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The Incidental Learning of L2 Chinese Vocabulary through Reading

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Abstract

The study investigated the effect of marginal glossing and frequency of occurrence on the incidental learning of six aspects of vocabulary knowledge through reading in the second language (L2) Chinese. Participants were 30 intermediate L2 Chinese learners in an American public university. The MACOVA tests indicated that the treatment group who read with marginal glossing significantly outperformed ($F = 6.686$, $p < 0.01$) the control group who did not read with marginal glossing on six aspects of vocabulary knowledge after reading two stories. Significant differences were found on receptive word form, productive word form, receptive word meaning, and productive word grammatical function. The two-way ANOVA test suggested that the treatment group performed consistently better on learning words repeated three times and one time, and there was no interaction between the groups and the frequency of occurrence the words. The findings indicated that reading interesting and comprehensible Chinese stories can be beneficial for the learning of Chinese words.

Keywords: L2 reading, marginal glossing, frequency of occurrence, incidental learning, receptive knowledge, productive knowledge, word form, word meaning, word grammatical function

Vocabulary is one of the most important aspects of second or foreign language (L2) learning. However, the number of words needed to be learned to become proficient in the L2 is too large to learn through direct learning alone. It needs to be supplemented with other activities to develop a depth of knowledge of known vocabulary, such as reading (e.g., Uchihara et al., 2019; Karami & Bowles, 2019; Moradan & Vafaei, 2016; Nagy & Herman, 1985; Nagy et al., 1985), listening (e.g., Zhang & Graham, 2019), watching TV (e.g., Peters & Webb, 2018; Puimège & Peters, 2019a, 2019b), and listening to songs (e.g., Pavia et al., 2019). Nagy et al. (1985) suggested that one effective way to produce large-scale vocabulary growth is through reading. First language (L1) research has shown that reading is the main way of learning new words (Horst et al., 1998; Nation, 2001; West & Stanovich, 1991). Nagy and Herman, after a review of the L1 literature, concluded, "Incidental learning of words during reading may be the easiest and single most powerful means of promoting large-scale vocabulary growth" (1987, p. 27). Research has also demonstrated that reading is important for L2 vocabulary development as well (Grabe, 2009; Hudson, 2007).

Words can be learned during the process of reading, in which the learner's attention is on comprehending the meaning of the reading materials. This "picking up" learning process is referred to as incidental learning (Hulstijn et al., 1996). One key factor to help L2 learners become proficient in the L2, including vocabulary, is "exposure to large amounts of L2 input material which is meaningful, interesting or relevant" (Hafiz & Tudor, 1990, p. 31). To enable incidental vocabulary learning in an L2, Day & Bamford (1998, p. 18) claim that there are two key factors. The first is that the L2 learners "must read materials with a very low ratio of unknown to known words", and the second is that "the reading of these easy texts must be plentiful" to allow multiple encounters with the unknown words. This enables the learners to focus on the meaning of the passage instead of the form.

An early study on the relationship between reading and incidental vocabulary learning is Saragi et al.'s (1978) *A Clockwork Orange* study. This study provided promising evidence for the efficacy of incidental L2 vocabulary learning through reading. However, subsequent L2 research led to contrasting findings (Day et al., 1991; Hulstijn, 1992; Pitts et al., 1989). Thus, for L2 learning, it could be concluded that incidental vocabulary learning through reading does occur but with small gains (Laufer, 2005; Lee & Hirsh, 2012; Nation, 2001; Peters et al., 2009; Min, 2008; Read, 2004a; Waring & Takaki, 2003).

Ways to promote incidental vocabulary learning

Given that the gains in L2 vocabulary knowledge, mainly word meaning, through reading are relatively small, researchers have investigated various factors that might promote incidental vocabulary learning (Chen, 2016; Hulstijn, 1992; Laufer & Rozovski-Roitblat, 2011; Mondria & Wit-de Boer, 1991; Peters et al., 2009; Watanabe, 1992). The findings have shown that deep elaboration on the meaning of the unknown words (Hulstijn, 1992; Mondria & Wit-de Boer, 1991; Watanabe, 1992), test announcement (Peters, 2007a; Peters et al., 2009; Sercu et al., 2006), word relevance (Peters, 2007b), and word-focused activities (Laufer, 2001, 2003) positively affect incidental vocabulary learning while reading.

Studies (Hulstijn et al., 1996; Peters et al., 2009) demonstrated that dictionary use positively affects incidental vocabulary learning. In addition, research suggests that the provision of marginal vocabulary glosses enhances incidental vocabulary learning (Cheng & Good, 2009; Eckerth & Tavakoli, 2012; Hulstijn, 1992, 1993; Hulstijn et al., 1996; Jacobs et al., 1994; Watanabe, 1992; Teng, 2019).

Word knowledge in the above-mentioned studies was mainly conceptualized as receptive word meaning knowledge. Word meaning, however, is only one aspect of word knowledge. According to Nation (2001), there are 27 aspects of vocabulary knowledge. Researchers have proposed the importance of various aspects of vocabulary knowledge and ways to measure those aspects of the knowledge (Qian, 2002; Read, 2004b; Schmitt, 2014; Pellicer-Sánchez & Schmitt 2010; Pigada & Schmitt, 2006; Webb, 2007a, 2007b), highlighting the need for more studies on the effect of reading on other aspects of vocabulary knowledge. Aspects of vocabulary knowledge that have been examined in previous studies including orthography, syntax, association, grammatical functions, and meaning and form (e.g., Webb, 2005); spelling, word meaning, and grammatical knowledge (e.g., Pigada & Schmitt, 2006); and spelling, word class, and recognition and recall of meaning (e.g., Pellicer-Sánchez & Schmitt, 2010).

