Increasing Chinese Character Recognition Using Incremental Rehearsal with a Morphological Component

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Increasing Chinese Character Recognition

Using Incremental Rehearsal with a Morphological Component

Lan Chen

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Abstract

In Chinese language learning, knowledge of character- and word- morphology has facilitated learning to read and write Chinese characters. Furthermore, the implementation of Incremental Rehearsal with a morphological component (IRM) has been found to effectively increase children’s Chinese character recognition. This study investigated the effects of IRM as an intervention in increasing Chinese character recognition for three level 3 Chinese language learners (ages 9-12) in a non-profit school, using an A-B single case design. The results indicated that the implementation of the IRM successfully contributed to increasing Chinese character recognition for all three participants. In addition, there was an upward trend in the data for each participant from baseline to the IRM intervention phase. Findings revealed no overlapping data for two participants and 83% non-overlapping data for one participant between baseline and intervention, indicating a functional relationship between implementation of IRM and character recognition increase. Therefore, the IRM was an effective intervention to increase Chinese character recognition.

*Keywords:* character- and word-morphology, Incremental Rehearsal with a morphological component (IRM), Chinese character recognition, A-B single case design
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Increasing Chinese Character Recognition

Using Incremental Rehearsal with a Morphological Component

**Literature Review**

With the booming economy of China during the recent 20 years, the field of Chinese as a foreign language (CFL) has developed rapidly both in Chinese-speaking countries and in non-Chinese-speaking countries. In the early-mid 1990s, Chinese language learning programs at the university level in the United States (U.S.) were rare. Currently, the increased interest in learning Chinese has been seen at all educational levels including college, secondary, and in some elementary schools in the U.S. (Williams, 2013).

**Elements Influencing the Recognition of Chinese Characters and Words**

Presently, the motivation to learn Chinese is high; however, many adults and children encounter challenges during the process of learning Chinese as a foreign language. These difficulties include objective elements and subjective elements which influence the Chinese character and word acquisition of learners (Williams, 2013). Since so many difficulties are confronted in learning Chinese, it is not surprising that Chinese learners struggle with learning Chinese characters.

**Objective elements.** The first and most common difficulty is caused by the different writing systems between the Chinese and English languages. English is an alphabetic language, but Chinese is a nonalphabetic language. In an alphabetic script, such as English, the orthography is based on grapheme-phoneme (i.e., letter-sound) correspondence (Williams, 2013). That is, the basic units of writing or graphemes (i.e., alphabetic letters) usually map onto the basic units of sound (i.e., phonemes) one-on-one, which do not require the semantic value individually. The property of grapheme-phoneme (i.e., letter-sound) correspondence attributes to
the importance of phonemic awareness in alphabetic language learners (Packard et al., 2006; Treiman, 1991). For this reason, alphabetic language readers, such as English readers, would be predisposed to use a phonological route to recognize words. For example, alphabetic readers would use these rules to pronounce the nonsense words, such as *wug*, which has no meaning (Williams, 2013).

In contrast, Chinese language is a logographic language. The basic units or graphemes in written Chinese (i.e., characters: symbols that embody meaning) map directly onto individual morphemes (i.e., the basic units of meaning), and the characters are closely linked to entire syllables which are composed of onset, rime and tone. That is, Chinese written language requires the morpheme-syllable-grapheme correspondence, which is called the morphosyllabic property (DeFrancis, 1989; Kwong & Burns, 2016). In other words, the semantic and orthographic correlation of Chinese characters usually are not random. Specifically, a certain Chinese character represents a certain meaning. Pertinent semantic (i.e., the meaning) information is directly embedded in the Chinese character. Thus, due to the morphosyllabic properties (i.e., a syllable must coincide with a morpheme; DeFrancis, 1989), Chinese language readers tend to decode characters via the combination of two routes: one is phonological route, and the other is semantic route. The difference in the process of word recognition results in some difficulties for learners who study Chinese as a foreign language because they are used to phonological processing route (Williams, 2013) but Chinese lacks sound-script correspondence (Shen, 2005). For example, the character ‘风/风’ (*fēng*) (wind) and the character ‘峰/峰’ (*fēng*) (peak) have the same sound (i.e., pronunciation), but they have different written scripts.

Additionally, a high volume of characters is needed to attain basic literacy skills. According to Shen and Ke (2007), characters are morphemes, which are used to build words in
the Chinese language. One who is literate in Chinese should grasp 7,000 characters, which are estimated to be used in daily life (Statistics of Commonly Used Chinese Characters, 1998), and a mastery of 3,500 commonly used characters is required for basic literacy (DeFrancis, 1984; Packard et al., 2006). Mastery of the aforementioned characters is a daunting task for children learning Chinese. Furthermore, from the perspective of orthographic structure, about 80-90% of the characters in modern Chinese are semantic-phonetic compound characters, which includes at least two or more radicals to imply the meaning and the pronunciation of the character (Shu & Anderson, 1997). Despite the large number of compound characters, there are only 26.3% of the phonetic radicals in compound characters that can accurately predict the reliable cues for pronunciation (Fan, Gao & Ao, 1984). Specifically, irregularity and inconsistency exist between the phonetic information and the phonetic radicals. The fact that the phonetic component is phonologically irregular increases the complexity and difficulty for learners who study Chinese as a foreign language (Williams, 2013). For example, the character ‘狂/kuáng/’ (crazy) is pronounced /kuáng/ with the first tone. The semantic radical 犭 on the left side indicates the character is related to the category of animal, the phonetic radical 王 on the right side is pronounced /wáng/, meaning king. The irregularity and the inconsistency of the pronunciation between the right phonetic component and the whole character increases the difficulty for learning Chinese characters.

