phonetic regularity and student proficiency level was found, $F(1, 43) = 6.40, p < .05, \eta_p^2 = .13$, reflecting that advanced proficiency level

students were more able to use regular phonetic radicals to learn the orthographic forms of the novel characters than intermediate proficiency level students were. Interestingly, there was also a three-way interaction between phonetic regularity, student level, and learning trial on orthographic learning, $F(2, 86) = 3.67, p < .05, \eta_p^2 = .08$. According to Figure 1, intermediate proficiency level students performed similarly on both phonetic regular and irregular conditions over the three trials; however, Figure 2 shows that advanced proficiency level students performed much better on phonetic regular characters than phonetic irregular characters over the first two trials, suggesting that advanced proficiency level students were more able to use regular phonetic radicals to learn the orthographic forms of the new words than intermediate proficiency level students in early trials.

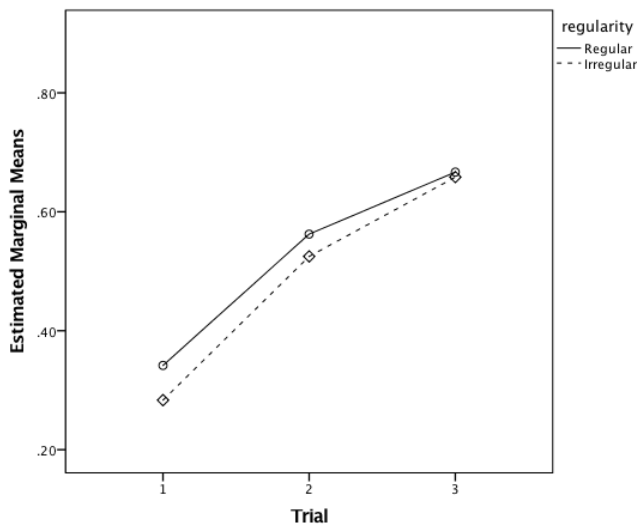


Figure 1. Mean proportions of correctness of orthographic forms with two phonetic regularity conditions over three trials at intermediate level.

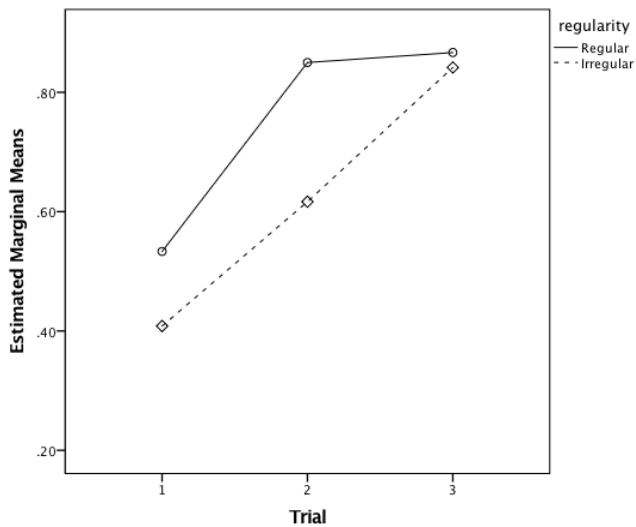


Figure 2. Mean proportions of correctness of orthographic forms with two phonetic regularity conditions over three trials at advanced level.

There was also a three-way interaction between semantic transparency, learning trial, and student proficiency level, $F(2, 86) = 4.43, p < .05, \eta_p^2 = .09$, shown by Figure 3 and Figure 4. As shown in Figure 3, intermediate proficiency level students benefited from semantic transparent radicals to acquire the orthographic forms of the new characters, especially at the second and third trials. Advanced proficiency level students, however, only benefited from semantic transparent radicals in the first trial, and the advantage disappeared in later trials.

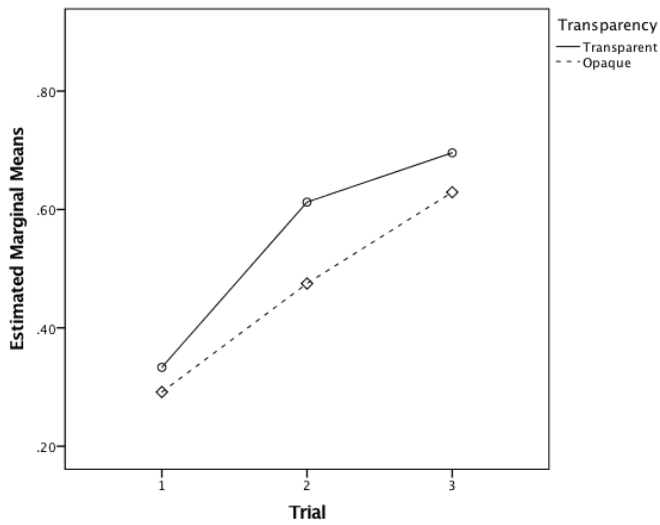


Figure 3. Mean proportions of correctness of orthographic forms with two semantic transparency conditions over three trials at intermediate level.

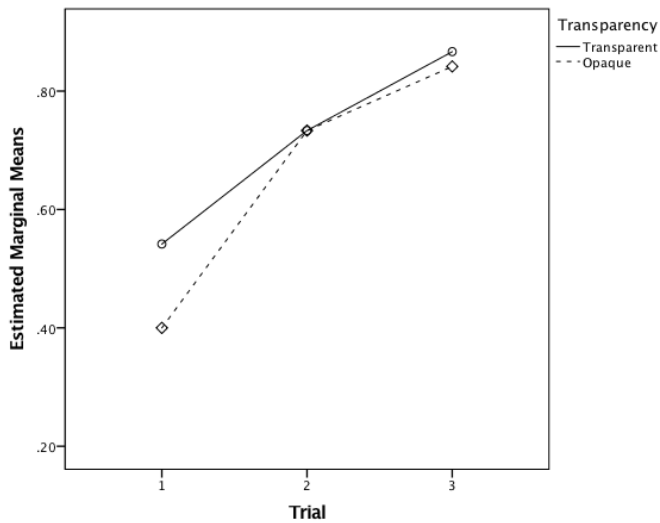


Figure 4. Mean proportions of correctness of orthographic forms with two semantic transparency conditions over three trials at advanced level.

The second ANOVA was conducted to find out whether CFL learners could implicitly learn the phonological forms of new characters. The dependent variable was

proportions of correctness of phonological choices. The independent variables were three within-subject factors: phonetic regularity, semantic transparency, and learning trial, and one between-subject factor: student proficiency levels. Table 2 shows the descriptive statistics of student correctness on phonological choice by proficiency level over three trials.

Table 2

Descriptive Statistics of Proportions of Correctness on Phonological Choice by Proficiency Level over Three Trials

			Intermediate (n = 30)		Advanced (n = 15)	
			<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Regular	Transparent	T1	0.43	0.31	0.73	0.20
		T2	0.62	0.28	0.82	0.18
		T3	0.74	0.26	0.87	0.13
	Opaque	T1	0.48	0.29	0.57	0.27
		T2	0.60	0.28	0.87	0.21
		T3	0.80	0.20	0.93	0.11
Irregular	Transparent	T1	0.48	0.31	0.40	0.30
		T2	0.57	0.33	0.63	0.23
		T3	0.63	0.31	0.87	0.16
	Opaque	T1	0.40	0.28	0.40	0.18
		T2	0.45	0.30	0.52	0.15
		T3	0.58	0.32	0.55	0.24

Similar to the results of student learning of orthographic forms, the ANOVA results showed significant main effects of phonetic regularity and semantic transparency, $F(1, 43) = 31.87, p < .01, \eta_p^2 = .43$ and $F(1, 43) = 5.05, p < .05, \eta_p^2 = .11$, respectively, meaning that both phonetic regularity and semantic transparency affected phonological learning of new characters. Students performed better on the phonological forms of the

regular and transparent characters. There were also main effects of learning trial and proficiency level, $F(2, 86) = 71.60, p < .01, \eta_p^2 = .63$ and $F(1, 43) = 4.88, p < .05, \eta_p^2 = .10$, suggesting that advanced proficiency level students learned more phonological forms than intermediate proficiency level students, and both groups showed growth over the trials.

