Novice Learners' Chinese-Character Learning Strategies and Performance

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Abstract

This study is a replication of Sung's (2012) study. This study investigated most frequently used Chinese-character learning strategies reported by 88 first-year college learners of Chinese, the factors underlying those strategies, and whether there is a relationship between those strategies and the learners' Chinese-character test performance. The results found 20 most frequently used strategies reported by the learners. Furthermore, the factor analysis extracted three components, which explained 44% of the variance. The results of the multiple regression tests showed that the participants who reported frequently using particular phonological strategies did better on the phonological comprehension part of the test and the ones who reported frequently using orthographic strategies did better on the graphic comprehension, graphic production, and phonological production parts of the test.

1 Context

With the growing economic status of China and Mandarin Chinese being identified as a critical language, learning Chinese as a foreign language has becoming a trend at U.S. schools in the past decade. Both the U.S. and the Chinese governments are eager to promote the learning of Mandarin Chinese in the United States. For example, the College Board collaborated with Hanban, the Confucius Institute Headquarters, to launch the Chinese Language and Culture Initiatives, which offer varieties of Chinese language and culture-related programs to support the increasing need for Chinese learning. Confucius Institutes and Classroom Program (CICC) and Chinese Guest Teacher and Trainee Program are examples of offered programs. These programs provide rich teaching resources, personnel, grants, and guidance to help develop new, and assist current, Chinese language and culture programs in the United States. With the U.S. and Chinese governments making such an effort to promote Mandarin-language instruction in the United States, the number of college students studying Chinese in the U.S. reached a new high in 2009 with approximately more than 61,000 college students studying Mandarin Chinese (Furman, Goldberg, & Lusin, 2010). This number has doubled since 1998.

2 English-speaking students' difficulties in learning Mandarin Chinese

The number of students studying Mandarin Chinese hit a record high in the latest enrollment survey and will possibly continue to increase in the future. However, researchers in the Chinese teaching field observe that many students are eager to study the language at the beginning, but due to the challenges they encounter while studying it, they lose interest and discontinue after one or

two semesters (Yin, 2003). Moreover, some of the students who make it to advanced level Chinese classes are observed to have problems finding effective strategies to study Chinese reading and writing. Hence, their Chinese level improves slowly (Xing, 2003). These students ultimately hit a bottleneck as they find it more and more difficult to increase their Chinese language level (Yin, 2003). For example, Xing (2003) states that many advanced level students have difficulties applying higher level vocabulary in their conversation and continue using the lower level vocabulary learned in beginner Chinese. Indeed, Chinese is a challenging language to learn for English-speaking students. Scholars have identified several features of Mandarin Chinese contributing to learning challenges faced by English-speaking students which are related to its writing system and Chinese as a tonal language.

Chinese is a logographic language system, which is distinctive from English, an alphabetic system. In English, one uses 26 letters to spell words, but in Chinese, one uses 24 basic strokes combined in different ways to form radicals, which are the basic components to make characters. A Chinese character is a morpheme, some of which can be used alone and some of which are combined in different ways to make words. A major challenge of learning Chinese is the amount of time and effort needed to remember what strokes and components make up each of the characters. This task is especially cognitively demanding for novice learners who have little knowledge of the strokes and components of characters (Lee & Kalyuga, 2011). A second difficulty in learning Chinese characters lies in the lack of correspondence between a character and its pronunciation (Sung & Wu, 2011). Some characters have a phonetic radical component, which cues the pronunciation of a character; however, as the Chinese language has evolved, these characters are no longer pronounced like their phonetic radical components, which adds to the difficulty of remembering the pronunciations of characters. The third challenge is the huge number of characters one needs to learn in order to be fully literate in Chinese (Sung & Wu, 2011). According to Wong, Li, Xu and Zhang (2010), there are 3000 commonly used Chinese characters which are seen in 99% of Chinese written materials; hence, knowledge of these characters are needed in order to function in a Chinese-speaking community.