Another issue that makes learning Chinese difficult is that Chinese is a tonal language. For example, in Mandarin Chinese, every syllable can be pronounced with one of four tones. If the neutral tone is included, there will be five tones. The tones distinguish syllables. This attributes to the different characters pronounced with the same syllable but different tones. For example, ‘搭/dā/’ (build) is pronounced with the first tone, a high and level tone; ‘达/dá/’
(arrive) is pronounced with the second tone, a rising tone; ‘打/dǎ/’ (hit) is pronounced with the third tone, a falling then rising tone, and ‘大 /dà/’ (large) is pronounced with the fourth tone, a falling tone. These four characters have the same onset (/d/) and rime (/a/), but distinct tones and meanings. Sometimes, characters own identical onsets, rimes, and tones but have different orthographic structures and meanings, which are called homophones (Kwong & Burns, 2016; Shu, Anderson & Wu, 2000). For example, ‘立/lì/’ (stand), ‘丽/lì/’ (beautiful), ‘利/lì/’ (benefit) and ‘励/lì/’ (encourage) are pronounced with the fourth tone (a falling tone), but they have different shapes and meanings. These cases also bring difficulties for learners who study Chinese as a foreign language.

**Subjective elements.** Some struggles in learning Chinese words and characters come from the students’ strategy in the learning process. For example, rote learning is widely used by CFL learners. For example, McGinnis (1999) conducted a survey on Chinese character learning strategies used by English-speaking learners of Chinese. The strategy of rote repetition was most frequently used, but students do not readily apply radical knowledge to learn characters. That is, they cannot utilize the semantic component and phonetic component of the character to learn Chinese characters. Shu and colleagues (2000) also mentioned the side effect of rote strategy in learning characters. Children without phonetic awareness often applied rote strategies, which would interfere with their learning progress. In particular, a large quantity of characters would be added to learn and they lack appropriate ways to assimilate the new characters effectively.

In addition, teachers play an important role in learning process; however, according to Wu, Li, and Anderson (1999), traditional instruction in teaching Chinese characters greatly depends on rote memorization. For example, teachers may repetitively demonstrate how to write characters stroke-by-stroke on the board and have children copy the characters on individual
notebooks until the skills for production are developed. Furthermore, Wang (1998) analyzed the four primary approaches used to teach Chinese characters in a CFL context: the radical approach, the high-frequency-hanzi approach, the phonetic approach, and the non-teaching approach. By using the radical approach, teachers explicitly analyze the role of semantic and phonetic radicals in the characters to stimulate students’ sensitivity to visual details. Wang (1998) argues that the knowledge of radicals should be taught as early as possible in order to facilitate their skill of consulting dictionary.

The second approach is high-frequency-hanzi approach (Wang, 1998). The supporters claim that students will individually develop the ability to analyze characters based on their semantic and phonetic components when the students acquire a “critical mass” of characters by learning a number of high-frequency characters. This approach is criticized because of disagreement on how many characters should be required to reach the “critical mass” (Wang, 1998). The third approach is phonetic approach, which emphasizes the function of phonological mediation, meaning the pronunciation of characters is stressed. This approach is under attack because of the assertion that character recognition results in phonological activation. The fourth approach is non-teaching approach, which emphasizes the development of students’ proficiency in oral language rather than consuming time on teaching characters. In addition, some teachers argue that literacy learning should be delayed till the third year of Chinese language study (Wang, 1998). Regardless of what approach is applied by teachers, it is necessary for teachers and students to learn Chinese orthography.

The Chinese Writing System

Unlike alphabetic language system, the basic unit of the Chinese writing system is the square-shaped character (Tong & Yip, 2015). Further, Chinese has been considered as one of the
most challenging languages to learn by non-native Chinese learners because of the nature of complex Chinese orthographic structure (Shen, 2005). A Chinese word can be built with one, two, or more characters. Written Chinese words are composed of three-tiers orthographic structures: characters, radicals, and strokes (Shen, 2005; Shen & Ke, 2007). Characters include two types: integral characters and compound characters. An integral character contains only one radical. For example, the character 自 consists of one radical, indicating the meaning of the character *self*. A compound character, however, consists of two or more radicals.

Radicals are the smallest meaningful basic orthographic units in compound characters; they can be further classified into two categories according to their orthographic functions: semantic radicals and phonetic radicals (Shen & Ke, 2007). That is, a phonetic radical represents the pronunciation of a compound character and a semantic radical provides clues to the meaning of the compound character (Shu & Anderson, 1997). Furthermore, strokes are the basic building units for radicals (Huang & Liao, 2007). In compound characters, radicals exhibit certain phonological and semantic regularities. For example, the character 志 (meaning *will* as a noun) consists of two radicals: 士 (phonetic radical) and 心 (semantic radical), indicating it is related to human’s heart. The character 志 is composed of seven strokes, 一 一 丶丶 丶 and 丶.

**Morphology and Character Recognition**

**Morphological features.** All languages have a fundamental feature: groups of words share morphological features (Shu & Anderson, 1997). For example, in English, an alphabetic language, the words such as *respect*, *respectful*, *respectable* share the root *respect* and their meanings are related. That is, the three words are morphologically related (i.e., the forms of these words are related to *respect*). In Chinese, a nonalphabetic language, the words such as 古诗 (ancient poem), 诗歌 (poem), and 诗人 (poet) share the character 诗 (poem) and they are
semantically related (i.e., the script of these words are related to the character 诗 ‘poem’ and the meanings of these words are related to the poem). Shu and Anderson (1997) noted that morphological relationships among words have influence on the way words are represented in memory and the processing of word recognition and meaning, and may also influence word acquisition of children. By the implementation of morphological instruction, Chinese language teachers can develop learners’ skills to recognize complex characters and words, and derive their meanings.

**Knowledge of morphology of Chinese characters and words.** In Chinese, every character represents a morpheme. Morphological analysis is one of the cornerstones of Chinese character and word learning. That is, the knowledge of morphology is critical for Chinese learners to acquire characters and words (Shu & Anderson, 1997). From the perspective of morphological structure in Chinese words, there are two levels.