Results showed a significant two-way interaction between phonetic regularity and student level, $F(1, 43) = 5.85, p < .05, \eta_p^2 = .12$, as well as a three-way interaction between phonetic regularity, student proficiency level, and learning trial, $F(2, 86) = 3.25, p < .05, \eta_p^2 = .07$, shown by Figure 5 and Figure 6. Intermediate proficiency level students did not benefit from regular phonetic radicals on learning phonological forms in the first trial; however, they acquired more regular phonological forms than irregular ones in the second trial, and the difference increased in the third trial. On the other hand, advanced proficiency level students benefited from regular phonetic radicals when learning the phonological forms from the first trial and consistently performed better on the characters with regular phonetic radicals over the trials.

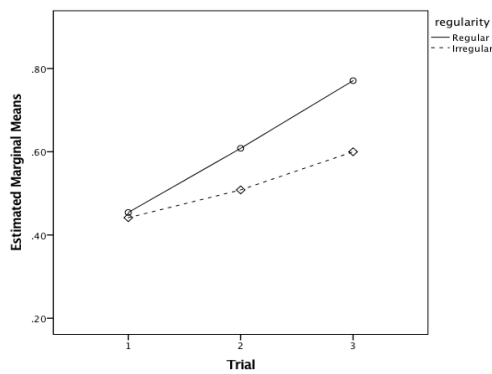


Figure 5. Mean proportions of correctness of phonological forms with two phonetic regularity conditions over three trials at intermediate level.

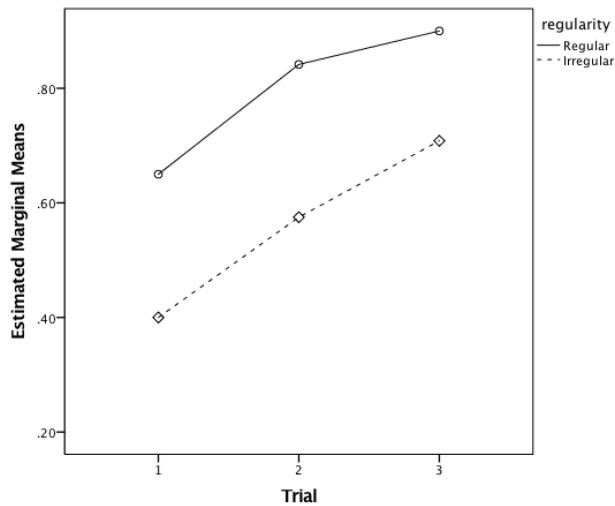


Figure 6. Mean proportions of correctness of phonological forms with two phonetic regularity conditions over three trials at advanced level.

More interesting, there was also a significant two-way interaction between phonetic regularity and semantic transparency, $F(1, 43) = 10.50, p < .01, \eta_p^2 = .20$, and a three-way interaction between phonetic regularity, semantic transparency, and learning trial, $F(2, 86) = 6.74, p < .01, \eta_p^2 = .15$, shown by Figure 7 and Figure 8. For regular characters, students acquired more semantic transparent characters than semantic opaque characters in the first trial, but this benefit disappeared in the latter two trials. Students may have paid more attention to semantic opaque characters in the first trial. Surprisingly, for irregular characters, students performed better on transparent characters than opaque characters, and the performance difference increased over the trials, meaning that students benefited more from semantic transparency on phonological learning under phonetic irregular condition than under phonetic regular condition. The results could be due to the enhanced attention to semantic cues when the phonetic radicals provide misleading pronunciation information.

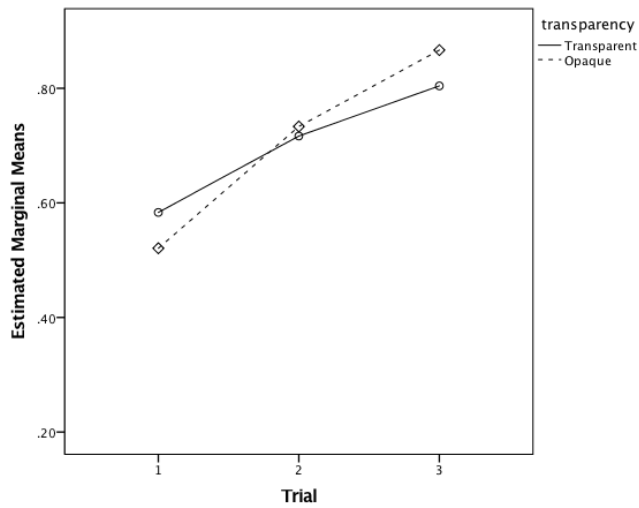


Figure 7. Mean proportions of correctness of phonological forms with semantic transparent conditions over three trials at phonetic regular condition.

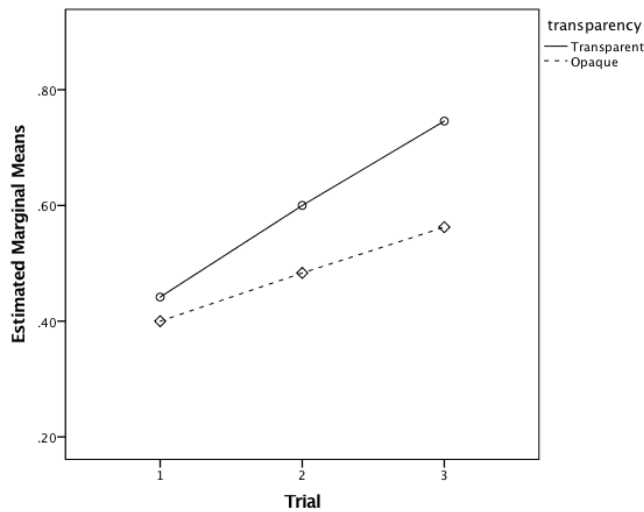


Figure 8. Mean proportions of correctness of phonological forms with semantic opaque conditions over three trials at phonetic irregular condition.

Findings for Study Two

To answer the research question whether CFL learners can infer meanings of new Chinese words in sentence context, a two-way repeated ANOVA was conducted. The dependent variable was proportions of correctness of target word meaning choice. The within-subjects factor was condition (context condition and decontextualized condition). The between-subjects factor was student proficiency level. Table 3 shows means and standard deviations of student performance from three proficiency levels under two conditions.

Table 3

Descriptive Statistics of Correctness of Target Word Meaning Choice with Two Conditions by Proficiency Level (N = 72)

	Level	M	SD	n
Decontextualized Condition	Novice	0.33	0.09	25
	Intermediate	0.47	0.10	31
	Advanced	0.49	0.09	16
Contextualized Condition	Novice	0.37	0.18	25
	Intermediate	0.61	0.10	31
	Advanced	0.71	0.06	16

Results show a significant main effect of context condition, $F(1, 69) = 57.44$, $p < .01$, $\eta_p^2 = .45$, suggesting that students were more able to infer the meanings of words embedded in sentence context than infer the word meanings using morphology. There was also a significant main effect of student proficiency level, $F(2, 69) = 50.59$, $p < .01$, $\eta_p^2 = .59$. As students became more proficient, they were more able to infer meanings of new words. Results also show a significant interaction between condition and student proficiency level, $F(2, 69) = 7.78$, $p < .01$, $\eta_p^2 = .18$. As Figure 9 illustrates, students

were more able to infer meanings of words in context condition with increasing proficiency levels, whereas students' abilities to use morphology to infer meanings of words increased from novice level to intermediate level but remained static until advanced proficiency level, reflecting that students did not gain much knowledge of lexical analysis after intermediate level.

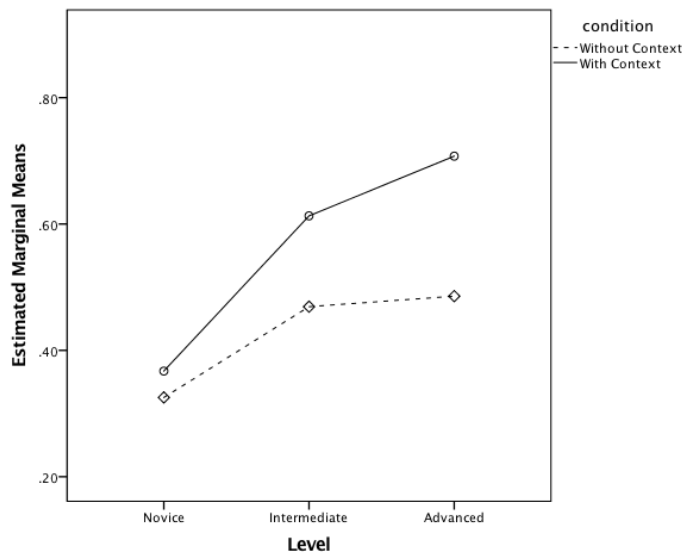


Figure 9. Mean proportions of correctness of target word choices by proficiency level and context condition.