The rest of the challenges lies on Chinese being a tonal language, which uses four tones to distinguish characters that otherwise are pronounced identically. For example, the character, 妈/ma/ with first tone, means 'mother' while the character, 骂/ma/ with the fourth tone, means 'to argue.' Hence, the learning of Chinese tonal knowledge is crucial for comprehending and producing spoken Chinese (Liu et al., 2011). Nevertheless, this learning task is found to be difficult for English-speaking students. Wang, Perfetti and Liu (2003) found that even for American college students who studied Chinese for a semester, they encountered great difficulty in acquiring the tone skill. The difficulty is mainly due to the lack of a tone feature represented in the students' native language, English. Another challenge related to tone is the large number of homophones in Chinese. For instance, 14 characters share the pronunciation /li/ with the fourth tone, each of which has a different meaning (Wang, 1998). Learners need to have sufficient character knowledge to be able to use the right characters in a specific context. Finally, the last challenge deals with the limitation of using the phonetic system, *pinyin*, to learn pronunciation. Due to the lack of correspondence between characters and their pronunciations, *pinyin*, the Chinese phonetic system, is used to provide visual pronunciation prompts in learning Chinese characters (Lee & Kalyuga, 2011). However, *pinyin*, which uses 25 of the 26 English letters, can be easily confused with pronunciation of English. For example, 'you' is pronounced as /yo/ in *pinyin*. Therefore, for learners whose native language shares the letters require extra cognitive effort for distinguishing *pinyin* pronunciation from English pronunciation (Lee & Kalyuga, 2011).

As researchers and educators recognize the challenges English-speaking learners face when learning Chinese, it is important to identify effective Chinese-character learning strategies in order to maximize the learners' language performance and reduce their learning frustration, which might ultimately result in the discontinuation of studying Chinese.

3   Literature review

3.1   Acquiring and processing Chinese characters

In order to investigate Chinese-character learning strategies, understanding how a reader processes and how a learner acquires Chinese characters is necessary. A model related to Chinese characters was developed by Perfetti and Tan (1998), who proposed a model of visual Chinese character identification, which describes the processes of how a reader of Chinese comes to recognize a character, when it is visually presented to him or her. This model does not offer information about strategies learners should use to effectively acquire Chinese characters; however, it identifies essential knowledge learners need in order to recognize a character's form, meaning and pronunciation. Perfetti and Tan (1998) explain that the model has three entities: the orthographic lexicon, the phonological lexicon, and the meaning system. When a character is presented to a reader, the reader first begins the stroke analysis, as strokes are the smallest units of a character. The detected stroke features activate the reader's orthographic lexicon. The orthographic lexicon then activates the phonological lexicon and the meaning system. In order to make the processes go from one stage to the next, the orthographic lexicon and phonological lexicon units need to exceed their thresholds. Perfetti and Tan (1998) state that the orthographic lexicon threshold is determined by the frequency of occurrence of the printed character in the reader's daily usage, while the phonological lexicon threshold is determined by the frequency of access to the character's phonological form in the reader's speech experience. In sum, this model illustrates that stroke knowledge is the first step in character recognition, while the orthographical and phonological knowledge assists readers to identify the meaning of a character.

Another model related to Chinese characters is the conception of vocabulary continuum developed by Lin (2004), which focuses on the acquisition of Chinese at word level through four forms: phonological comprehension (PC), graphic comprehension (GC), phonological production (PP), and graphic production (GP). Lin's (2004) model proposes that there is a particular sequence of acquiring Chinese words, which is in the order of PC, GC, PP, and GP. In other words, comprehending Chinese words is considered the easiest to acquire, while writing Chinese words is considered the most difficult. Nevertheless, Lin (2004) claims that as learners gain sufficient character learning experience, their Chinese vocabulary development may mirror their L1 vocabulary level. Ultimately, learners' L1 vocabulary level is a factor to determine their Chinese vocabulary level.

The aforementioned models informed the researcher about the Chinese-character recognition and Chinese-word acquisition processes. These models were used in this study to help interpret and explain the study results. In addition, the theoretical categories (GC, GC, PP, and GP) in Lin's model were applied in the design of the assessment instrument used in this study (See Section 5, "Method" for more explanations).

3.2   Studies related to Chinese-character learning strategies

Even though a sophisticated model of effective Chinese-character learning has not been developed, researchers (Chung, 2007; Everson, 1998; Jin, 2006; Ke, 1998; Kuo & Hooper, 2004; Shen, 2004; Shen, 2005; Shen, 2008; Taft & Chung, 1999; Wang, 1998; Wang & Leland, 2011; Winke & Abbuhl, 2007; Xu & Jen, 2005; Zhu & Hong, 2005) have been conducting experiments and studies to find ways for learners of Chinese to bypass the tremendous difficulty in learning Chinese characters and acquire the language more effectively. Each of the studies done had a specific focus. A few studies investigated the effect of particular learning strategies on Chinese-character recognition. For example, Jin (2006) found that among the three strategies (paying attention to radicals, focusing on character stroke sequences, and studying *pinyin* pronunciation), the learners who used the strategy of paying attention to radicals outperformed the other two groups in a post-Chinese-character recognition test. Taft and Chung (1999) took a step further to investigate the effect of learners' study of radical information on their recognition of Chinese characters. The

study result showed that focusing on learning radical information while (rather than before or after) studying new characters yielded the best learning result.