**Character morphology.** The first level morphological analysis is focused on the internal structure of characters (Anderson, Li, Ku, Shu, & Wu, 2002; Chen, Allport, & Marshall, 1996; Chen, Shu, Wu, & Anderson, 2003; Shu & Anderson, 1997). The internal structure may be referred to as *character morphology* (Nagy et al., 2002) but is termed *orthographic structure* by Packard and colleagues (2006). Character morphology refers to knowledge of the positions and functions of semantic and phonetic radicals within a character. Based on the aforementioned concepts, there are over 80% of the characters in modern Chinese are semantic-phonetic compound characters. For example, the characters ‘铜/tóng/ (copper), ‘铁/tiě/(iron)’, and ‘钢/gāng/(steel)’ have the same semantic radical on the left part, which is a reduced form of the character, 金/jīn/ meaning gold, indicating the character has a semantic connection with metal.
The phonetic radicals on the right part of these characters have the connections with how the characters are pronounced.

Based on the relation between the semantic radical and the meaning of a character (i.e., semantic transparency), semantic-phonetic characters can be divided into three kinds: transparent characters, semitransparent characters and morphologically opaque characters (Shu, Chen, Anderson, Wu, & Xuan, 2003; Tong & Yip, 2015). Based on the regularity and consistency between the pronunciation of phonetic radical and the pronunciation of the whole compound character (i.e., phonetic regularity), there are three types: regular characters, semiregular characters and irregular characters. Both the semantic transparency and phonetic regularity have effect on character acquisition of Chinese learners (Williams, 2013). It is assumed that learners would increase the character morphology (i.e., radical awareness) with the implementation of morphological instruction. Using the knowledge of character morphology, Chinese language learners would be able to analyze the internal structure of characters (i.e., semantic radicals and phonetic radicals) and infer the meaning of characters, which would be contribute to character acquisition.

**Word morphology.** The second level of morphological analysis of Chinese words is termed word morphology, which refers to knowledge of how a single character (i.e., a morpheme) with a given meaning may appear in different compound words that have independent meanings but are semantically related (Packard et al. 2006; Shu & Anderson 1997). To illustrate, the three compound words ‘枫树/fēng shù/(maple tree)’, ‘杨树/yáng shù/(poplar tree)’, and ‘柳树/liǔ shù/(willow tree)’ share the same character ‘树/tree’, indicating they are semantically related. Both character morphology and word morphology are conceptually related and have been found to affect Chinese learners’ character and word acquisition related (Packard
et al., 2006; Shu & Anderson, 1997,1998; Wu et al. 2009). Since the knowledge of character morphology and word morphology could strongly affect character and word acquisition, it is necessary to implement the morphological instruction to teach characters. With the increase of character- and word-morphology, the learners would apply the knowledge to morphologically analyze characters and words from the two levels of morphological structure, which would facilitate character and word learning in Chinese.

**Previous Studies on Morphological Knowledge**

Morphological knowledge is a critical part of character and word learning, which has great influence on Chinese children’s character and word acquisition. Shu and Anderson (1997) found that elementary school children were aware of the radicals in characters, and children could use the information in radicals to learn and remember characters recently introduced by teachers. Additionally, the research found that the morphological knowledge was to develop with grade (Shu & Anderson, 1997). In their second study, researchers found that the hybrid use of the information of conceptually easy word and the accessible information of radicals facilitated the process of deriving the meaning of unfamiliar characters. More importantly, the higher ability children made better performance only on characters with accessible radical analysis, which indicated that they could make more use of radical knowledge than low-ability students (Shu & Anderson, 1997). Essentially, the study showed that it was necessary to possess knowledge of semantic radicals, knowledge of word meanings, and strategy of using radical analysis in Chinese character and word learning. The study also implied that the explicit instruction in strategies for using radical knowledge might be beneficial for low-ability children.

Similarly, Shu, Anderson and Wu (2000) did a study to investigate the influence of morphological knowledge, but at the level of character phonetic radicals, on Chinese children’s
character and word acquisition (i.e., the role of phonetic awareness). The results indicated that
the familiarity and regularity of characters had a powerful influence on the children’s
pronunciation. Regularity had a stronger influence on the pronunciation of unfamiliar characters
than familiar characters (Shu et al., 2000). Results indicated that information in phonetic radicals
of characters is important for learning and remembering the pronunciation of unfamiliar
characters as well as familiar characters (Shu et al., 2000). This clearly implies that the strong
influence of phonetic awareness on pronunciation of characters.

Some studies investigated the role of radical awareness (the first level of morphological
knowledge) in learning Chinese characters of non-native Chinese learners. Taft and Chung
(1999) carried out a simple study to determine whether knowledge of the internal radical
structure of Chinese compound characters helped novice learners to memorize the characters.
The results showed that the group of radicals early (i.e., who were provided radical knowledge
right at the first presentation of the character), performed the best. Furthermore, Shen and Ke
(2007) also found a learner having excellent performance on the radical knowledge application
test would have a good command of radical knowledge, and found there was a moderate positive
correlation between the vocabulary test and the radical knowledge test (Shen & Ke, 2007).

Both of the aforementioned studies concluded that learners’ radical knowledge facilitated
character recognition and reading. This implies it is important for character learners to set up the
awareness of radicals in order that they can effectively learn Chinese characters. William (2013)
examined the effects of both semantic and phonetic radicals on Chinese character identification
by high-intermediate level Chinese as a foreign language (CFL) learners. The result also
indicated that the presence of a semantically relevant radical facilitated character recognition.
William (2013) suggested that targeted instruction on semantic processing strategies be employed to help CFL learners learn characters while the phonological route is being developed.

In addition, Packard and colleagues (2006) comprehensively examined whether developing children’s character morphology and word morphology would benefit their learning to write Chinese. The students were provided with an intervention of morphological instruction to train their character morphology and word morphology. Students in the intervention group had better performance in writing Chinese characters than a control group (Packard et al., 2006). This implies it is essential to consider developing character morphology and word morphology as an effective educational intervention for Chinese character learning.

Kwong and Burns (2016) utilized the intervention of Incremental Rehearsal (IR) and Incremental Rehearsal with a morphological component (IRM) to investigate the effectiveness of IRM for teaching Chinese character recognition. The study found that both IR and IRM effectively increased children’s Chinese character recognition. IRM is an effective hybrid method of Incremental Rehearsal (IR) and morphological instruction. That is, IR is a flashcard drill method used as an intervention to strengthen the visual stimuli and prompt for verbal responses. Morphological instruction is a method to facilitate character learning by explicitly analyzing the morphological components of characters from two levels: character morphology and word morphology (Kwong & Burns, 2016).