A second two-way repeated ANOVA was conducted to examine whether students from different proficiency levels use different lexical inferential strategies to infer the meanings of words under different conditions. Table 4 presents the descriptive statistics of students' selection rates on different strategies with two conditions by proficiency level.

Table 4

Means and Standard Deviations of Selection Rates of Three Inferential Strategies by Context Condition and Proficiency Level

Condition	Strategy	Novice (<i>n</i> = 25)		Intermediate (<i>n</i> = 31)		Advanced (<i>n</i> = 16)	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Decontextualized	Context	0.21	0.09	0.12	0.07	0.07	0.05
	Integrated	0.30	0.11	0.46	0.11	0.49	0.09
	Morphology	0.30	0.09	0.32	0.11	0.36	0.10
Contextualized	Context	0.23	0.11	0.19	0.08	0.18	0.08
	Integrated	0.35	0.19	0.59	0.13	0.69	0.08
	Morphology	0.20	0.10	0.14	0.08	0.08	0.05

Results show a significant main effect of strategy, $F(2, 138) = 330.28, p < .01, \eta_p^2 = .83$. It also found a significant interaction between strategy and student proficiency level, $F(4, 138) = 38.84, p < .01, \eta_p^2 = .53$, and a significant interaction between strategy and condition, $F(2, 138) = 73.59, p < .01, \eta_p^2 = .52$. There was also a significant three-way interaction between strategy, condition, and student proficiency level, $F(4, 138) = 6.43, p < .01, \eta_p^2 = .16$. According to Figure 10, when words were presented alone, there was no sentence context for students to analyze; therefore, under decontextualized condition, context strategy was treated as distractor and was not analyzed. As Figure 10 illustrates, there was no noticeable difference between integrated strategy and morphology strategy used by novice proficiency level students. At intermediate level, students were more able to use integrated strategy than morphology strategy to infer the meanings of words, suggesting that students at intermediate level can make use of both word internal and external (contextual) cues to infer the word meanings. This strategy difference pattern remained similar at the advanced level.

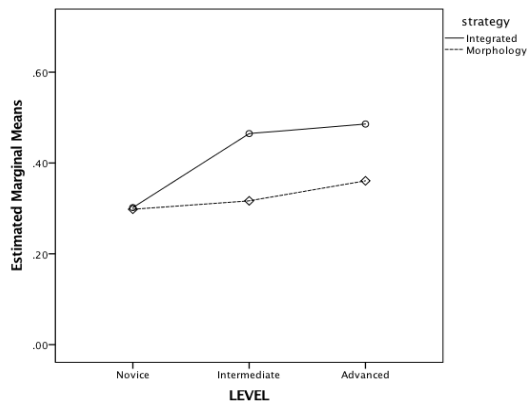


Figure 10. Mean proportions of selection rates on two inferential strategies by proficiency level at decontextualized condition.

On the other hand, as Figure 11 illustrates, for the contextualized condition, novice students used both context and morphology strategies, indicated by high selection rate on context and morphology choices. As student proficiency level increased, students were more able to integrate context and morphology to infer the meanings of the words.

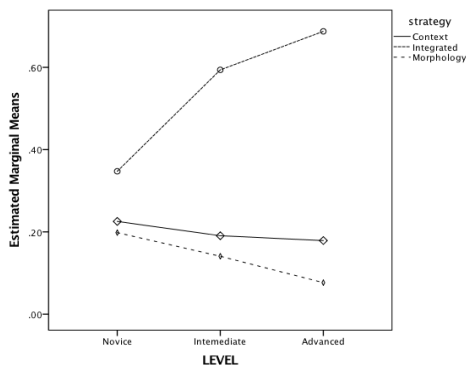


Figure 11. Mean proportions of selection rates on three different inferential strategies by proficiency level at contextualized condition.

To further investigate the extent to which individual differences in linguistic skills predicted students' abilities to infer meanings of words, a Multiple Linear Regression

analysis was conducted. The dependent variable was proportions of correctness on the incidental word learning task; and the independent variables were student linguistic skills, including word reading, word semantic knowledge, semantic radical knowledge, and phonetic radical knowledge (See Table 5 for Pearson Correlation Coefficients).

Table 5

Pearson Correlation Coefficients for Student Inferential Abilities and Other Linguistic Skills (N = 72)

Variable	1	2	3	4	5
1. Inferential Ability	-	0.72**	0.76**	0.66**	0.76**
2. Word Reading		-	0.96**	0.85**	0.84**
3. Word Semantic Knowledge			-	0.85**	0.86**
4. Semantic Radical Knowledge				-	0.71**
5. Phonetic Radical Knowledge					-

* $p < .05$. ** $p < .001$.

Results show a significant regression, $F(4, 67) = 28.68, p < .01$. Table 6 shows that $R^2 = .63$ and the adjusted $R^2 = .61$, meaning that 61% of the variance in students' abilities to infer meanings of words can be predicted from word reading, word semantic knowledge, semantic radical knowledge, and phonetic radical knowledge combined. Results show that phonetic radical knowledge was a significant predictor ($p < .01$) and word semantic knowledge was a marginally significant predictor ($p = .05$).

Table 6

Multiple Linear Regression Analysis Summary Predicting Student Inferential Abilities from Word Reading, Word Semantic Knowledge, Semantic Radical Knowledge, and Phonetic Radical Knowledge (N=72)

Variable	<i>B</i>	<i>SEB</i>	β	R^2	ΔR^2
				0.63	0.61
Word Reading	-0.08	0.07	-0.28		
Word Semantic Knowledge	0.31	0.16	0.55*		
Semantic Radical Knowledge	0.06	0.08	0.12		
Phonetic Radical Knowledge	0.26	0.09	0.44*		

* $p < .05$. ** $p < .001$.

Summary of Findings

The findings from Study One show that CFL learners can implicitly learn the orthographic and phonological forms of novel Chinese characters, and such ability improved with increasing proficiency levels. When learning irregular characters, they relied on semantic transparency to remember the phonological forms of words. The findings of Study Two show that CFL learners were better able to infer the meanings of words in context than without context, and both word semantic knowledge and phonetic radical knowledge were significant predictors to student lexical inference skills.

CHAPTER V: DISCUSSION

Discussion of the Findings

This dissertation, building upon previous research on orthographic learning and incidental word learning, aimed to understand the underlying mechanism of orthographic learning and incidental word learning in CFL learners. The first study explored whether CFL learners can use phonetic regularity and semantic transparency to learn the orthographic and phonological forms of novel Chinese characters in a self-teaching paradigm. The second study investigated (1) whether CFL learners can infer the meanings of new Chinese words in a reading context, and (2) the extent to which individual differences in linguistic skills predict incidental word learning. Study One involved intermediate and advanced CFL students. Study Two involved the same group of intermediate and advanced CFL students as in Study One, as well as novice students.

Orthographic and Phonological Learning of Chinese Characters

The results of Study One show that orthographic and phonological learning of new characters was affected by both regularity of phonetic radicals and transparency of semantic radicals within characters. More specifically, advanced proficiency level students benefited from phonetic regularity more than intermediate proficiency level students did in the first trial in learning orthographic forms of new characters, whereas intermediate level students only showed an advantage of using phonetic radicals in the first trial, and the advantage diminished quickly after the second trial. These findings could be explained by advanced students' better awareness of the functionality of phonetic radicals and better knowledge of phonetic radicals. On the other hand, advanced level students only showed significantly better performance on transparent characters in

the first trial and performed similarly on transparent and opaque characters in the last two trials, whereas intermediate students benefited from semantic transparent radicals more over trials, suggesting that both intermediate and advanced students can use semantic radical knowledge to learn the orthographic forms of new characters.

Similarly, the researcher was interested in whether phonetic radical regularity and semantic radical transparency affect phonological learning of CFL learners via self-teaching. Results show that intermediate CFL learners were only able to use phonetic regularity to learn the phonological forms after the second exposures of new characters, suggesting that their phonetic knowledge was still under development. However, advanced CFL learners performed better on phonetic regular characters consistently over three learning trials, suggesting they have developed adequate knowledge of phonetic regularity.