Frequency of occurrence

Research has also demonstrated that the incidental learning of vocabulary through reading is affected by other factors, specifically the frequency of occurrence of words in the reading material (Peters et al., 2009; Waring & Takaki, 2003; Uchihara et al., 2019). L1 and L2 incidental learning studies have found that the number of times an unknown word is met in context affects whether its meaning will be acquired and the extent of learning (e.g., Horst et al., 1998; Jenkins et al.,1984; Saragi et al., 1978; Zahar et al., 2001). Nagy and colleagues (Nagy et al., 1985; Nagy & Herman, 1985, 1987) claimed that incidental vocabulary learning is a gradual process. The gains are made in small increments with repeated encounters. Uchihara et al.'s (2019) meta-analysis reported a medium effect of frequency of occurrence on vocabulary learning (r = .34), which indicated that frequency and vocabulary learning shared around 12% of common variance.

Although research has provided evidence for the positive benefits of reading on incidental vocabulary learning, most of the studies have been conducted with alphabetic languages such as English, Dutch, and French. There is a lack of empirical research on the incidental learning of L2 vocabulary through reading in non-alphabetic languages. It is unclear whether the same results could be attained in non-alphabetic languages, such as learning Chinese as a foreign language (CFL).

Reading in Chinese as a foreign language

Chinese has traditionally been referred to as a logographic or morphosyllabic writing system (Wang et al., 2003). Each Chinese character encodes sound and meaning at the level of the syllable. For example, "马" is a Chinese character meaning "horse", and is pronounced as "mǎ". Chinese characters are composed of radicals, which are meaningful orthographical components of characters. An integral character is composed of one radical while a compound character is composed of two or more radicals. For example, "马" (mǎ, horse)is an integral character since it is composed of one radical while "妈" (mā，mother)is a compound character that is composed of two radicals, "女" and "马". Radicals can be further divided into semantic and phonetic radicals (Mo, 2013). Semantic radicals denote the meaning of the characters while the phonetic radicals denote the pronunciation of the characters. According to Li et al. (1992), 56% of the phonetic radicals could relatively faithfully represent the sound of the compound characters, and around 87% of the semantic radicals could provide meaning cues for the compound characters. A Chinese word can be composed of one character or two characters and above. The two-character words account for 74% of Chinese vocabulary (Shen & Ke, 2007).

Reading in Chinese seems to cause a lot of difficulties among L2 Chinese learners (Shen & Ke, 2007; Zhang, 2016; Zhou, 2018). The reading difficulty may cause anxiety among learners of Chinese, especially among English-speaking learners of Chinese (Zhou, 2017). In order to read in Chinese, learners need to be able to recognize the basic radicals, then the single characters. Besides the meaning of the single characters, learners of Chinese need to also know the meaning of the compound words which are composed of single characters. Research has shown that radical knowledge contributes to Chinese character meaning retention (Chen, 2019) and radical knowledge and single character reading have contributions to compound character reading in Chinese (e.g., Wong, 2017).

Due to the large number of Chinese characters and the enormous amount of two-character

words, learning all the characters and words in Chinese through classroom instruction seems a daunting task. Furthermore, research has shown that words could be learned incidentally through reading, yet little is known about whether and to what extent incidental learning of Chinese characters and words through reading would occur. To fill this gap, our study explored the effects of marginal glossing and frequency of occurrence on Chinese word learning through reading by L2 Chinese learners.

This study addresses the following two research questions:

(1) How does the use of marginal glossing impact the incidental learning of six aspects of vocabulary knowledge through reading in a CFL context?

(2) What is the relationship among the frequency of occurrence, marginal glossing, and the incidental learning of the vocabulary through reading?

Method

Participants

The participants in this study were 30 adult CFL learners in an American public university. The participants were from two sections of second-year Chinese 201 classes. Students enrolled in Chinese 201 either because they had completed the Chinese 102 course successfully or were placed into Chinese 201 based on their Chinese placement test results. The Chinese proficiency level of the participants was approximately intermediate-mid level according to the ACTFL proficiency scale. The age of the participants ranged from 18 to 49 years old, with a mean age of 22 years. The number of years of learning Chinese ranged from one to six years. Students from one class were randomly selected to be the control group and those from the other class, the treatment group. There were 15 students in the treatment and control groups respectively. Table 1 lists the descriptive statistics of the participants.

Table 1

Descriptive Statistics for Participants' Age and Length of Learning Chinese

	N	Age		Length of learning Chinese in Years	
		Mean	*SD*	*Mean*	*SD*
Treatment group	15	22	7.94	2.8	1.62
Control group	15	28	1.42	3.67	3.14

Research Design

The study used a quasi pre-test post-test research design with convenience sampling. Participants in both the treatment and the control groups were asked to read two Chinese stories. The only difference was that the stories read by the treatment group were accompanied by marginal glossing of 16 Chinese words with pinyin and English meaning.

The participants assigned to the control group read the same stories, but without the marginal glossing. Participants were tested on their knowledge of the receptive meaning of the target words before reading two stories. After reading the stories, all participants were tested on six aspects of vocabulary knowledge.

A Multivariate Analysis of Covariance (MACOVA) test was performed to examine whether there was a significant difference between the two groups in the learning of six aspects of vocabulary knowledge. The pre-test score was treated as a covariate, which took into account the group difference in vocabulary knowledge before the treatment. A two-way ANOVA test was conducted to investigate the interaction between marginal glossing, frequency of occurrence, and vocabulary learning.

Key terms

This study adopted Nation's (2001) definition for the six aspects of vocabulary knowledge. In this study, the six aspects of vocabulary knowledge were defined as follows:

- Receptive word form knowledge refers to learners' ability to recognize the written form of the word.
- Productive word form knowledge refers to learners' ability to write the word.
- Receptive meaning knowledge refers to whether the learners can recall the appropriate meaning for the word form.
- Productive work meaning is defined as whether the learners can produce the word form to express a meaning.
- Receptive knowledge of grammatical functions is defined as whether the learners can recognize the correct use of the word in context.
- Productive grammatical function knowledge refers to learners' ability to use the word incorrect grammatical patterns.