**Summary**

Character- and word-morphology have shown to facilitate learning to read and write characters; the implementation of IRM has been found to facilitate Chinese character recognition. Therefore, it is reasonable to hypothesize that the instruction of IRM would be related to Chinese character recognition (Kwong & Burns, 2016). The present study will
examine the effects that enhancing IRM instruction would have on Chinese character recognition among learners of Chinese as a foreign language.

**Methods**

**Purpose**

The purpose of this study was to investigate the effects of Incremental Rehearsal with a morphological component (IRM) as an instruction in increasing Chinese character recognition for three level 3 Chinese language learners (ages 9-12) in a non-profit school. This study aimed to extend research in which the IRM was employed to increase Chinese character recognition (Kwong & Burns, 2016). In research conducted by Kwong and Burns (2016), the IRM was created as an intervention to enhance children’s Chinese recognition. One limitation was that the IRM as an intervention didn’t investigate the effectiveness of IRM at the level of word morphology, which diluted the effects of IRM. Additionally, the study of Kwong and Burns (2016) was a preliminary study and was not replicated by other researchers. Furthermore, the previous research has called for the need to further measure the retention of Chinese character taught by the IRM (Kwong & Burns, 2016). The current study utilized the IRM as an intervention to investigate the effectiveness of the IRM from two levels: character morphology and word morphology, which broadened the domain of the study on the IRM and ascertain the functional relationship between the Character recognition and the instruction of the IRM.

**Research Question**

Does the instruction of Incremental Rehearsal with a morphological component (IRM) increase Chinese character recognition for three level 3 Chinese language learners, ages 9-12?
Hypothesis

Incremental Rehearsal with a morphological component (IRM) as an intervention has been effective at facilitating children’s Chinese character recognition by strengthening their radical awareness (i.e., character morphology; Kwong & Burns, 2016). Based on this previous research, I hypothesize that the implementation of IRM as an intervention would increase Chinese character recognition for Chinese language learners (ages 9-12).

Research Design

An AB single-case design was utilized to investigate the effectiveness of IRM in increasing Chinese character recognition. IRM was implemented according to Kwong and Burns (2016). During both phases (AB) of the study, the participants were assessed using the same measure one at a time. During each session, data for each participant was collected separately from two levels: character morphology and word morphology. Each participant needed to have five stable data points respectively at two levels to move from baseline (Phase A) to the IRM intervention phase (Phase B). Baseline stability was considered to be no more than three points between the lowest and highest number of recognized characters, respectively at the two levels. After five stable data points were collected, participants transitioned into the IRM intervention (Phase B) of the study.

Independent variable. The independent variable in this study was the instruction of IRM (Kwong & Burns, 2016). IRM combines the flashcard drill method with Chinese character morphological components to increase children’s character recognition (Kwong & Burns, 2016). Characters were taught from two levels of morphological structure. The first level (i.e., radical awareness or character morphology) focused on the analysis of the internal structure of characters, and had students get the knowledge that semantic radical gives the clue to meaning.
and phonetic radical offers a clue to pronunciation. The second level (i.e., morphological awareness) emphasized word morphology, which required students to be aware of the semantic contributions of individual characters to the meaning of a multi-morpheme word (Kwong & Burns, 2016; Packard et al. 2006; Shu & Anderson, 1997).

**Dependent variable.** The dependent variable was students’ Chinese character recognition (i.e., retention of characters). Based on Kwong and Burns (2016), students were asked to read presented characters, which were specially selected. If students responded with correct pronunciation and tone within three seconds of presentation, the character was counted as recognized (i.e., retained). The number of characters recognized in the research was recorded. In the current study, the researcher used specially selected nine semantic-phonetic characters to assess students’ character recognition. The time of character presentation to students was calculated with the use of a clock on a cell phone.

**Setting and Participants**

**Setting.** The study was implemented at a nonprofit school in Central California. The school is affiliated with the local Chinese Association, and the school building is also used by local Chinese community to hold activities, such as celebrating Chinese traditions. The goal of the school is to effectively teach students (usually ages 6-15) to foster an awareness and appreciation for the depth, diversity and cultural heritage of the Chinese language, customs and traditions through instruction and participation in structured school and community activities. The focus is more on language, which is the request from parents. The school schedule is set according to the students’ school semesters, but the instruction is only provided on Saturday morning. The school serves students in the class of level 1 through level 6 (from easy to difficult) in separate classrooms. The total school enrollment is 19 students: 2 students in level 1 class, 8
students in level 3, and 9 students in level 6. The demographics of the student population are all students having Chinese lineage with at least a Chinese grandparent (personal communication, September 28, 2017).

**Participants.** The researcher served as the teacher who implemented the intervention. The participants were selected by convenience of being in a readily accessible level 3 class. The intervention was originally developed for the whole class with the purpose of not interfering with the normal course of student learning, all the class were simultaneously received the intervention. However, eligible participants for this study involved five students who met the criteria: they have had a minimum of two years of learning Chinese language in this non-profit school, but they continue to struggle grasping and remembering the characters (i.e., have difficulty in the recurrence and identification of characters that have been taught) and they still need to improve knowledge for their Chinese character development. The current teacher nominated five students who met the criteria of participant selection of the present research. However, there were only three students left as participants owing to two students’ two-time absence during the intervention phase. Each participant was given a pseudoname as a means to provide confidentiality and anonymity.

**Student 1.** Mike is a nine-year-old, Chinese American boy in the level 3 class. He attends his mainstream general education class and is not recipient of any special resource services.

**Student 2.** Mia is a ten-year-old, Chinese American girl in the level 3 class. She attends her mainstream general education class and is not recipient of any special resource services.

**Student 3.** Halona is a twelve-year-old, Chinese American girl in the level 3 class. She attends her mainstream general education class and is not recipient of any special resource services.
Measures

Retained character data were collected and measured on the number of recognized characters for each participant (Kwong & Burns, 2016). Multiple-choice tests have been considered to be used to measure students’ character learning performance, which is typically employed in quantitative research studies with large groups of participants (Shu & Anderson, 1997). The current study expanded the method of measurement used by Kwong and Burns (2016), which only measured from character morphology. Instead, the current study assessed from the two levels: character morphology and word morphology. That is, the number of characters recognized was counted from two levels respectively.