A few studies about Chinese-character recognition and production involved the use of technology. For instance, Xu and Jen's (2005) study examined the effect of computer-assisted language learning strategies on the learners' performance in Chinese-character recognition and production. The authors developed special Chinese-character input software which was intended to reinforce learners' *pinyin* pronunciation and character knowledge. The study result illustrated that the experiment group, which was assigned to use the software to study characters, scored higher than the control group on the oral and Chinese recognition post-tests. In a different study, Zhu and Hong (2005) compared the effect of four types of computer-assisted flash card learning strategies (character only, character with voice, character with stroke order animation, and character with voice and stroke order animation) on Chinese-character recognition and written production. The authors concluded that the learners who used computer flash cards with voice only performed better than other groups. Another study, which compared different computer-based learning strategies (translation, verbal mnemonics, visual mnemonics, dual coding mnemonics, or self-generated mnemonics), discovered that learners who used the self-generated mnemonics strategy yield best character recognition learning result (Kuo & Hooper, 2004).

A couple of studies looked into strategies learners frequently used to study Chinese characters or words in an non-experimental setting. Wang's (1998) survey revealed that the first-year college learners in her study frequently used copying character repetitively, using flash cards, and making one's own glossary words to memorize characters. Wang's (1998) analysis pointed out that the learners saw a character as a whole without taking it apart to study its components such as radical, shape, phonetic indicator, or sound. In contrast, Shen's (2005) study on college learners of different Chinese levels found that the most frequently used strategies by the participants were orthographic-knowledge-based, which include radical knowledge, graphemics, semantics, and phonetics, which are cues to encode characters. Like Shen's (2005) study, several other studies focused on investigating learners' frequently used strategies and perceptions on the effectiveness of various strategies in learning Chinese characters or words. For example, Winke and Abbuhl's (2007) study identified three types of strategies (output-based, cognition-based, and input-based) learners of Chinese at different level thought to be fundamental to their study of Chinese at the word level. The result of Ke's (1998) study, in which the majority of the participants valued the use of character components and graphic structure for their character learning, echoed Shen's (2005). Wang and Leland's (2011) findings also supported of Shen's (2005) and Ke's (1998) studies in that the novice participants believed that the learning of Chinese orthography features helped them acquire Chinese characters. In addition, the authors also found that the participants believed that practicing characters through cooperative learning is effective.

A study conducted by Sung (2012) took a step further to investigate not only the most frequently used Chinese-character learning strategies and factors underlying those strategies, but also the relationship between learners' strategy use and their language performance. The results of Sung's (2012) study found seven most frequently used strategies, four of which were stroke-orthographic-knowledge-based, while the remaining three were phonological-semantics-knowledge-based. Furthermore, Sung (2012) reported that the stroke-orthographic-knowledge-based strategies accounted for 6.8% of the learners' character learning performance.

The studies mentioned above provided information on Chinese-character learning strategies that college learners frequently used or perceived to be effective to use. They also provided information on the effects of particular strategies or specially designed software on Chinese-character recognition and/or production in experimental settings. However, there is not more than one study (Sung, 2012) in the current literature which identifies learners' self-reported frequently used strategies to study Chinese characters/words, and their effects on the learners' Chinese-character/word performance. Furthermore, Sung (2012) identified a limitation in her study – that is, the quizzes used to measure learners' language performance were orthographic-production-based. This means that only writing, one of the four language skills (listening, speaking, reading, and writing), was investigated. The current study intended to overcome this limitation. Moreover, there needs to be

more studies to ensure that Sung's (2012) study results were reliable, valid, and general. Many studies such as this one will be needed to fill this gap in the field.