Reading Materials

The reading materials were two Chinese stories taken from *Tales and Traditions: Readings in Chinese Literature Series, Volume 2* (Xiao, Wang, Xiao, & Liu, 2009). The first story, 仓颉造字 (*Cang Jie Created Chinese Characters*), is about a historiographer of the Yellow Emperor and the creator of pictographs in Chinese characters named Cang Jie. The second story is an introduction to 元宵节 (*Lantern Festival*), a festival celebrated on the fifteenth day of the first month in the lunar calendar. (See Appendix A for the two stories.)

Both stories had marginal glossing. Based on the pre-test results and vocabulary that the participants had learned in their Chinese courses, the researchers reconstructed the original marginal glosses to exclude words the participants knew and included words from the stories that they might not know. The researchers also adapted the content of the two stories so that eight out of 16 target words appeared three times, and the other eight appeared only once. Altogether, the marginal glosses included 16 words, eight for each story. The marginal glossing in the control group's stories was deleted. Table 2 shows the basic information about the two stories.

Table 2

Reading Materials

Chinese titles	仓颉造字	元宵节
English titles	Cang Jie Created Characters	Lantern Festival
Length	438 characters	535 characters
16 Glossary words	发明(fā míng, to invent) 表达(biǎo dá, to express) 图形(tú xíng, pattern, figure) 组合(zǔ hé, combination) 代表(dài biǎo,to represent) 观察(guān chá, to observe) 首领 (shǒu lǐng, leader) 召集(zhào jí, to convene)	圆缺(yuán quē, wane and wax) 猎人(liè rén, hunter) 射死(shè sǐ, to shoot dead) 战胜(zhàn shèng, to defeat) 人间(rén jiān, human world) 纪念(jì niàn, to commemorate) 蜡烛(là zhú, candle) 灾难(zāi nàn, disaster)
Frequency of occurrence	Three times (发明;表达;图形;组合) Once (代表;观察;首领;召集)	Three times (圆缺;猎人;射死;战胜) Once (人间;纪念;蜡烛;灾难)
Characters	Traditional and simplified	Traditional and simplified

Testing Materials

One pre-test and six post-tests were designed to measure learners' vocabulary knowledge.

The pre-test was to check the participants' knowledge of the target words before reading. The participants were asked to tick the words they knew from a word list and write the English meaning for the words. The items in the pre-test had three categories: (a) 16 target words, (b) four non-words–words created by combining two Chinese characters together, but did not exist in Chinese, and (c) 14 general words–easy words learned by the participants in their previous Chinese courses. The non-words provided the basis for a correction to adjust for guessing and response bias. The general words were added to adjust the difficulty level of the test and further distract learners' attention from the target words. The participants earned one point for each word they indicated they knew. The pre-test was reliable with a Cronbach's Alpha value of .752. The highest possible score was 16 points.

Six post-tests were designed to measure the six aspects of vocabulary knowledge.

Productive word form test. The productive word form test was a dictation test to measure learners' productive written form knowledge. The test items were the 16 target words. Each word was read twice by one of the researchers. The participants were asked to try their best to write the whole word, one character, or part of a character.

The total score for each word was one point. If the learner correctly wrote one character, 0.5 points were given. Most of the Chinese characters in the target words were composed of two radicals (components of Chinese characters). If one radical of the character was correctly

written, 0.25 point was given. If one part of the radical was correctly written, 0.1 points were given. The purpose of giving partial credit to the spelling was to take the accumulation of written word form knowledge into consideration.

*Receptive word form test***.** The receptive word form test measured receptive knowledge of orthography. The participants were asked to circle the correctly written word that they had encountered in the reading. The distracters were created to resemble the target word both phonetically and orthographically. In Example (1), the four words share the same pronunciation. Orthographically, 组 and 祖 look similar because they share the same radical. In this multiple-choice test, each correct answer was credited with one point. The highest possible score was 16.

Example (1) a.组合 b.祖和 c.组和 d.祖合

Receptive word meaning test. The receptive word meaning test measured learners' receptive knowledge of word meaning, that is, whether the learner could recall the appropriate meaning for the word form. A translation test was designed. The participants were asked to write the English meaning for 16 Chinese target words. One point was credited to a correct meaning. No partial credit was given.

Example (2) 发明 ( )

Productive word meaning test. The fourth test measured whether learners could recall the correct Chinese form for the English meaning provided. The same scoring method for productive word written form was applied here, and partial credit was given.

Example (3) To invent ( )

Receptive word grammatical function test. A grammatical judgment test was designed to measure receptive knowledge of grammatical functions, that is, whether the participants could recognize the correct use of the words in context. Each target word was in a sentence in which it might be either used correctly or incorrectly. Incorrect use of the target word was either caused by the wrong use of the part of the speech or the incorrect word order. In Example (4), the underlined target word 庆祝 (to celebrate) was incorrectly used as an adverb. In Example (5), the word order was wrong. The participants were asked to make a judgment about whether the target word was used correctly. There were two options: *Yes* or *No*. For any correct answer, one point was credited. No points were given for incorrect answers.

Example (4) 中国新年的时候，家里人一起庆祝地过年。
Example (5) 他的作品永远人间留在。

Productive word grammatical function test. The productive knowledge of the grammatical function test was a sentence construction test. The participants were cued with the target words and asked to construct Chinese sentences. The participants were also instructed to use pinyin for the characters they did not know how to write. For any grammatically correctly constructed sentence, one point was credited; no partial credit was given.