It seems that phonetic radicals exerted a larger effect on learning orthographic forms for advanced level students, but semantic radicals benefited orthographic learning more for intermediate level students. This is consistent with the findings of Zhang and Li (2016) study on orthographic learning in CFL learners of Thai background. As for phonological learning, phonetic radicals played a more important role in learning phonological forms of both intermediate and advanced level students; however, advanced level students were able to apply the phonetic strategy earlier than intermediate level students. This is not surprising, due to the sheer number of differences between phonetic radicals and semantic radicals. The number of commonly used phonetic radicals is much greater, and it takes more time to possess good knowledge of phonetic radicals and develop phonetic awareness. Therefore, advanced level students are more able to use

phonetic radicals to learn orthographic forms. However, there are only a small number of commonly used semantic transparent radicals. Even intermediate level students are able to acquire a sufficient amount of semantic radicals to help them learn orthographic forms. This interpretation was supported by the orthographic knowledge development pattern that semantic radicals develop earlier and faster in both Chinese native children (Anderson et al., 2003; Chan & Nunes, 1998; Ho et al., 2003; Packard et al., 2006; Shu & Anderson, 1997; Shu et al., 2000) and CFL learners (Shen, 2000; Shen & Ke, 2007; Shu et al., 2000; Taft & Chung, 1999).

A major finding of the first study was that phonetic regularity interacted with semantic transparency for phonological learning of novel characters in CFL learners. When learning to pronounce regular characters, the effect of semantic transparency on phonological learning diminished over trials; however, when learning irregular characters, the effect of semantic transparency on phonological learning increased over trials, meaning that semantic transparency has a greater effect on learning phonological forms of irregular characters in CFL learners. This means that when phonetic radicals within characters provide misleading phonetic cues, students rely on semantic transparent radicals to help them remember the pronunciations of the characters. Another noteworthy finding of the first study was that semantic radical transparency not only affect the learning of orthographic forms of characters but also influenced the learning of phonological forms of characters in CFL learners, suggesting that semantic radicals play a critical role in orthographic and phonological learning of characters.

The current study remedied the limitations of the previous studies on investigating whether phonetic regularity and semantic transparency affect orthographic and

phonological learning of characters in native Chinese children that the experimental materials were annotated by phonetic aid system, which drew students' attention away from characters and resulted in no phonetic effect on learning orthographic forms of characters (Xiao, 2013; Ho, 2013). The experimental materials of Study One were presented with concurrent audio recordings and were revised into more story-like passages on ordinary life topics, which are more cognitively and socially appropriate for adult learners. The results found a significant effect of phonetic regularity on orthographic and phonological learning in CFL learners. The results are consistent with the findings of the second study of Ho (2013), in which the phonetic aid system was eliminated in the experiment that Taiwanese second graders were able to use phonetic regularity for learning orthographic forms of characters. The results also are consistent with Xiao's (2013) finding that phonetic regularity interacted with semantic transparency on learning phonological forms of characters. When learning regular and semi-regular characters, there was no effect of semantic transparency; when learning irregular characters, there was a significant effect of semantic transparency. These findings are further confirmed by Ho's (2013) third study, which did not find an effect of semantic transparency when all the characters embedded in the materials were regular characters.

To date, there is no consensus on how learners of Chinese establish automatic word representations regardless of whether they are native Chinese or CFL learners. The findings of Xiao (2013) support the common assumption that learning Chinese characters requires more semantic related strategies, as semantic transparency affected both orthographic and phonological learning of characters in her study, but phonetic radicals did not. However, the conclusion of Ho (2013) was more aligned with the view proposed

by Share (1995) in the Self-teaching Hypothesis that learning Chinese orthography should be largely reliant on the phonological recoding afforded by characters and that orthographic processing is secondary, due to the fact that there was no effect of semantic transparency in Ho's study. This inconsistency in the interpretations of the previous studies was due to flaws in the research designs that experimental materials were denoted by phonetic aid systems (Xiao, 2013) and the embedded pseudocharacters were all regular characters when examining semantic transparency effect (Ho, 2013). Zhang et al. (2016) did not provide phonological input to analyze how phonetic regularity and semantic transparency interact in the orthographic and phonological learning of CFL learners of Thai background. The current study remedied the limitations of the previous research designs by replacing the phonetic aid system with audio recording and provided the opportunity to analyze the findings of the related studies holistically, which provided clearer evidence of the underlying mechanism of orthographic and phonological learning in both Chinese children and CFL learners. To the author's knowledge, this study is the first attempt to understand CFL learners' orthographic learning process from a self-teaching perspective and how semantic and phonological factors interact in the orthographic learning process.

The findings are consistent with the finding of CFL learners of Thai background that intermediate level learners were more reliant on orthographic and morphological (semantic radical) information for learning the orthographic forms of characters, and the reliance on orthographic information gradually disappeared with the increasing knowledge of morphological knowledge (Zhang & Li, 2016). This study allowed the comparison of self-teaching process in CFL learners from typologically different

language backgrounds. The results show that CFL learners from Thai and English backgrounds both rely on orthographic and semantic information to self-teach the orthographic forms of new characters.

The findings of Study One provided evidence to support the self-teaching view of Share (1995) that the phonological recoding opportunity afforded by phonetic properties within characters facilitates orthographic and phonological learning of characters, as CFL learners acquire more orthographic and phonological forms of new characters with the presence of phonetic regular radicals. Like learners of shallow orthographies, such as Hebrew and English, there are relatively direct and consistent linkages between phonemes and graphemes. Phonetic radicals within regular characters provide a linkage between printed forms and their sounds, allowing students to phonologically decode regular characters.

Meanwhile, there is also compelling evidence in support of this study's hypothesis that semantic radicals play a more critical role in the formation of new characters in both Chinese children and CFL learners' orthographic lexicons, as both Chinese children and CFL learners performed better on the orthographic and phonological forms of transparent characters and relied more on semantic transparency to learn to read when there were no phonetic cues provided by the characters. When learning irregular characters, the formation of phonological forms is facilitated by semantic radicals, suggesting that orthographic processing of Chinese characters and property function are critical to learning to read characters in the self-teaching paradigm. This finding is particularly important in learning to read Chinese because of the complexity of internal structures of characters and the indirect association between

printed forms and their sounds. CFL learners have to learn the internal structure of characters and develop radical functional awareness to be able to apply semantic strategies in learning to read.

The findings of the current study suggest that learning to read a deep orthography, like Chinese, requires orthographic processing prior to phonological processing. Unlike English, there are relatively direct associations between graphemes and phonemes, and the onset of reading is the beginning of self-teaching and developing grapheme-phoneme correspondence rules for successful phonological recoding in future learning (Share, 1995). Whereas there are indirect associations between printed forms and their sounds in characters, and beginning Chinese learners develop the knowledge of character internal structures and the building blocks of characters before they start to realize phonetic regularity and semantic transparency of characters. Gradually, learners develop dual orthographic processing pathways depending on the presence or absence of regular phonetic radicals; and in the absence of phonetic cues, semantic transparent radicals function as a facilitation device to build the associations between printed forms and sounds. This view also further postulated that the depth of orthography is a spectrum, and the deeper the orthography, the more orthographic processing is required by the language learners, which supports the hypothesis that learning to read Chinese requires more semantically related strategies.

The conclusion of the study is also supported by previous works on the importance of semantics and integration of semantics, phonology, and orthography on orthographic learning on word recognition (e.g., Coltheart et al., 1977; Perfetti, 2007; Seidenberg et al., 1984) and also by the cross-linguistic study (McBride-Chang et al.,

2005) that concluded phonological awareness plays a more critical role in learning alphabetic languages, but morphological awareness is more important for reading in Chinese. The current study provides empirical evidence that orthographic and semantic processes are critical in learning to read Chinese for CFL learners.

Incidental Word Learning

Recognizing the importance of semantics and morphological structure in learning of Chinese orthography and words, Study Two aimed to further explore whether CFL learners were able to incidentally acquire the meanings of words in reading context. This inquiry is especially important for CFL learners due to the fact that learning to read Chinese is very challenging and that vocabulary development is essential to reading. Research has shown that native English-speaking children acquire hundreds of words through incidental learning during normal reading every year (Carlisle et al., 2000; Hulstijn, 2003; Jenkins & Dixon, 1983; Merriam et al., 2007; Nagy et al., 1985), emphasizing the importance of using both morphology and context to infer the meanings of words in reading context. However, previous research has put a great emphasis on the importance of morphological knowledge in vocabulary acquisition and morphology as a lexical inferential means to infer meanings of words presented in isolation in monolingual and foreign language research (Carlisle et al., 2000; Deacon & Kirby, 2004; Ku & Anderson, 2001; McBride-Chang et al., 2005) and lacked a focus on reading context.