4   Research questions

This study intended to investigate three aspects regarding Chinese-character learning strategies. First, this study aimed to identify the most frequently used Chinese-character learning strategies as reported by first-year English-speaking non-Chinese native learners. Second, this study hoped to find possible underlying factors characterizing those strategies. Third, this study intended to investigate whether or not there is a relationship between those strategies and the learners' Chinese-character test performance. Hence, the present study posed the following research questions:

1. What Chinese-character learning strategies are reported as most frequently used by first-year Chinese language beginners?
2. What categories, if any, exist among the most frequently used strategies reported by the learners?
3. Is there a relationship between the most frequently used strategies reported by the learners and their Chinese-character test performance?

5   Method

This study is a replication of Sung's (2012) study. This study asked the same research questions, investigated the same type of learners (true beginners in college whose first language was English), used the same types of instruments, namely, a questionnaire and a Chinese-character assessment, to collect data, and used the same kinds of data analysis methods (such as factor analysis and multiple regression tests). For example, like in Sung's (2012) study, this study also used the Character Learning Strategy Inventory adopted from Shen's (2005) study. The inventory, which consists of 59 Chinese-character learning strategies, was reported as highly reliable and suitable to be adopted in other studies (Shen, 2005; Sung, 2012). However, there was a major difference between Sung's (2012) and this study, which lies in the assessments used to measure the learners' Chinese-character performances. In Sung's (2012) study, the classroom teachers wrote their own quizzes which only emphasized orthographical production – called GP in Lin's (2004) model. In this study, the researcher designed the assessment, which included all four categories (GC, GC, PP, and GP) of Chinese-word knowledge identified in Lin's (2004) model. As Sung (2012) noted in her study, a limitation of her study is that she "only investigated one correlation, which was between the commonly used strategies and the orthographical production-based performance. However, other possible correlations may exist and need to be investigated, such as between strategies and phonological comprehension, orthographical comprehension, or phonological production" (p. 207). The new design of the assessment in this study hopes to overcome the limitation identified in Sung's (2012) study and develop a more rigorous research design which could more accurately examine the relationship between strategy use and Chinese-character performance.

5.1   Participation and the Chinese courses

This study's target participants were true beginners who were non-Chinese heritage language learners enrolled in the first-year Chinese courses at a university in the United States. In addition, students with an Asian background, who might have had Chinese character knowledge (for example, Japanese or Korean students), were excluded from this study. In sum, this study involved 88 participants from the United States who spoke English as their first language. There were 60 males and 28 females in the study, ranging in age from 18 to 34 years with an average age of 20.5.

Although taught by different instructors, the first-year Chinese courses in which the participants were enrolled shared the same syllabus and learning objectives. According to the course description in the syllabus,

Students will gain communicative competencies in the four language skills: speaking, listening, reading, and writing. Students will also be exposed to cultures and customs. To be specific, students will learn to use basic grammar structures and vocabulary in sentences, write approximately 100 Chinese characters, recognize approximately 250 Chinese characters, and learn about major Chinese celebrations.

The textbook used in these courses was Chinese Odyssey Volume I (Wang et al., 2007), which consists of 10 lessons that introduce basic Chinese vocabulary and grammar.

5.2   Instruments

This study adopted Shen's (2005) Character Learning Strategy Inventory questionnaire to examine learners' Chinese-character learning strategy use. The questionnaire had an overall Cronbach's Alpha value of close to 0.8 indicating respectable reliability; hence it was adopted for use in this study. Shen (2005) used a semi-structured questionnaire with open-ended questions to identify strategies learners used to study Chinese characters. Her learners identified a total of 176 strategies. Among the 176 strategies, she selected 59 strategies which were used by more than 5% of the learners to be the items in the second questionnaire. This study adopted Shen's second questionnaire. A pilot study done by the researcher before the current study tried to elicit any strategies other than the 59 listed in Shen's (2005) questionnaire; however, the pilot study results showed that not many learners identified the same additional strategies; therefore, the additional strategies were not added to the questionnaire used in this study. The 59 strategy items in the questionnaire were divided into five parts following the sequence of Chinese-character learning stages. The five stages are listed as follows: (1) strategies used when characters are first introduced; (2) strategies used to increase understanding of new characters after they have been introduced; (3) strategies used to memorize newly learned characters; (4) strategies used to practice new characters; and (5) strategies used to preview or review new characters (Shen, 2005). The questionnaire items were on a 5-point Likert scale with "1" being "Never or almost never true of me," "2" being "Generally not true of me," "3" being "Somewhat true of me," "4" being "Generally true of me," and "5" being "Always or almost always true of me."