The target characters and the two-character words formed with the target character and the non-target character that were written on the flashcards were presented to participants individually in random order one at a time, asking them to read the characters and words. In terms of the target characters in isolation, if the student responded with correct pronunciation and tone within three seconds of presentation, then the character would be counted as recognized (i.e., retained). If the characters pronounced incorrectly or with incorrect tone, the character would not be counted as retained (Kwong & Burns, 2016). In terms of two-character words, the measurement criteria were the same as the ones used for characters in isolation, but adding one criterion, that is, even if the non-target character for combining the two-character words was recognized, but the target character was not recognized, and then the target character could not be counted as retained. In the current study, nine semantic-phonetic characters as target characters and nine two-character words were used to assess character recognition of each participant. Each two-character word is formed with one target character and one nontarget
character (see Appendix A). The number of characters recognized on the three participants was collected using a tally chart to record the data (see Appendix B).

**Validity.** To ensure validity, all independent observers were trained to have explicit knowledge of measurement criteria for recognized characters (Kwong & Burns, 2016). Observers were also trained how to calculate and record data on the recognized characters (see Appendix B). Specially selected nine semantic-phonetic characters were used to assess students’ character recognition.

**Reliability.** Inter-rater reliability (IRR) was executed by having an independent observer (i.e., co-teacher) to calculate and record 45% of assessment for each participant during the baseline and intervention phases. Both the researcher and the co-teacher independently recorded each participant’s responses in order to achieve at least 80% reliability. Reliability was calculated for each participant by the following formula: agreements divided by agreements plus disagreements multiplied by 100%. Agreement between the researcher and the independent observer was calculated at 100% reliability.

**Intervention**

The IRM was developed by Kwong and Burns (2016) as an instructional method and has been shown to be effective to facilitate children’s Chinese character retention. The IRM emphasizes the combination use of Incremental Rehearsal (IR) and morphological instruction. During the instruction, teachers use the flashcard drill and the explicit explanation of each character’s morphological components to strengthen association among characters, the pronunciation, and meaning. The use of flashcards can save instructional time, and strengthen single visual stimuli and prompt verbal responses (Kwong & Burns, 2016). For this study, the students took part in six sessions during the instructional intervention. The implementation of
IRM lasted for 25-30 minutes each session. Each target character written on the flashcard was presented to students and was taught from the two levels based on the character’s morphological structure.

The first level (radical awareness) emphasized character morphology, which focused on the pronunciation of the character and the analysis of the internal structure of characters, and had students get the knowledge that semantic radical gives the clue to meaning and phonetic radical offers a clue to pronunciation. The specific and interlocking steps of first level teaching involved: 1) teaching students how to pronounce the character, and students will be asked to read after the teacher; 2) depicting the internal structure of the character to students; 3) explicitly analyzing the function of semantic and phonetic radicals within the character; 4) explaining the meaning of the character. The second level (morphological awareness) emphasized word morphology, which had students attend to the semantic contributions that individual characters have on the meaning of a multi-morpheme word. That is, developing students’ morphological awareness of other words including the same character. During the second step of the intervention, such questions were asked as: What is the meaning of this character? What words can be formed using this character? What is the connection between the character and these words?

**Materials**

*Classroom Chinese course material.* The students use the books of *Zhongwen* (*Mandarin Chinese Language*), which was designed by China’s Jinan university (Jia, 2012) for overseas Chinese learners and their children to learn Chinese language and culture. The course materials consist of 12 textbooks. *Zhongwen* is adopted as Chinese language course materials in the school of participants in the present study. Book 1 is used for the beginners in the first year.
The students who study Book 1 are in Level 1 class. Book 2 is used for the students in the second academic year. The students who study Book 2 are in Level 2 class. Book 3 is used for the students in the third academic year. The students in this study are in a Level 3 class and utilize Book 3. Characters used in the present study were classified into two types: familiar characters and unfamiliar characters.

**Familiar characters.** Familiar characters refer to the characters which had been introduced in the textbooks: Book 1 and Book 2. These characters had also been listed in the textbook as the learning goal to be grasped by the students. These familiar characters including integral characters and semantic-phonetic compound characters were used to build compound words in the present study.

**Unfamiliar characters.** Unfamiliar characters refer to the characters which had not been learnt in Book 1 and Book 2, and they were taught during the instructional intervention. These unfamiliar characters were used as target characters in the present study. And there was another criterion for the selection of unfamiliar characters in the study. In terms of orthographic structure of the selected semantic-phonetic compound characters, semantic radicals are on the left and phonetic radicals are on the right.

**Test materials.** Nine target characters were tested for baseline and intervention assessment. Each character was assessed from the two levels: character morphology and word morphology. For the assessment of the first level (i.e., character morphology), students were measured respectively from the semantic radical awareness and the phonetic radical awareness. For measuring the effects of semantic awareness, there were three types of target characters used: morphologically transparent character with familiar radical; morphologically transparent character with unfamiliar radical; and morphologically opaque character. There were two target
characters selected for each type. For measuring effects of phonetic awareness, there were three types of target characters used: regular character; irregular character; and semiregular character. Each type included one correspondent character. For the assessment of the second level, nine two-character words were used to measure the word morphology. Each word is formed with a correspondent target character and a non-target character. All non-target characters are familiar characters which were learnt by students.

Each of the familiar and unfamiliar characters was written on 4 x 6 inch index cards, using portrait orientation in regular script, to be used during assessment and instruction. The integral characters were written in black marker. For the semantic-phonetic characters, the semantic component of every compound character was written in green marker, and phonetic component was written in red marker. For the convenience of assessment and instruction, each of semantic-phonetic compounds as target characters was written in isolation on one side of the card, and the two-character words that are formed with the target character and the non-target character were written on the other side of the card.