The six post-tests were reliable with Cronbach's values of .727, .801, .820, .805, .700, and .786 for receptive form, receptive meaning, receptive grammatical function, and productive form, productive meaning, and productive grammatical function tests.

Both traditional and simplified versions of the seven tests were prepared for the participants, and students chose either simplified or traditional tests to complete. For the tests, see Appendix B.

A debriefing survey (Appendix C) was also designed to ask the participants' opinions on the reading passages and the tests.

Procedure

Four sessions were held. Session 1 was the pre-test. It occurred during a regularly scheduled class meeting. The participants were asked to circle the words they thought they knew and write the English meanings. Ten days later, in Session 2, the participants read two stories. The delay between the two sessions was provided in order to diminish any possible effects of exposure to the target words.

Session 3 consisted of the six post-tests and immediately followed Session 2. As for the order of the tests, the productive knowledge of word form test (dictation test) was given first, then the receptive knowledge of word form test, receptive knowledge of word meaning test, productive knowledge of word meaning test, receptive knowledge of grammatical function, and productive knowledge of word grammatical usage test.

Session 4 was the debriefing survey session. Some participants completed the survey in class, and some took the survey home and brought it back the second day.

The participants in both groups were not told in advance that they would be tested on their knowledge of the words. They were told that they would answer comprehension questions after reading. This was to create conditions similar to incidental learning. Table 3 is a summary of the procedures. The data were analyzed using SPSS 20.

Table 3

Procedures

Session	Content	Time
1	Pre-test	10 minutes
2	Reading	20 minutes
3	Six post-tests	30 minutes
4	Debriefing survey	5 minutes

Results

RQ 1: How does the use of a marginal glossing impact the incidental learning of six aspects of vocabulary knowledge through reading in a CFL context?

Before conducting statistical analysis, the data were checked to make sure that the assumptions for conducting a MACOVA test were met. The data were normally distributed, and there was equality of variances between the marginal glossing group and the control group in six aspects of vocabulary knowledge. A MACOVA test was used to compare whether the treatment group and the control groups differed in the learning of the six aspects of vocabulary knowledge after reading two Chinese stories, using pre-test vocabulary knowledge as a covariate. It indicated there was a significant effect of marginal glossing on the learning of the six aspects of vocabulary knowledge through reading, after controlling for the effect of two groups' pre-test vocabulary knowledge, Pillai's trace = 0.757, F (1, 28) = 6.686, p = 0.003, d = .800. The observed power was .965. The effect sizes were medium to large according to Plonsky and Oswald's (2014) recently suggested more conservative criteria.

Before the treatment, the participants in the control group knew one out of the 16 target words and its English meaning. In contrast, the treatment group knew 0.8 words out of the 16 target words (Table 4). After reading two Chinese stories, the treatment group performed better on all six measures of vocabulary knowledge than the control group (Table 5).

Table 4

Descriptive Statistics of Pre-test of Receptive Word Meaning Knowledge of 16 Target Words

Group	N	*M*	*SD*	95% of CI for mean		Min	Max
				LL	UL		
Treatment group	15	0.8	0.94	0.28	1.32	0	3
Control group	15	1	1.26	0.33	2.32	0	3
Total	30	0.86	1.01	0.4	1.32	0	3

Note. CI = confidence interval; LL = lower limit, UL = upper limit.

Table 5

Descriptive Statistics of Means for Marginal Gloss Group and Control Group in Six Aspects of Vocabulary Knowledge (with SD)

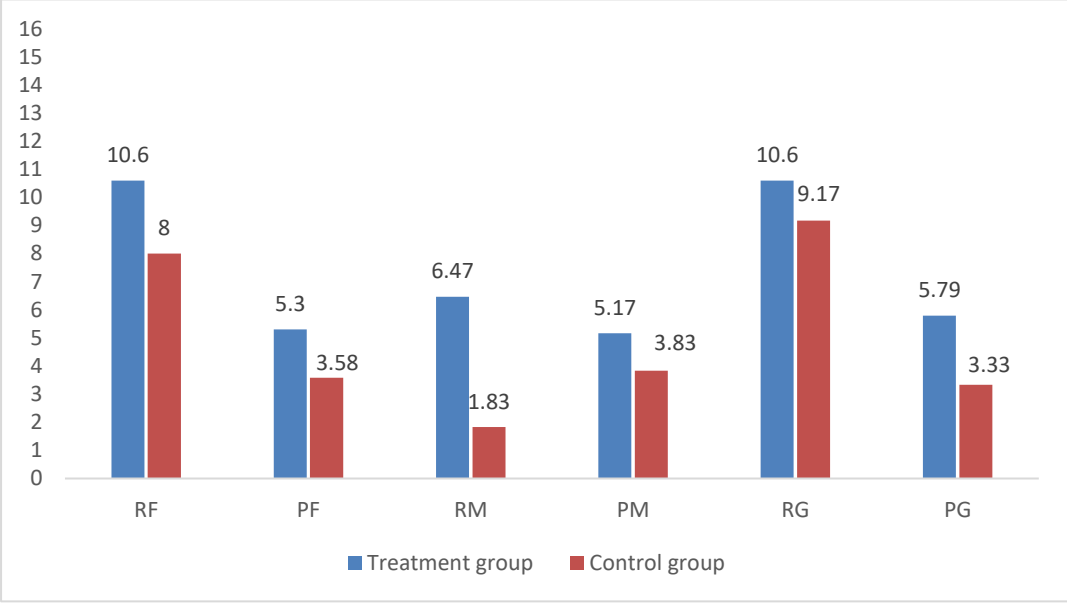
Groups	RF	PF	RM	PM	RG	PG
Treatment group	10.6(2.29)	5.30(1.33)	6.47(3.22)	5.17(2.75)	10.6(1.99)	5.79(2.81)
Control group	8.00(3.03)	3.58(2.01)	1.83(2.13)	3.83(2.75)	9.17(2.56)	3.33(2.58)

Note. RF = receptive form, PF = productive form, RM = receptive meaning, PM = productive meaning, RG = receptive grammatical function, PG = productive grammatical function.