Studies on incidental word learning in a reading context in native Chinese speaking children found that elementary children are able to incidentally acquire the meanings of novel words embedded in the stories that provide contextual clues for the

novel words (Ku & Anderson, 2001; Shu et al., 1995); and Chinese children can infer the meaning of semi-transparent words presented with sentence context (Han, 2015).

However, studies on incidental word learning in CFL learners of English background are scarce.

Building on the previous research on incidental learning in Chinese, Study Two investigated whether CFL learners of English background could incidentally acquire the meanings of words in reading context. CFL participants included novice, intermediate, and advanced proficiency levels to see how students from different proficiency levels differentiated their lexical inferential strategies. Students were asked to interpret compound words in two conditions (with context and without context). The results show that CFL learners were more able to infer the meaning of words presented with context than the words presented without context, and such lexical inference ability increased with increasing proficiency levels. The findings are consistent with those of native Chinese children (Han, 2015; Shu et al., 1995) and Japanese foreign language learners (Mori, 1996).

Study Two further analyzed lexical inferential strategies used by CFL learners when words were presented in different conditions (with context and without context). The results suggest that intermediate and advanced CFL learners were reliant on morphology to analyze the meanings of words presented in isolation. They inferred the meanings of the words based on their individual morpheme rather than synthesizing the information. In contrast, when words were presented with context, advanced CFL learners were better able to integrate morphological information and contextual cues to infer the meanings of words than intermediate learners. More specifically, CFL learners

used more context strategy and less morphological strategy to infer the meanings of words with increasing proficiency levels. This finding is consistent with the findings of CFL learners of Thai background (Zhang & Li, 2016). Han (2015) and Mori (1996) reported similar findings that novice learners were more reliant on morphology to infer the meanings of words even when words were presented in context. Thus CFL learners seem to exhibit similar incidental word learning patterns as native Chinese children.

The two studies, taken as a whole, provide evidence that insights into Chinese character internal structure, function of phonetic and semantic radicals, and morphology are critical factors to learning Chinese as a foreign language. The findings suggest that learning Chinese, a deep orthography, requires substantial orthographic process prior to phonological recoding due to the complexity of Chinese orthography. The findings are especially instrumental for CFL learners who learn Chinese using different approaches from native Chinese learners. Furthermore, the study provides clearer understanding of the orthographic and incidental learning mechanism of CFL learners, which has implications for rethinking the current pedagogical approach for CFL and for building a foundation for facilitating a more self-regulated learning approach for CFL learners, which is currently overlooked.

Pedagogical Implications

CFL learners typically learn Chinese through a communicative approach with the goal to be able to communicate with Chinese speaking people quickly and effectively. This approach, however, implies an unsystematic introduction of characters. A great number of compound characters and words are learned before their subcomponents (radicals) are instructed. In contrast, Chinese children start to learn simple characters,

which are the building blocks of compound characters and function as either semantic or phonetic radicals within compound characters. Later, the building blocks of compound characters become self-teaching devices to facilitate the acquisition of compound characters.

Research has shown that young Chinese children as early as first grade start to develop awareness of the internal structure of characters and their radicals and at third grade start to be able to use radical function to assist character learning (Anderson et al., 2003; Ho & Bryant, 1997; Ho et al., 2003; Packard et al., 2006; Shu & Anderson, 1997; Shu et al., 2000). However, CFL learners learn to read through communicative approaches in which characters are not taught systematically and introduced mostly as components of words. As a result, CFL learners only slowly develop awareness of character internal structure and radical function regularity, which is supported by the earlier studies that semantic radicals and radical frequency facilitate character learning (Shen, 2000; Shen & Ke, 2007; Su, 2010; Wang et al., 2004; Williams, 2013, Zhang et al., 2016). It is debatable whether phonetic radicals should be explicitly taught because the varying reliability of phonetic radicals may distract or confuse CFL learners (Taft & Chung, 1999). The orthographic and morphological knowledge of CFL learners is largely overlooked in current CFL curriculum and classroom instruction, resulting in the challenge for CFL learners to reach advanced literacy.

The current study also yields compelling evidence that without explicit instruction CFL learners are able to use phonetic regularity and semantic transparency to learn the orthographic and phonological forms of characters and infer the meanings of words in natural reading, like native learners of Chinese and English. The conclusion of this

dissertation challenges the current CFL instructional approach of characters and supports a more systematic character teaching, introducing more simple characters and common radicals at the beginning of the learning phase of CFL learners to allow a better understanding of the formation of Chinese characters and words. Later, CFL learners can use simple characters and radicals as self-teaching devices to teach them compound characters and compound words in natural reading. More opportunities should be provided to promote self-regulated learning and strategic reading of CFL learners. For example, based on students' proficiency levels, more leisure reading materials in which unfamiliar word coverage is under 5% should be designed and developed to facilitate incidental word learning to ease the challenge of learning to read Chinese.

Limitations and Future Research Recommendations

One of the limitations of the current study was that the orthographic learning task in Study One asked students to recall and produce the meanings of the 16 pseudocharacters embedded in the stories, which posed a high demand on students' working memory resulting in a floor effect. Therefore, semantic test performance was not analyzed in the current study. It is theoretically and pedagogically important to understand whether CFL learners are able to use phonetic regularity and semantic transparency to incidentally learn the meanings of characters via self-teaching and how phonetic regularity and semantic transparency interact in the lexical learning of characters. In future research, a semantic multiple-choice task instead of semantic production should be designed to reduce the memory load for CFL learners. Moreover, it will be interesting to see how CFL learners process orthographic and phonological forms of semi-regular characters. Last but not least, Study Two only provided two conditions

(words only and words with context). In future research, a context only condition (e.g., 今天晚上有___, 我们一起去山上看吧.) should be provided to compare how CFL learners use different lexical inferential strategies.

Conclusion

This dissertation first set out to investigate the orthographic and phonological learning of characters and incidental learning of words in CFL learners in two theoretical frameworks: Self-teaching Hypothesis and incidental word learning. The findings of Study One provide clear evidence that CFL learners are able to use phonetic regularity and semantic transparency to learn the orthographic and phonological forms of characters after limited exposures to the character in a story context. The findings of Study Two show that CFL learners' ability to engage in incidental word learning in reading context and to use lexical inferential strategies increases with Chinese proficiency level. Along with the analysis of the results, pedagogical implications and instructional insights are provided. Systematic instruction of Chinese characters is recommended to CFL teachers. Self-regulated and strategic learning capitalizing on character and word structure should be promoted to facilitate character recognition and vocabulary growth to ease the challenge of CFL learners.

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APPENDIX A: IRB Approval Letter and Informed Consent Document



*INSTITUTIONAL REVIEW BOARD
OFFICE OF RESEARCH INTEGRITY*

DATE: November 10, 2016

TO: Yang Liu
FROM: Western Kentucky University (WKU) IRB

PROJECT TITLE: [985795-1] The Effect of Incidental Learning on Second Language Learners of Chinese
REFERENCE #: IRB 17-169
SUBMISSION TYPE: New Project

ACTION: APPROVED
APPROVAL DATE: November 10, 2016
EXPIRATION DATE: November 10, 2017
REVIEW TYPE: Expedited Review

Thank you for your submission of New Project materials for this project. The Western Kentucky University (WKU) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by a *signed* consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of November 10, 2017.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Paul Mooney at (270) 745-2129 or irb@wku.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Western Kentucky University (WKU) IRB's records.

Informed Consent Document



INFORMED CONSENT DOCUMENT

Project Title: The Effect of Incidental Learning on Second Language Learners
Investigator: Yang Liu, Honors College and yang.liu@wku.edu

You are being asked to participate in a project conducted through Western Kentucky University. The University requires that you give your signed agreement to participate in this project.
You must be 18 years old or older to participate in this research study.

The investigator will explain to you in detail the purpose of the project, the procedures to be used, and the potential benefits and possible risks of participation. You may ask any questions you have to help you understand the project. A basic explanation of the project is written below. Please read this explanation and discuss with the researcher any questions you may have.

If you then decide to participate in the project, please sign this form in the presence of the person who explained the project to you. You should be given a copy of this form to keep.

1. Nature and Purpose of the Project:

The purpose of this project is to investigate whether foreign language learners of Chinese (CFL) can incidentally learn the orthographic forms (written forms) and meanings of new Chinese characters and words while reading. Participants must be at least 18 years old and native English speakers who have taken Chinese for at least two months to participate in this study.