**Procedures**

The following procedure was adapted from the previous research of Kwong and Burns (2016). A stable baseline of five data points for each participant respectively at two levels were collected one at a time based on the two levels of character’s morphological structure, and they were recorded using a character retained chart. That is, each student was tested for baseline recognition of nine target characters and nine two-character words. The characters recognized by each student were recorded as data for each student. There were five consecutive sessions in the first week to collect baseline data. Each session lasted for 15-20 minutes, two-three minutes per student. In order not to affect the regular teaching tasks for whole class, when one student was
assessed on each session, the other students did the related practices listed in the textbook. After a stable baseline was established, participants transitioned to intervention. The whole class simultaneously were given the IRM instructional intervention. Each intervention lesson continued for 25-30 minutes. After each period of intervention, the students were tested for collecting intervention data to exam the effectiveness of the IRM intervention. The IRM intervention data collection procedures were identical to the baseline data collection procedures.

**Fidelity.** To ensure intervention fidelity, procedural fidelity was measured by the secondary observer for 50% of the intervention sessions to verify the consistent implementation of intervention procedures as previously described by the researcher. The secondary observer watched as the implementation of the independent variable (i.e., morphological instruction) occurred during the intervention sessions. The secondary observer was given a separate implementation checklist (see Appendix C) for IRM condition, which included six features of the intervention. The observer documented the items accurately implemented by the researcher. The number of items observed was divided by the total number of items in implementation checklist and multiplied by 100%. Fidelity of implementation was 100% for all participants.

**Ethical Considerations**

Consideration was taken for any potentially harmful effects from the intervention. The present study was conducted during the normal school days, but the intervention did not interfere with the normal course of student learning because the content of the intervention was closely related to the text book students used, and was based on the course schedule. It can be stated that there were no negative effects resulting from this study. Additionally, students were not informed that they were a part of a study or of a procedure that an instructional intervention was being implemented. To assure further confidentiality, participants’ names were not used in the
study, which were replaced by using pseudonyms for participants. Students were not faced with any physical, mental, or emotional harm at any point in the study.

**Validity threats.** Potential threats to validity should be taken into consideration. Likely sampling biases must be noted. Participants were selected for convenience as well as meeting some specific criteria. To insure the outcome of the study, the participants were not informed of the intervention and their participation in the study. So, the participants did not subjectively participate in the intervention with purpose. Issues with reliability were examined for threats to validity. The researcher was in the intervention procedure all the time, and ensured that the intervention followed the specific instructional plan for data collection. To avoid research bias, there was a second observer present during 45% of the study period.

**Social Validity**

At the completion of the study, the approach of questionnaire, which is the most frequently used method (Kennedy, 1992), was utilized to estimate the importance, effectiveness, acceptability, and satisfaction with the implemented intervention (Kennedy, 2005). The inter-observers completed a four-point Likert scale (i.e., 1 = strongly disagree to 4 = strongly agree) social validity questionnaire (see Appendix D). The questionnaire consists of six questions, created by the researcher. The responses were kept confidential. Due to the data that are based on discrete, quantifiable elements (Likert scale), descriptive statistics were conducted to specifying the responses regarding the intervention (Kennedy, 2005). The responses of the interobserver was also used to evaluate whether this will be an effective intervention that could be replicated in other classrooms. Results indicated that the interobservers thought the IRM intervention had positively effect on increasing students’ Chinese character recognition. All respondents also indicated that they would be willing to implement IRM in their teaching area.
Data Analysis

In the statistical analysis of the data, the participant is the unit of analysis. Intervention data as well as baseline data were analyzed to provide a precise measure of whether there is a change in the characters acquisition of the participants. Descriptive statistics and other visual analysis such as graphs and charts were considered as methods to communicate characteristics of the data and help to better understand the characteristics of the participants (McMillan, 2016). The present study utilized descriptive statistics and graphs to analyze the collected data in order that these methods can provide a more comprehensive review of results as Frey, Nolen, Edstrom, and Hirschstein (2005) suggest. The mean and standard deviation (SD) were used to measure the data in the baseline and in the intervention from the aspects of total recognized characters at two levels of character’s morphological structure. The trends shown in individual participant’s data from baseline to intervention were analyzed. In particular, the overlapping data analysis was utilized to determine whether the IRM intervention is successful and effective in increasing Chinese character recognition.

Results

The results are presented in Figures 1-6, depicting the number of characters recognized across the two phases of this study (i.e., A-B). Figures 1, 3, and 5 respectively reflect data for the three participants and show the number of characters recognized from the level of character morphology. Figures 2, 4, and 6 respectively reflect data for the three participants and show the number of characters recognized from the level of word morphology. Data in each graph is organized by participants and separated between baseline and IRM intervention with a dotted line. The x-axis is the session number, and the y-axis is the number of characters recognized. Baseline and IRM intervention data were collected over a period of eleven sessions, across five
weeks. The study was able to transition into the IRM intervention phase due to the attainment of stability, which was defined in baseline as no more than three points between the lowest and highest number of recognized characters, respectively at the two levels for each participant.

Mike displayed a mean score of zero character recognized in baseline, which was respectively measured from both levels: character morphology and word morphology (Figures 1 and 2). After IRM intervention, Mike showed an increase in Chinese character recognition. Specifically, the mean for Mike’s IRM phase is 6.67 (SD = 2.66) from the level of CM and 7.00 (SD = 2.90) recognized characters measured from WM, both with a range of 2-9.

*Figure 1. Number of characters recognized for Mike measured at the level of CM.*
Figure 2. Number of characters recognized for Mike measured at the level of WM.

Mia displayed a mean score of zero character recognized in baseline, which was respectively measured from both levels: character morphology and word morphology (Figures 3 and 4). On average Mia recognized 7.00 (SD = 3.52) of characters, measured from CM, and 7.33 (SD = 3.61) from WM. The range for both levels was 0-9.

Figure 3. Number of characters recognized for Mia measured at the level of CM.
Halona displayed a mean score of zero character recognized in baseline, which was respectively measured from both levels: character morphology and word morphology (Figures 5 and 6). After intervention, Halona displayed an immediately increased average of 8.33 (SD = 0.82) recognized characters measured from CM, and 8.67 (SD = 0.82) from WM, both with a rage of 7-9.