Figure 1 shows that the participants in the treatment group who read the stories with marginal glossing had higher scores than the control group on all of the measures of vocabulary knowledge.

Figure 1

Mean differences in six aspects of vocabulary knowledge between the marginal glossing group and the control group



Note. RF = receptive form, PF = productive form, RM = receptive meaning, PM = productive meaning, RG = receptive grammatical function, PG = productive grammatical function.

Univariate analyses were conducted to examine whether the difference in the six aspects of vocabulary knowledge between the two groups was significantly different. The results indicated that significant differences existed in receptive word form, F (1, 28) = 8.710, p = .009, d = 0.339, power = 0.794; productive word form, F (1, 28) = 8.542, p = .038, d = 0.334 , power = 0.787; receptive word meaning, F (1, 28) = 15.522, p = .001, d = 0.477, power = 0.960; and productive grammatical function knowledge, F (1, 28) = 4.507, p = .049, d = .210, power = .517. The effect sizes were small according to Plonsky and Oswald's (2014) more conservative criteria.

RQ2: What is the relationship among the frequency of occurrence, marginal glossing, and the incidental learning of the vocabulary through reading?

In order to examine the relationship among group conditions, frequency of occurrence, and vocabulary learning, the six aspects of vocabulary knowledge were summed, and a mean was calculated. We summed the six aspects of vocabulary knowledge because our focus was on the effects of group condition and frequency of occurrence on vocabulary knowledge as a whole, not on each aspect of vocabulary knowledge. A two-way ANOVA test was performed. The results indicated that there was a significant effect of group conditions on the learning of words occurred three times, F (1, 28) = 6.931, p = .017, d = 0.278, power = 0.702, and on the acquisition of words occurred one time, F (1, 28) = 4.587, p = .046, d = 0.203, and power = 0.527. The descriptive statistics are presented in Table 6. In general, both groups performed better on the learning of vocabulary knowledge of words occurred three times than those occurred once. Furthermore, there was no interaction between group conditions and

frequency of occurrence, which indicated that the treatment group performed better than the control group on the learning of both words occurred three times (treatment group, $M = 4$; control group, $M = 3.33$) and words occurred once (treatment group, $M = 2.8$; control group, $M = 2.2$) (Table 6). Figure 2 is a representation of the relationship between the group condition and frequency of occurrence.

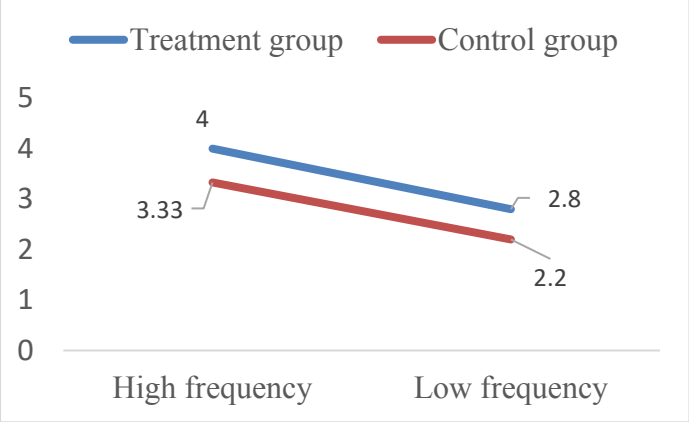
Table 6

Descriptive Statistics of Mean and SD for Treatment Group and Control Group on High and Low Frequency Word Knowledge

Frequency	Group	*M*	*SD*
Three times	Treatment group	4	0.87
	Control group	3.33	1.18
Once	Treatment group	2.8	1.1
	Control group	2.2	0.8

Figure 2

The interaction between group conditions and the frequency of occurrence



Note. High-frequency words (three times); low-frequency words (one time)

Survey results

The debriefing survey provided extra information on the participants' opinions and perceptions on reading materials, the focus of their attention, learning outcomes, and the role of marginal glossing. Since the purpose of the debriefing survey was to gain a general understanding of all the participants' opinions, we did not compare whether there were differences in their responses between the treatment and the control groups.

Question 1 asked the participants' opinions of the two stories. 20 out of 30 participants thought that the stories were interesting to read. Question 2 asked about the difficulty level of the two stories. Nine participants indicated that the stories were on the hard side, 19 thought that they were easy to read, and two wrote that that the stories were not too difficult or too

easy.

Questions 3 and 4 asked if learners' attention was on the meaning of the passages or the meaning of the unknown words. 26 out of 30 indicated that their attention was on the meaning of the passage. Table 7 lists some of the participants' responses to Questions 3 and 4.

Table 7

Participants' Comments on the Focus of Their Attention

Participant	Comments
1	My attention was on the meaning of the passage overall because the passage was generally easy to read besides these new words, giving the impression that my project was to use these words to understand the passage and not to focus on these words particularly.
15	Meaning of the passage. I thought it would be a comprehension test.
19	Meaning of the passage because the story was interesting.

Thus, participant responses to Questions 1 to 4 suggested that, even though one-third of the participants felt that the stories were not easy to read, they thought that the stories were interesting and, for the majority of the participants, their attention was on the meaning of the passage, suggesting that if words were learned while reading, they were learned incidentally.

Question 5 asked participants if they thought they had learned any words. Twenty-eight out of 30 participants indicated that they had learned some words, and some of them gave examples of the words they had learned. Participant 8 said, *"Yes, I do. Repetition helps a lot, even when I am not purposefully trying to memorize."* Only two participants indicated that they did not learn any new words.