2. Explanation of Procedures:

All participants will complete two experiments of orthographic learning and concept of word, which will take students one hour in total. After these two experiments, participants will be administered orthographic judgment, phonetic and semantic radical knowledge, word reading, 5-minute reading test, and working memory, as well as a brief language background survey. It will take about one hour to complete all five tasks. The intermediate and advanced students will participate in an additional incidental word learning experiment, which takes about 40 minutes.

3. Discomfort and Risks:

The investigator does not anticipate any discomfort or risk in completing the tasks involved in the study.

4. Benefits:

Students will develop effective strategies to learn new Chinese characters or vocabulary while reading.

WKU IRB# 17-169
Approval - 11/10/2016
End Date - 11/10/2017
Expedited
Original - 11/10/2016

5. Confidentiality:

Participants will NOT be asked to provide their names to identify students who have participated in the study. The data will be coded with numbers and kept in locked cabinets on WKU campus for at least three years.

6. Refusal/Withdrawal:

Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. Anyone who agrees to participate in this study is free to withdraw from the study at any time with no penalty.

You understand also that it is not possible to identify all potential risks in an experimental procedure, and you believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

Signature of Participant

Date

Witness

Date

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT
THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY
THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Paul Mooney, Human Protections Administrator
TELEPHONE: (270) 745-2129



WKU IRB# 17-169
Approval - 11/10/2016
End Date - 11/10/2017
Expedited
Original - 11/10/2016

APPENDIX B: Orthographic Learning Experiment

Story 1

李文文很喜欢运动，尤其喜欢游泳。夏天天气很热的时候，她常常和朋友一起去海边、河边或者冷边游泳。她认为这真是一种享受啊。

Story 2

李文文去公园玩儿，她发现公园里有很多苹果树。树上的苹果都熟了，她捡起一根长树枝去够苹果。几个苹果从树上掉了下来。

Story 3

中午学校的餐厅有很多种面食，有面条、饺子、包子，还有粽子。李文文不是很喜欢吃面食，所以她每次在学校餐厅都吃米饭和菜。

Story 4

李文文很喜欢吃水果，可是家里没有了。她跑去商店，看到商店里有香蕉、苹果、西瓜、梨、草莓和莖。苹果和西瓜很便宜，所以李文文买了一些。

Story 5

虽然李文文的宠物狗是上个月死的，可是她现在还是很想念她的狗，常常一个人看他的照片哭，心里还是很刺。

Story 6

李文文一直在发烧，她以为自己只是感冒了。可是去医院一看才知道自己得了疹。这种病不好治，所以她有点担心。

Story 7

李文文的宿舍里住着四个女生。因为在她们一起生活了两年了，所以她们已经成为了好妯。大学毕业以后，她们也会成为一生的好姐妹。

Story 8

上个星期一是李文文学校开运动会的日子。李文文参加了跳远比赛，在比赛中她稍了三次，一次比一次远。她最后得了第一名。

Story 9

李文文养了一只小狗，可爱极了。它特别喜欢吃苹果。每次李文文把吃剩的苹果扔到地上，它就把苹果放进嘴里咂了很长时间，好像很享受的样子。

Story 10

星期天一大早，李文文就和她的同学一起去了宠物商店。在店里，她们看到了猫、狗、美国矮马，还有犏。小动物们都可爱极了。

Story 11

前段时间，李文文每天吃蛋糕和点心，也不运动每天坐着学习，所以胖了不少。最近运动减肥以后，她变得不胖不瘦很靓。

Story 12

李文文的家很焦，去学校很方便。不是很远，所以不用坐公共汽车；也不是很近，所以她每天都骑自行车去上课。

Story 13

在历史课上，李文文的老师告诉他们1000多年以前，在中国住着一种古人。因为他们人数很少，所以现在中国已经没有这个民族的人了。

Story 14

李文文刚搬到一个新的公寓，可是公寓里没有家具。所以她去家具店买了一把椅子、一张床、一张桌子和一个柜子。这样朋友来了也有地方坐。

Story 15

李文文最喜欢吃妈妈做的菜。今天下午她很早就从大学校园回来，妈妈给她钁了很多菜，都是李文文爱吃的菜。

Story 16

李文文很喜欢听别人讲故事。小的时候，她的奶奶总给她讲中国历史上很有名的故事和人物。现在她常常听电视上谂故事，故事说得也很有意思。

ANSWER SHEET

Reading Comprehension

Story 1

- a. () Wenwen Li likes swimming.
b. () Wenwen Li often swims with her parents in the summer.

Story 2

- a. () Wenwen Li found many pear trees in the park.
b. () Fruits on the trees in the park are getting ripe.

Story 3

- a. () There are many dishes made with flour in the cafeteria at school.
b. () Wenwen Li does not like to eat rice at cafeteria.

Story 4

- a. () Wenwen Li likes eating fruit.
b. () Wenwen Li went to store and bought some vegetable.

Story 5

- a. () Wenwen Li's cat died last month.
b. () Wenwen Li is still sad about the death of her pet.

Story 6

- a. () Wenwen Li thought she got a cold.
b. () Wenwen Li does not worry about her illness.

Story 7

- a. () There are four girls living in Wenwen Li's dorm.
b. () They dislike each other after graduation.

Story 8

- a. () There was a sport contest at Wenwen Li's school last Monday.
b. () Wenwen Li won a game.

Quizzes

Story 1

- ✚ Which of the following character did you see in the Story # 1?

A. 沃 B. 吟 C. 沃 D. 泠

What is the pronunciation of the character that you saw in the Story #1?

A. xīn B. tiān C. xiān D. jīn

What is the meaning of the character that you saw in the Story # 1?

Story 2

- ✚ Which of the following character did you see in the Story 2?

A. 掾 B. 稼 C. 孺 D. 孛

What is the pronunciation of the character that you saw in the Story #2?

A. qiā B. xué C. jué D. jiā

What is the meaning of the character that you saw in the Story # 2?

Story 3

Which of the following character did you see in the Story 3?

- A. 衽 B. 饊 C. 饅 D. 梅

What is the pronunciation of the character that you saw in the Story #3?

- A. zài B. měi C. fěi D. gài

What is the meaning of the character that you saw in the Story # 3?

Story 4

Which of the following character did you see in the Story # 4?

- A. 莢 B. 苘 C. 窩 D. 窠

What is the pronunciation of the character that you saw in the Story #4?

- A. huò B. xiàng C. guò D. liàng

What is the meaning of the character that you saw in the Story # 4?

Story 5

Which of the following character did you see in the Story #5?

- A. 剌 B. 剌 C. 恠 D. 慄

What is the pronunciation of the character that you saw in the Story #5?

- A. tái B. dōng C. lái D. zhōng

What is the meaning of the character that you saw in the Story # 5?

Story 6

Which of the following character did you see in the Story #6?

- A. 痞 B. 瘡 C. 瘡 D. 痞

What is the pronunciation of the character that you saw in the Story #6?

- A. gé B. hé C. suì D. huì

What is the meaning of the character that you saw in the Story # 6?

Story 7

Which of the following character did you see in the Story #7?

- A. 媪 B. 眈 C. 妣 D. 眈

What is the pronunciation of the character that you saw in the Story #7?

- A. tí B. me C. xí D. le

What is the meaning of the character that you saw in the Story # 7?

Story 8

Which of the following character did you see in the Story #8?

- A. 稍 B. 跹 C. 蹠 D. 稽

What is the pronunciation of the character that you saw in the Story #8?

- A. yǒu B. gǒu C. hàn D. kàn

What is the meaning of the character that you saw in the Story # 8?

Reading Comprehension

Story 9

- a. () Wenwen Li likes to eat apples.
b. () Wenwen Li lets her dog eat her leftover apples.

Story 10

- a. () Wenwen Li went to pet store with her classmates on Sunday morning.
b. () Wenwen Li saw cute cats and dogs in the zoo.

Story 11

- a. () Wenwen Li gained a lot of weight due to overeating Chinese food.
b. () Recently, she started to exercise.

Story 12

- a. () Wenwen Li doesn't take bus to school.
b. () Wenwen Li rides bike to school everyday.

Story 13

- a. () Wenwen Li learned something about China in chemistry class.
b. () In China, this type of minority people extinguished.

Story 14

- a. () Wenwen Li just moved to a new apartment.
b. () There are furniture in her new apartment.