Figure 4. Number of characters recognized for Mia measured at the level of WM.

Figure 5. Number of characters recognized for Halona measured at the level of CM.
Discussion

The purpose of this study was to investigate the effects of IRM as an instruction in increasing Chinese character recognition for three level 3 Chinese language learners (ages 9-12) in a non-profit school. The study also extended the previous research on IRM by examining how it impacted the participants’ Chinese character recognition from the two levels of morphological knowledge: character morphology and word morphology. For this study, it was hypothesized that the implementation of IRM as an intervention would increase Chinese character recognition of the participants. Based on the data collected, the hypothesis of this study has been confirmed. The results obtained from this study indicate that the implementation of the IRM successfully contributed to increasing Chinese character recognition for the participants.

The results indicate a positive trend was found that resulted in number of characters recognized increasing when the IRM was implemented. Furthermore, the percentage of overlapping data was calculated for baseline and the IRM intervention phases; thus, indicating a functional relationship between implementation of IRM and an increase in number of characters recognized. The results from this current study are similar to findings in previous research;

Figure 6. Number of characters recognized for Halona measured at the level of WM.
indicating, the implementation of IRM in teaching Chinese language learners can effectively increase Chinese character recognition (Kwong & Burns, 2016).

Mike demonstrated great improvement at both CM and WM levels during the IRM intervention phase. There was no overlapping data between the baseline phase and intervention phase indicating an immediate response to the IRM intervention. Specifically, after the first session (i.e., at the beginning of intervention), he recognized two characters at both levels. Additionally, there was a clear upward trend respectively in the data of two levels as the intervention progressed for Mike. All these suggest that IRM was effective in increasing Mike’s Chinese character recognition.

Mia also showed improvement at both levels during the IRM intervention phase. Although there was overlap between the baseline and intervention phases (i.e., no change was observed until the second session of intervention phase), the rate of non-overlapping data was still 83%. There was, however, a change in trend, as there was a consistent increasing trend during the IRM intervention phase, which reversed the horizontal trend during the baseline. All the data and trend analyzed above showed evidence for the effects of IRM on increase of Mia’s Chinese character recognition.

As for Halona, she showed immediate and great improvement at both levels during the IRM intervention phase. Visual analysis displayed there was no overlapping data between the baseline phase and intervention phase. Additionally, a drastic upward and consistent trend was present at both levels. It must be specially pointed out that her improvement was great at the beginning of the first session during the IRM phase. Specifically, her beginning number of recognized characters soared up to seven at both levels from zero in baseline, and no downward number of recognized characters had been shown. The increasing trend was also consistent and
was kept the number of nine for the last three sessions at both levels. So, compared with Mike and Mia, the IRM intervention had an immediate and biggest impact on Halona.

The further comparison analysis exhibited that Mike and Mia had some difficulties at the beginning of the first-time intervention, trying to adapt to the IRM instruction. It was likely to implicate that some extraneous factors had influence on their learning. These factors mainly involved two aspects of teacher and student. On the one hand, Mike and Mia were used to adopting such learning strategy as rote learning to study characters like other CFL learners, which corresponds with the survey of McGinnis (1999); and at the same time, they could not immediately apply the new method (i.e., analysis of morphological components) to character learning. As Shu and colleagues (2000) stated that these students could not utilize the semantic component and phonetic component of the character to learn Chinese characters. The 30-minute IRM instruction could not make too much function in helping the two students learn characters. On the other hand, it indicated that the rote learning was closely related to the former teacher’s teaching strategy, which is traditional instruction as Wu and colleagues (1999) stated. This approach emphasizes stroke-by-stroke learning characters without analyzing the semantic and phonetic radicals, which didn’t develop students’ character- and word- morphology to learn characters. All these aspects interfered with their learning progress. Although there were difficulties in the first session, the results from the more IRM instruction showed IRM is more effective for their learning.

However, compared with Mike and Mia, it is visible by the results that Halona made instant progress at the first session. Her good performance indicated that the IRM instruction made great effect on her immediately and she has had some basic morphological awareness in learning characters in daily Chinese learning. Also, her good performance indicated student with
high ability to make more use of radical knowledge to learn Chinese characters can make better performance, which is similar to the finding of Shu and Anderson (1997).

In this study, the results also showed that the more and further replication in the following sessions ruled out the plausibility of extraneous variable which approximately contributed to the great improvement of all three participants and indicated that the positive and strong effect of IRM on their learning. So, it could conclude that when students were provided radical knowledge right at the first presentation of the character and were given the explicit analysis of characters to develop their character- and word-morphology, it would facilitate character learning. Previous studies had analyzed the effect of morphology and found the similar results (e.g., Packard et al., 2006; Shen & Ke, 2007; Shu & Anderson, 1997; Taft & Chung, 1999).

Further, with IRM instruction, the whole visual stimuli were strengthened and the explicit analysis of morphological components of characters enhanced the participants' character learning. Specifically speaking, the great performance of all the three participants may indicate that IRM instruction could efficiently and effectively transfer information of characters in a dual-track way: the visual and verbal way. The dual-track approach facilitated the participants’ character learning and supported memory retention. Given the logographic nature of Chinese, on the one hand, the explicit analysis of morphological components of character could provide an efficient pathway for learners to know the connection between the orthographic form, the meaning, and the pronunciation of character. This would be beneficial for learners to decode a character into two components with the radical awareness (i.e., semantic and phonetic radical awareness) and read the character in an accurate way. On the other hand, when the flash card written with character was presented to student, it could have whole clearly visual stimuli. It
would facilitate learners to encode the character as a visible whole based on the knowledge of radicals composing the character.

Additionally, the good performance of all the three participants indicated that the IRM instruction could motivate participants’ character learning. In IRM intervention phase, all the three participants showed strong interest in listening and reading the characters. No matter whether they had basic radical awareness before IRM intervention, and whatever characters were taught (i.e., the six types of characters selected in the current study, such as transparent character, regular character, etc.), all the three students were made excited to concentrate on learning characters and made good responses.