Question 6 asked them whether they thought a glossary of vocabulary would facilitate their reading comprehension and vocabulary learning. Twenty-six out of 30 believed that a glossary of vocabulary would facilitate their reading comprehension and vocabulary learning.

Discussion

The main results of the study are that L2 learners of Chinese, a logographic language, can learn vocabulary incidentally through reading, and more importantly, that marginal glossing enhanced the acquisition of Chinese words. This supports the findings of previous investigations on the incidental learning of vocabulary in alphabetic languages (Day et al., 1991; Dupuy & Krashen, 1993; Horst et al., 1998; Hulstijn, 1992; Hulstijn et al., 1996; Nagy et al., 1985; Pitts et al., 1989). Chinese characters and words are one of the main obstacles for L2 Chinese readers (Zhou, 2018). Firstly, there is a large number of Chinese characters. According to Sun (2006), 47,043 Chinese characters were collected in kāng xī zì diǎn, a Chinese dictionary (1716 CE). Moreover, Chinese has gone through a disyllabic process where monosyllabic words were expressed in a disyllabic format in modern Chinese. For

example, in ancient Chinese, "to buy" was either "购" (gòu) or "买" (mǎi), both meaning "to buy." This meaning was expressed by a disyllabic word 购买 in modern Chinese. After Chinese characters were combined into Chinese words, L2 Chinese readers have another list of Chinese words to recognize in order to read in Chinese. This study has shown that by reading two Chinese stories, L2 Chinese readers could learn Chinese words incidentally. This has strong pedagogic implications for L2 Chinese teaching because readers could be encouraged to read Chinese graded readers in order to learn Chinese words.

More importantly, the group that read the story with the marginal glosses performed significantly better in vocabulary knowledge tests than the group without the marginal glosses. Unlike languages such as English, there is no space between Chinese characters. For example, in the following Chinese sentence, "我喜欢夏威夷" (wǒ xǐ huān xià wēi yí, I like Hawaii), there are no spaces between the characters. Deciding the word boundaries makes it difficult for beginning L2 learners reading in Chinese (我/喜欢/夏威夷, I/like/Hawaii). A glossary provides not only the meaning and pronunciation for the words, but also information on word boundaries since each word was listed as a single entry. This might be one reason why marginal glosses enhanced Chinese word learning.

It should also be noted that the effect of marginal glosses was uneven across the six aspects of vocabulary knowledge. The treatment group performed significantly better compared to the control group in four aspects of vocabulary knowledge: the receptive and productive word form, receptive word meaning, and productive grammatical function knowledge.

The findings suggest that reading interesting and comprehensible Chinese stories can be beneficial for recognizing and writing the form of Chinese characters, which is considered very difficult for L2 learners of Chinese, especially those who are used to alphabetic language writing systems. This is in agreement with previous research on alphabetic languages (Nation, 2001; Schmitt, 2014) and in L2 Chinese (e.g., Zhang & Li, 2016). When learners read the marginal glossed Chinese words (together with meaning and pinyin), they might pay attention to the radicals that compose Chinese characters. Eighty-one percent (81%) of Chinese characters are semantic-phonetic compound characters (Sun, 2006, p.105). The number of semantic radicals is limited generally to the basic Chinese radicals students learn in the first few weeks of their elementary Chinese class. The 16 target words in this study have 32 characters, among which 24 of them were semantic-phonetic compound characters. For example, for the target word 战胜, 戈 in 战 means dagger-axe and 占 on the left is a phonetic radical. The second character 胜 is composed of a meaning radical 月 and the phonetic radical 生. 戈 , 月, and 生 are all high-frequency radicals that students have learned. Thus, since Chinese characters are composed of basic high-frequency radicals, marginal glossing provided them with an opportunity to focus their attention on the basic radicals of Chinese characters in the target words. This is in agreement with previous empirical research on the role of radicals on Chinese compound character reading and retention (e.g., Wong, 2017; Chen, 2019).

In CFL contexts, students may be required to mechanically write one character 10 or 20 times in order to master its spelling. If the writing of the Chinese characters may be learned incidentally by reading interesting materials, which may also provide the learning of other aspects of vocabulary knowledge, reading extensively might be beneficial in L2 Chinese classrooms.

Receptive meaning was another aspect of vocabulary knowledge that the marginal glossing group acquired better than the control group. The reason might also be related to how Chinese characters are constructed. Precursor research has shown that, when L2 Chinese readers encounter unknown characters, their first strategy is to guess the meaning of the words from the context (e.g., Zhou, 2018). However, contextual clues are not always sufficient for word meaning acquisition (e.g., Den Broek et al., 2018). After guessing, the marginal glossing group students could refer to the marginal glossing to confirm their guesses. However, for the control group students, their guesses could be correct or incorrect, and there was no way for them to confirm, hence it is harder for them to recall the meaning of the words after reading.

The marginal glossing group did better in the productive grammatical function test. One possible reason is that Chinese word order is more flexible compared to that of alphabetic languages (Sun, 2006). Since the marginal glossing provided information on the part of speech and meaning, students in the marginal glossing group could construct sentences on their own. While for the control group, no information on the parts of the speech of the words was available. This was further complicated by the fact that word classes (parts of speech) in Chinese is a relatively vague concept. Most Chinese words could function as other parts of speech depending on their positions in a sentence (Norman, 1988). Thus, the lack of parts of speech information and the difficulty in determining word-class might hinder the construction of grammatically correct sentences for the control group learners.