Story 15

- a. () Wenwen Li went back home this afternoon from her working place.
b. () Wenwen Li loves her mother's cooking.

Story 16

- a. () Wenwen Li likes listening story telling.
b. () Wenwen Li used to listen to her grandpa's story telling when she was young.

Quizzes

Story 9

Which of the following character did you see in the Story #9?

- A. 阡 B. 咍 C. 佬 D. 佬

What is the pronunciation of the character that you saw in the Story #9?

- A. qiān B. jiān C. lǎo D. hǎo

What is the meaning of the character that you saw in the Story # 9?

Story 10

Which of the following character did you see in the Story # 10?

A. 獐 B. 缦 C. 绩 D. 獾

What is the pronunciation of the character that you saw in the Story #10?

A. měi B. guì C. fěi D. zuì

What is the meaning of the character that you saw in the Story # 10?

Story 11

Which of the following character did you see in the Story# 11?

A. 脱 B. 膈 C. 瞠 D. 眈

What is the pronunciation of the character that you saw in the Story #11?

A. jué B. zāo C. xué D. gāo

What is the meaning of the character that you saw in the Story # 11?

Story 12

Which of the following character did you see in the Story # 12?

A. 迳 B. 迷 C. 焦 D. 爍

What is the pronunciation of the character that you saw in the Story #12?

A. zhēng B. bàn C. shēng D. zàn

What is the meaning of the character that you saw in the Story # 12?

Story 13

Which of the following character did you see in the Story # 13?

A. 伟 B. 玮 C. 偈 D. 埒

What is the pronunciation of the character that you saw in the Story #13?

A. shū B. zū C. gē D. hē

What is the meaning of the character that you saw in the Story # 13?

Story 14

Which of the following character did you see in the Story # 14?

A. 榧 B. 铤 C. 柶 D. 铤

What is the pronunciation of the character that you saw in the Story #14?

A. guó B. huó C. huí D. tuí

What is the meaning of the character that you saw in the Story # 14?

Story 15

✚ Which of the following character did you see in the Story #15?

A. 焮 B. 钹 C. 瓠 D. 汽

What is the pronunciation of the character that you saw in the Story #15?

A. qì B. yǒu C. zǒu D. dì

What is the meaning of the character that you saw in the Story # 15?

Story 16

✚ Which of the following character did you see in the Story #16?

A. 谗 B. 谄 C. 侈 D. 谔

What is the pronunciation of the character that you saw in the Story #16?

A. tíng B. míng C. tuō D. duō

What is the meaning of the character that you saw in the Story # 16?

APPENDIX C: Phonetic Radical Knowledge Task

Phonetic Radical Knowledge

Name:

Please write down the pronunciations with tones of the following characters.

Item	Character	Pronunciation
1.	今	
2.	学	
3.	在	
4.	或	
5.	来	
6.	会	
7.	么	
8.	有	
9.	老	
10.	贵	
11.	觉	
12.	生	
13.	哥	
14.	国	
15.	气	
16.	名	
17.	天	
18.	家	
19.	每	
20.	向	
21.	冬	
22.	合	
23.	习	
24.	看	
25.	先	
26.	美	
27.	高	
28.	半	

29.	书	
30.	回	
31.	友	
32.	多	
33.	也	
34.	中	
35.	文	
36.	去	
37.	力	
38.	后	
39.	太	
40.	可	
41.	面	
42.	更	
43.	非	
44.	方	
45.	右	
46.	坐	
47.	出	
48.	要	

APPENDIX D: Semantic Radical Knowledge Task

Semantic Radical Knowledge

Name:

Please write down the meanings of the following semantic radicals.

Item	Radical	Meaning
1.	氵	
2.	彳	
3.	礻	
4.	艹	
5.	冫	
6.	疒	
7.	日	
8.	禾	
9.	口	
10.	豸	
11.	目	
12.	灬	
13.	亻	
14.	木	
15.	钅	
16.	讠	
17.	忄	
18.	女	
19.	阝	
20.	纟	
21.	月	
22.	土	
23.	火	
24.	扌	

25.	个	
26.	宀	
27.	广	
28.	足	
29.	辶	
30.	灬	

APPENDIX E: Word Reading and Semantic Knowledge Task

Chinese Word Reading

Name:

Please write down the pronunciations with their tones and meanings of the words.

Item	Word	Pronunciation	Meaning
1.	学生		
2.	照片		
3.	医生		
4.	星期		
5.	喜欢		
6.	电视		
7.	打球		
8.	春天		
9.	饿		
10.	宿舍		
11.	可爱		
12.	舞会		
13.	肚子		
14.	过敏		
15.	后天		
16.	好处		
17.	辣		
18.	道理		
19.	生气		
20.	历史		
21.	建议		
22.	文学		
23.	世界		
24.	奇怪		
25.	陌生		
26.	骑		
27.	出发		
28.	故事		
29.	退休		
30.	机会		
31.	小气		
32.	考虑		
33.	安排		

34.	沟通		
35.	失望		
36.	功能		
37.	失去		
38.	老百姓		
39.	稳定		
40.	请假		
41.	合同		
42.	提醒		
43.	改善		
44.	接受		
45.	民主		
46.	文明		
47.	描绘		
48.	感受		
49.	传说		
50.	独特		
51.	单独		
52.	区域		
53.	精致		
54.	标志		
55.	尊重		
56.	朴实		
57.	伦理		
58.	联盟		
59.	威胁		
60.	领先		

APPENDIX F: Incidental Word Learning Experiment

实验二

Version A

Part 1 第一部分

Multiple choice: There are 22 words, and choose the correct meaning for each word.

1. 音信

- A. hearing from someone
- B. seeing, meeting
- C. grading
- D. believing

2. 学名

- A. a name of a school
- B. a calculator
- C. an expression
- D. a scientific name

3. 休学

- A. to take a leave of absence from school
- B. to be hungry
- C. to be sick in hospital
- D. to be in a school break

4. 言行

- A. morals
- B. command, order
- C. words and deeds, speech and behaviors
- D. congratulations

5. 手语

- A. a puppet show
- B. a sign language
- C. archeology
- D. youth

6. 大意

- A. a title
- B. the main idea, the gist
- C. a big thought, ambition
- D. a calendar

7. 知名

- A. well-known, celebrated
- B. smart
- C. jealous
- D. know-it-all, conceited

8. 同化

- A. to change in the same manner
- B. to understand
- C. to assimilate to, to adopt to
- D. to construct

9. 百出

- A. to exit, to depart
- B. to be assigned
- C. to come up one after another
- D. to sleep

10. 本土

- A. harbor
- B. the main land
- C. church
- D. books you read on Saturdays

11. 名作

- A. recognition, reputation
- B. libraries
- C. novels

D. masterpieces, famous stories

12. 并存

A. to measure

B. to go well

C. to maintain simultaneously, to be compatible

D. to stand with both legs

13. 成色

A. quality

B. discoloration

C. flavor, texture

D. production

14. 世故

A. life experience, wisdom

B. deep, profound

C. the stories of the deceased

D. same, resemble

15. 安分

A. obedient, honest

B. timid, fearful

C. smart, cute

D. peace, safe

16. 关头

A. turning point

B. manager

C. administrators

D. opportunity, leverage

17. 兴头

A. arrangement, plan

B. happy things

C. boring things

D. enthusiasm

18. 外快

A. good job

B. bonus

C. happy life

D. time flies when outside

19. 吃紧

A. do not understand, not clear

B. important, critical

C. not enough to use, not enough to eat

D. old, damaged

20. 竟自

A. blame oneself

B. surprisingly

C. assemble, merge

D. finally, lastly

21. 老成

A. mature, prudent

B. strong, can accept

C. often succeed

D. forthright, open

22. 不齿

A. look down upon

B. leisure, rest

C. no teeth

D. disappointed, helpless

Part 2 第二部分

Multiple choice: There are 22 sentences and choose the correct meaning that fits the each underlined word in the sentence context.