Therefore, the results of all the three participants suggest that the IRM was successfully effective in increasing Chinese character recognition, which is in alignment with the survey of Kwong and Burns (2016). More importantly, the analysis of data exhibited that there was inconsistency of numbers recognized respectively at the two levels. Specifically, the overall numbers of characters recognized by each student at the level of word morphology were higher than those measured at the level of character morphology, no matter what kind of target semantic-phonetic compound characters was involved as listed in this study. This inconsistency suggests that student character learning should be based on CM and should be necessary to combine with WM because familiar character could assist unfamiliar character learning. They are interdependent and interact with each other. So, the results recommend that the utilization of IRM strategy increase CFL learners’ character recognition.

All in all, given that (a) Chinese language is a logographic language, (b) each character contains three linguistic components, such as shape, sound, and meaning (Kwong & Burns, 2016; Shen, 2005), (c) about 80-90% of the characters in modern Chinese are semantic-phonetic
compound characters (Shu & Anderson, 1997), and the morphological awareness plays an important role in character learning (e.g., Packard et al., 2006; Shen & Ke, 2007; Shu & Anderson, 1997; Taft & Chung, 1999), and (d) the positive effect of IRM has been found in the study of Kwong and Burns (2016) and the current study, all these strongly suggest that IRM should be an effective strategy for helping Chinese character learning in practical instruction. By using the IRM strategy, teachers could strengthen whole visual stimuli rather than focusing on individual strokes, help students develop morphological awareness, and thereby help students apply morphology into character learning. The current study also suggest that teaching character should especially focus on the level of word morphology rather than the character in isolation.

Limitations and Future Research

There are several limitations to consider when interpreting the results. One limitation was the sample size and variability within the sample. Three students were selected to participate in this study for meeting the specific criteria (i.e., having learnt Chinese for two years and having difficulty in the recurrence and identification of characters that have been taught). Although these students studied Chinese in the same class, they varied in general education grade and in age. Future research could explore the effects of IRM intervention with more participants that are made up of homogeneous samples of the same age and in the same grade. This would allow the researcher to determine if IRM can have equal effectiveness for a larger and more similar group of participants.

In addition, this study utilized simple AB single case design and was conducted for a short time frame. For future study, if time permitted, the researcher should consider the extension of AB design over a longer period in order to improve the validity of the study. By the implementation of IRM intervention for a longer period, a large amount of characters could be
taught using IRM intervention and assessed. The researcher could analyze the repeated measures data to examine whether the effects of IRM is not likely coincidental.

Moreover, due to the limited study time, homophones and the characters with the same phonetic radicals were not measured in the current study. Although the advantage of IRM is to achieve visual-verbal pairing for Chinese character recognition, the lack of these characters’ measurement limited and weakened the examination of the effects of IRM. Future research should more focus on measuring the large number of homophones and the characters with the same phonetic radicals. By measuring these characters after the intervention of IRM, the students’ ability of morpheme discrimination and morpheme transfer could be further examined, which would widen the examination of IRM’s effectiveness.
References


*Statistics of commonly used Chinese characters* 现代汉语通用字表 (1998). Beijing, China: Linguistics Publisher 语文出版社


Appendix A

Lists of semantic-phonetic characters and the two-character words for assessment, with semantic radicals and phonetic radicals.

<table>
<thead>
<tr>
<th>Character in isolation</th>
<th>Two-word character</th>
<th>Semantic radical</th>
<th>Phonetic radical</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I</strong></td>
<td><strong>II</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. 誠</td>
<td>謊話</td>
<td>言</td>
<td>荒</td>
</tr>
<tr>
<td>2. 探</td>
<td>探望</td>
<td>手</td>
<td>畚</td>
</tr>
<tr>
<td>3. 愉</td>
<td>欢愉</td>
<td>心</td>
<td>俞</td>
</tr>
<tr>
<td>4. 锤</td>
<td>木锤</td>
<td>金</td>
<td>垂</td>
</tr>
<tr>
<td>5. 狂</td>
<td>狂热</td>
<td>犬</td>
<td>王</td>
</tr>
<tr>
<td>6. 特</td>
<td>特长</td>
<td>牛</td>
<td>寺</td>
</tr>
<tr>
<td>7. 纺</td>
<td>纺车</td>
<td>糊</td>
<td>方</td>
</tr>
<tr>
<td>8. 妙</td>
<td>奇妙</td>
<td>女</td>
<td>少</td>
</tr>
<tr>
<td>9. 裸</td>
<td>裸眼</td>
<td>衣</td>
<td>果</td>
</tr>
</tbody>
</table>
### Appendix B

Number of characters recognized

<table>
<thead>
<tr>
<th>Student</th>
<th>Item 1</th>
<th>Item 2</th>
<th>Item 3</th>
<th>Item 4</th>
<th>Item 5</th>
<th>Item 6</th>
<th>Item 7</th>
<th>Item 8</th>
<th>Item 9</th>
<th>Total</th>
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</table>

Date:  
Session:  
Signature:
## Appendix C

Implementation Checklist for Fidelity

<table>
<thead>
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<th>Date:</th>
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<table>
<thead>
<tr>
<th>Features of Interventions</th>
<th>Observed</th>
<th>Unobserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Model how to pronounce the unfamiliar character and ask students to read after the teacher</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Explain the semantic radical of the character</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Explain the phonetic radical of the character</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Explain the meaning of the character</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Explain the two-character words sharing same character -------Word morphology</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Model how to pronounce the two-character word and ask students to read after the teacher</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix D

Social Validity Questionnaire

<table>
<thead>
<tr>
<th>Questions</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>This treatment was necessary and effective.</td>
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<tr>
<td>I found this treatment acceptable for increasing the student’s skills to master Chinese characters.</td>
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<tr>
<td>I think this treatment improved the student’s skills to master Chinese characters.</td>
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<tr>
<td>I think the student’s skills to learn Chinese characters would remain at an improved level even after the end of the treatment.</td>
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<tr>
<td>I would be willing to carry out this treatment myself if I wanted to increase the student’s skills to master Chinese characters.</td>
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</tr>
<tr>
<td>I would suggest the use of this treatment to other Chinese character learners.</td>
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</table>