The present study also investigated the interaction among marginal glossing, frequency of occurrence, and the learning of the vocabulary. The results indicate that words that were encountered three times demonstrated greater learning on vocabulary knowledge than one encounter under both marginal glossing and control group conditions. Frequency of occurrence was found to have a significant effect on vocabulary learning in alphabetic languages as well (Horst et al., 1998; Jenkins et al., 1984; Rott, 1999; Saragi et al., 1978; Webb, 2007a). The present study extends this line of research to non-alphabetic languages such as Chinese.

Limitations and Suggestions for Future Research

Since this study is an exploratory study, it has several limitations that warrant future research. First, the six post-tests only included 16 target words. Also, the sample size of the present study was limited. Another limitation is the lack of delayed post-tests. It might be possible that the vocabulary learning reported in this study would not have been retained in delayed post-tests. The present study only investigated six aspects of vocabulary knowledge. According to Nation (2001), there are 27 aspects of vocabulary knowledge. Future studies could be designed to investigate more aspects.

The research on incidental learning of vocabulary knowledge has been extended to the learning of collocations (e.g., Webb, Newton, & Chang, 2013; Pellicer-Sánchez, 2017); a comparison of different learning conditions like reading, reading while listening, and listening (e.g., Brown et al., 2008; Webb & Chang, 2015); and the role of background variables such as L2 proficiency and gender in incidental learning of vocabulary (Lee & Pulido, 2017). Types of glossing is another factor that is worth investigating (Khezrlou et al., 2017; Sadeghi et al., 2016; Varol & Erçetin, 2019; Warren et al., 2018). This also points to future directions for research on incidental vocabulary learning in non-alphabetic languages.

Conclusion

This study is one of the first studies to explore the L2 incidental learning of Chinese words through reading. Thus, this study contributes to the understanding of L2 incidental vocabulary learning in non-alphabetic languages. The present study explored how the generally low gains of L2 incidental vocabulary learning can be increased by adding marginal glosses to the reading material. This exploration was accomplished by investigating the influence of marginal glossing and the frequency of occurrence on the learning of six aspects of vocabulary knowledge among CFL learners. The results found that incidental learning of the vocabulary was greater when intermediate L2 readers were given the pinyin and meaning of the words through marginal glosses than when no external information concerning the unknown words was available. Words that were encountered three times were acquired better compared to words that were encountered only once for both the marginal glossing group and the control group. Thus, this study has demonstrated that L2 incidental vocabulary learning during reading does occur in a non-alphabetic context. The marginal glosses greatly enhanced the learning of different aspects of vocabulary knowledge.

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Appendix A

Reading passages

倉頡造字

漢字是美麗的文字，你知道漢字是怎麼發明[1]的嗎?

很久以前，中國人沒有文字。 有一個叫倉頡的人，他很聰明，想要發明漢字，想要發明一種方法來表達[2]人們的想法。他每天想啊，想啊，但是想不出來。

有一天，他在地上看到一個奇怪的腳印，他不認識，就去問一位老人，老人看了一看，說："這是雞的腳印，你看，那腳印又細又長，只有雞的腳才長成這樣。"

倉頡聽完，非常高興，不是因爲他認識了雞的腳印，而是他突然想到，世界上的東西，都有自己的特點（characteristics），只要把這些特點記下來，不就能代表[3]不同的東西了嗎?

然後，倉頡開始認真地觀察[4]身邊的東西，他看到太陽是圓圓的， 就用一個  來代表太陽；月亮是彎彎的，那就畫一個彎  吧，山是  水是  。就這樣倉頡畫出了越來越多的圖形[5]，每一個圖形可以表達不同的意思，他還發現把這些圖形組合[6]在一起，還可以表達更多的意思，比如把山和水組合在一起就是一個詞，山水；把日和月組合在一起就是另一個詞， 日月。

倉頡把這些圖形拿去給黃帝（Yellow Emperor）看。黃帝覺得這種表達意思的方法很好。于是他召集[7]了天下的首領[8]，讓他們把這些圖形帶回去給人們。人們用了這些圖形以後，可以記住更多的東西了。慢慢地，這些圖形就成了我們今天的漢字了。

1 發明 v. fā míng invent
2 表達 to express; convey
3 代表 v. dài biǎo to represent
4 觀察 v. guān c to observe
5 圖形 n. tú xíng patterns
6 組合 v. zǔ hé to compose
7 召集 v. zhào jí to summon
8 首領 n. shǒu lǐng chief; leader

元宵節

元宵節是中國的一個節日，是農曆的第一個月的第十五天。中國農曆和月亮的圓缺[9]有關系，每個月的第一天和最後一天月亮最缺，第十五天月亮最圓。農曆一月十五是過完新年後的第一個月圓的日子，叫"元宵節"。月亮的圓缺和別的節日也有關系，比如，中秋節也是月圓的日子。

關于元宵節有很多有意思的故事。有一個故事說，古時候天上住著"天帝"（God），他有很多漂亮的鳥, 他很喜歡這些鳥。有一天，他有一只鳥不見了。這只鳥飛到了人間[10]。有一個獵人[11]不知道這是天帝的鳥，不小心把它射死[12]了，獵人看了一下這只死鳥，才發現他射死的是天帝的鳥。天帝知道有人把鳥射死了，非常生氣，就要天兵天將（divine troops）在正月十五把人們都燒死。天帝的女兒知道了這個消息，很難過。爲了幫助人們，她悄悄地把這個消息告訴了人間的人們，讓大家做好准備。開始的時候人間的人們都非常害怕，不知道應該怎麽辦。後來大家想出了一個辦法，就是在正月十五這一天晚上，每人都在家門口挂上紅色的燈籠，點上蠟燭[13]，並且放鞭炮和煙花。這樣天帝從天上遠遠的看下來，會看見地上一片紅色的光，以爲天兵天將已經把人們都燒死了，就不會再生氣了。到了元月十五這天晚上，到處都挂起了燈籠，放起了鞭炮，煙花。人們一邊看燈籠，
一邊吃著又香又甜的湯圓，慶祝自己又戰勝[14]了一場災難[15]。後來，爲了慶祝人們戰勝了這場災難，戰勝了天帝，也爲了紀念[16]這次成功，人們把這一天定爲"元宵節"，年年慶祝，成爲中國人最喜歡的節日中的一個。