1. 你真的不能从她的外观来了解她。

- A. a photo
- B. a program
- C. an appearance
- D. an outlook, prospect

2. 报纸的字体变大了，读起来更容易了。

- A. magazines
- B. scripts/letters used every day
- C. printing type, type face, font
- D. pages

3. 今天晚上有月食，我们到山顶去看吧，看得清楚。

- A. monthly meal tickets
- B. a traffic light
- C. fireworks
- D. a lunar eclipse

4. 高德中没有私心，所以大家都喜欢他。

- A. short-sighted
- B. not selfish, not self-centered
- C. nasty
- D. insincere, untruthful

5. 男人先天就比女人聪明的观点是不对的。

- A. romantically
- B. generally
- C. innately, by birth
- D. heavenward

6. 没有鱼的话，用肉代用也可以。

- A. to debate

B. to substitute for, to use in place of

C. to cook

D. to consume time

7. 这个作文写得很好，着眼点很有意思。

A. a topic

B. memory

C. a viewpoint

D. a pair of glasses

8. 昨天，终于入手了一直想要的书。

A. to freeze

B. to obtain, acquire

C. to order

D. to put ones' hands into

9. 我们学校的分校在旁边的城市。

A. a school branch

B. computers

C. a time-table or a daily schedule at school

D. dormitory

10. 在中餐店的门口，有食物的样本。

A. a sample

B. a picture book

C. table cloth

D. menu

11. 预知地震是很难的。

A. to prevent

B. to know a schedule

C. to predict, to foresee

D. to ferment

12. 我们已经先约好了，所以不能参加晚会了。

A. work to do

B. anticipation

C. differences

D. a previous engagement, promise

13. 为了几块钱就这么下作，真没出息。

A. bad product

B. research method

C. mean, despicable

D. angry, fuss about

14. 变相提高价格是不合理的。

A. to form changes without changing content

B. to disgust, to be sick of

C. invincible, randomly

D. appearance, change of style

15. 你对我这样，这是有些见外了。

A. lack

B. see the world, enrich experience

C. ostracize, exclude

D. accidentally, unexpectedly

16. 这篇文章充满了白话，和这本杂志的一贯风格很不一样。

A. blunt, plain words

B. ambiguous, words that are hard to understand

C. void, words that lack evidence

D. funny, funny words

17. 这次书展中各种图书比重的改变，适应了当前我国的社会需要。

A. weight comparison

B. proportion

C. appearance, look

D. content, theme

18. 这件事情定然成功。
- A. definitely
 - B. changed look
 - C. really, quite
 - D. calm manner
19. 他亲自安排孩子的学习时间表, 过问孩子们的时间情况。
- A. to supervise, to grasp
 - B. to participate, to comment
 - C. to carefully ask
 - D. to happily spend time
20. 他们比邻坐下, 小声聊天。
- A. to compare two neighboring things or people
 - B. opposite to, face to face
 - C. to select among choices
 - D. neighboring, close
21. 采访过程中大家反应都很淡漠。
- A. no enthusiasm
 - B. enthusiastic, active
 - C. low and high
 - D. shallow and deep
22. 我们应该把考试当作等闲之事。
- A. leisure, have time
 - B. ordinary, typical
 - C. well-known, famous
 - D. primary, important

实验二

Version B

Part 1 第一部分

Multiple choice: There are 22 words, and choose the correct meaning for each word.

1. 外观

- A. a photo
- B. a program
- C. an appearance
- D. an outlook, prospect

2. 字体

- A. magazines
- B. scripts/letters used every day
- C. printing type, type face, font
- D. pages

3. 月食

- A. monthly meal tickets
- B. a traffic light
- C. fireworks
- D. a lunar eclipse

4. 私心

- A. short-sighted
- B. not selfish, not self-centered
- C. nasty
- D. insincere, untruthful

5. 先天

- A. romantically
- B. generally
- C. innately, by birth
- D. heavenward

6. 代用

- A. to debate

B. to substitute for, to use in place of

C. to cook

D. to consume time

7. 着眼点

A. a topic

B. memory

C. a viewpoint

D. a pair of glasses

8. 入手

A. to freeze

B. to obtain, acquire

C. to order

D. to put ones' hands into

9. 分校

A. a school branch

B. computers

C. a time-table or a daily schedule at school

D. dormitory

10. 样本

A. a sample

B. a picture book

C. table cloth

D. menu

11. 预知

A. to prevent

B. to know a schedule

C. to predict, to foresee

D. to ferment

12. 先约

- A. work to do
- B. anticipation
- C. differences
- D. a previous engagement, promise

13. 下作

- A. bad product
- B. research method
- C. mean, despicable
- D. angry, fuss about

14. 变相

- A. to form changes without changing content
- B. to disgust, to be sick of
- C. invincible, randomly
- D. appearance, change of style

15. 见外

- A. lack
- B. see the world, enrich experience
- C. ostracize, exclude
- D. accidentally, unexpectedly

16. 白话

- A. blunt, plain words
- B. ambiguous, words that are hard to understand
- C. void, words that lack evidence
- D. funny, funny words

17. 比重

- A. weight comparison
- B. proportion
- C. appearance, look
- D. content, theme

18. 定然

- A. definitely
- B. changed look
- C. really, quite
- D. calm manner

19. 过问

- A. to supervise, to grasp
- B. to participate, to comment
- C. to carefully ask
- D. to happily spend time

20. 比邻

- A. to compare two neighboring things or people
- B. opposite to, face to face
- C. to select among choices
- D. neighboring, close

21. 淡漠

- A. no enthusiasm
- B. enthusiastic, active
- C. low and high
- D. shallow and deep

22. 等闲

- A. leisure, have time
- B. ordinary, typical
- C. well-known, famous
- D. primary, important

Part 2 第二部分

Multiple choice: There are 22 sentences and choose the correct meaning that fits the each underlined word in the sentence context.

1. 李友已经3年没有音信了。
- A. hearing from someone
 - B. seeing, meeting
 - C. grading
 - D. believing
2. 人有个复杂的学名是人类。
- A. a name of a school
 - B. a calculator
 - C. an expression
 - D. a scientific name
3. 因为生病休学了一年，学习上落后了。
- A. to take a leave of absence from school
 - B. to be hungry
 - C. to be sick in hospital
 - D. to be in a school break
4. 那个人的言行不一，你不要相信他。
- A. morals
 - B. command, order
 - C. words and deeds, speech and behaviors
 - D. congratulations
5. 我想学习手语。
- A. a puppet show
 - B. a sign language
 - C. archeology
 - D. youth
6. 这个话的大意，请写一下。
- A. a title
 - B. the main idea, the gist
 - C. a big thought, ambition

D. a calendar

7. 王华先生是一位知名的学者。学习中文的学生都知道他。

A. well-known, celebrated

B. smart

C. jealous

D. know-it-all, conceited

8. 来中国已经5年了，还是没能被中国文化同化。

A. to change in the same manner

B. to understand

C. to assimilate to, to adopt to

D. to construct

9. 各种问题百出，不知道怎么办好。

A. to exit, to depart

B. to be assigned

C. to come up one after another

D. to sleep

10. 这个岛离本土很远，坐飞机要6个小时。

A. harbor

B. the main land

C. church

D. books you read on Saturdays

11. 我打算夏天休假的时候，读一些中国的文学名作。

A. recognition, reputation

B. libraries

C. novels

D. masterpieces, famous stories

12. 工作和学习很难并存。

A. to measure

B. to go well

C. to maintain simultaneously, to be compatible

D. to stand with both legs

13. 这种茶的成色非常好。

A. quality

B. discoloration

C. flavor, texture

D. production

14. 小玲并不懂得这些世故的道理。

A. life experience, wisdom

B. deep, profound

C. the stories of the deceased

D. same, resemble

15. 这个孩子很安分，大家都很喜欢他。

A. obedient, honest

B. timid, fearful

C. smart, cute

D. peace, safe

16. 他不服输，因为这是最后的关头，一定要坚持到底。

A. turning point

B. manager

C. administrators

D. opportunity, leverage

17. 虽然我呆在家里很闷，但我不能因为要不闷就把她的兴头都打断了。

A. arrangement, plan

B. happy things

C. boring things

D. enthusiasm

18. 现在要想吃得好一点，过得舒服一点，没有外快行吗？

A. good job

B. bonus

C. happy life

D. time flies when outside

19. 先把那些吃紧的地方修饰一下，其他的以后再说吧。

A. do not understand, not clear

B. important, critical

C. not enough to use, not enough to eat

D. old, damaged

20. 虽然没有人教，但他摸索了一段时间，竟自学会了。

A. blame oneself

B. surprisingly

C. assemble, merge

D. finally, lastly

21. 站长二十七八岁，山东人，很老成。

A. mature, prudent

B. strong, can accept

C. often succeed

D. forthright, open

22. 他的所作所为让我们很不齿。

A. look down upon

B. leisure, rest

C. no teeth

D. disappointed, helpless