9 圓缺 n quē waxes and wanes
10 人間 n. rén jiān the human world
11 獵人 n. liè rén a hunter
12 射死 v. shè sǐ to shoot (sth or sb) to death
13 蠟燭 n. là zhú candle
14 戰勝 v. zhàn shèng to triumph over
15 災難 n.zāi nàn disatser
16 紀念 v. jì niàn to commemorate

Appendix B

Test batteries

1. Pre-test
Instruction: Please tick the words you know and write down the English meaning.

苹果		猎人	
美国		旅游	
发明		圆缺	
大海		意思	
首领		人间	
华眉		卧铺	
代表		射死	
中文		毯子	
观察		蜡烛	
囊七		冰仙	
图形		战胜	
风景		桌子	
组合		灾难	
戴气		盒饭	
表达		纪念	
天气		火车	
召集		男朋友	

2. Receptive knowledge of word form
Instruction: Please circle the words you think you had encountered in the two stories you read.

1	a. 泼名 b. 发名 c. 泼明 d. 发明
2	a. 伐表 b. 代表 c. 伐麦 d. 代麦
3	a. 现察 b. 观祭 c. 现察 d. 观察
4	a. 圆形 b. 图刑 c. 图形 d. 圆刑
5	a. 组合 b. 祖和 c. 组和 d. 祖合
6	a. 麦达 b. 麦达 c. 麦达 d. 表达
7	a. 招集 b. 召集 c. 招隽 d. 召隽
8	a. 目领 b. 首领 c. 目铃 d. 首铃
9	a. 圆缺 b. 圈缸 c. 圆缸 d. 圈缺
10	a. 认问 b. 人间 c. 认间 d. 人问
11	a. 猎人 b. 措人 c. 猎刃 d. 措刃
12	a. 谢毙 b. 射毙 c. 射死 d. 谢死
13	a. 蜡烛 b. 腊虫 c. 蜡虫 d. 腊烛
14	a. 战胜 b. 沾牲 c. 战牲 d. 沾胜
15	a. 火难 b. 灾谁 c. 火谁 d. 灾难
16	a. 级念 b. 级唸 c. 纪念 d. 级唸

3. Productive knowledge of word form
Instruction: Please try your best to write the word you hear. Each word will be read twice.

1.
2.
3.
4.
5.
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12.
13.
14.
15.
16.

4. Receptive knowledge of word meaning
Instruction: Please write down the English meaning of the following words.

1. 发明		9. 圆缺	
2. 代表		10. 人间	
3. 观察		11. 猎人	
4. 图形		12. 射死	
5. 组合		13. 蜡烛	
6. 表达		14. 战胜	
7. 召集		15. 灾难	
8. 首领		16. 纪念	

5. Productive knowledge of word meaning
Instruction: Please write down the Chinese words for the following English meaning.

1. to invent		9. waxes and wanes	
2. to represent		10. human world	
3. to observe		11. hunter	
4. patterns		12. to shoot to death	
5. to compose		13. candle	
6. to convey		14. to triumph over	
7. to summon		15. disaster	
8. chief; leader		16. to commemorate	

6. Receptive knowledge of grammatical functions
Instruction: Please indicate whether the following word is grammatically correctly used or not.
1). 人们是怎么<u>发明</u>电脑的呢？
2). <u>代表</u>的他很伤心, 死了。

3). 他认真地**观察**了一下这个房子。
4). 他**图形**了北京的风景。
5). 他把两个汉字**组合**在一起, 变成了一个词。
6). 他说的话很**表达**。
7). 他**召集**了很多人, 给他们讲旅游的好处。
8). 他是公司的老板, **首领**了很多人。
9). 月亮的**圆缺**是每个月都会发生的。
10). 他写得书**人间**留在。
11). 兔子一见见到**猎人**, 就跑了。
12). 他**射死**把兔子了。
13). 他们晚上**蜡烛**了。
14). 日本没有**战胜**别的国家。
15). 夏威夷**灾难**了, 死了很多人。
16). 为了**纪念**他们结婚的日子, 他给她买了花。

7. Productive knowledge of word grammatical usage.
Instruction: Please use the following words to make sentences. You can use Pinyin for the words you don't know how to write.

1. 发明	
2. 代表	
3. 观察	
4. 图形	
5. 组合	
6. 表达	
7. 召集	
8. 首领	
9. 圆缺	
10. 人间	
11. 猎人	
12. 射死	
13. 蜡烛	
14. 战胜	
15. 灾难	
16. 纪念	

Appendix C

Debriefing Survey

1. What do you think of the reading passages?
2. The reading passages are easy or difficult? Why?
3. Did you realize that you would be tested on vocabulary while you were reading? Why?

4. Was your attention on the meaning of the passages or the meaning of the unknown words while you were reading? Why?
5. Do you think you learned some words?
6. Do you think a glossary of unknown words would facilitate your reading comprehension and vocabulary learning? Why?

Appendix D

The Correlation Among Six Post Vocabulary Tests

Pre-test	RF	PF	RM	PM	RG	PG
1						
.426	1					
.343	0.430	1				
.327	0.602**	0.427	1			
.345	0.468*	0.502*	0.716**	1		
.236	0.512*	0.167	0.610**	0.363	1	
.205	0.553*	0.493*	0.774**	0.833**	0.374	1

Note: RF =receptive form; PF = productive form; RM = receptive meaning; PM = productive meaning; RG = receptive grammar; PG = productive grammar.
**Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.