This study used a test designed by the researcher to collect the participants' Chinese character performance data. The test was given after the participants were taught the seventh lesson in the textbook. The purpose of the test was to evaluate the participants' knowledge of the Chinese characters learned in each of the seven lessons taught. The design of the test follows the four forms identified in Lin's (2004) model of the conception of vocabulary continuum. Part A focused on testing the participants' PC level: the participants were to write down the English translations of the words said by their instructors. Part B focused on testing the participants' GC level: the participants were shown ten two-character words and were to write down their *pinyin* and English translations. This part of the test extended the testing of participants' GC level to include testing the comprehension of *pinyin* associated with the words. One might argue that asking participants to write down *pinyin* is testing their PP level; however, knowing how to write down the *pinyin* of the words does not guarantee that one knows how to pronounce them correctly. Hence, this study sees the *pinyin* knowledge as an extension of the GC knowledge, and not the PP knowledge. Part C aimed to test the participants' GP level: the participants were shown ten English words and were to write down their Chinese translations. The words selected for Part C consisted of characters that the participants were expected to know how to write in the seven lessons. Part D aimed to test the participants' PP level: the participants met with their instructors one by one, were shown ten two-character Chinese words and asked to read them aloud to their instructors. This part of the test is limited to testing the participants' PP level using graphic symbols as clues, and not conversation in a natural setting. Each part accounted for 25% of the test grade.

5.3 Procedures

The Character Learning Strategy Inventory questionnaire was collected on the same day that the participants took the test, which was in the 12th week of the semester, after the participants had had seven lessons. The researcher explained to the participants the purpose of the study and the benefits derived from the results of this study. Students who agreed to participate in the study signed the consent form. The participants were informed that their participation would remain anonymous. The participants took approximately 15 minutes to complete the questionnaire and 30 minutes to finish the test. A total of 88 questionnaires and tests were completed and used for the data analysis.

6 Results

This study used the SPSS statistical software to analyze the questionnaire and test data. All the statistical tests run in this study had a minimum conventional level of significance, $p = .05$. For the first research question, "What Chinese-character learning strategies are reported as most frequently used by first-year Chinese language beginners?", the mean and standard deviation of the 59 character learning strategies were compared and the ones which had means above 3.5 were considered as most frequently used strategies by the participants. For research question 2, "What categories, if any, exist among the most frequently used strategies reported by the learners?", factor analysis was run to help identify the commonalities among the most frequently used strategies. For the third research question, "Is there a relationship between the most frequently used strategies reported by the learners and their Chinese-character test performance?", four multiple regression tests were run to determine whether or not there was a significant relationship between learners' self-reported, most frequently used character-learning strategies and their Chinese-character test performance. For the four multiple regression tests, the predictor variables were the groups of the self-reported, most frequently used strategies extracted from the factor analysis test. The criterion variable was the participants' grade for Part A (testing of PC level) of the test for the first test, the participants' grade for Part B (testing of GC level) of the test for the second test, the participants' grade for Part C (testing of GP level) of the test for the third test, and the participants' grade for Part D (testing of PP level) of the test for the fourth test. Each of the multiple regression tests helped determine the extent to which the predictor variables predict the criterion variable and the strength of each predictor variable in the prediction of the criterion variable (Coolidge, 2000).

The Character Learning Strategy Inventory questionnaire was employed to ascertain which strategies were reported by the respondents reported as the most frequently used to learn Chinese characters. The statistical result found that 20 of the 59 strategies had average scores higher than 3.5 on the Likert scale. The 20 most frequently used strategies are given in Table 1.

Table 1. Twenty most frequently used strategies

Twenty Most Frequently Used Strategies	N	M	SD
3. I try to repeat the character (or word) several times aloud (or silently to myself). (Stage 1)	88	4.41	0.89
9. I write the character (or word) down. (Stage 1)	88	4.39	0.81
7. I pay attention to how the character (or word) is used in context. (Stage 1)	88	4.07	0.92
17. I convert the word to my own native language and find an equivalent in meaning. (Stage 2)	88	4.05	1.09
2. I pay attention to the tone and try to associate the sound with *pinyin*. (Stage 1)	88	4.02	1.02
11. I look in the textbook or dictionary to check the character's (or word's) meaning that I am not sure of. (Stage 2)	88	3.95	1.05
10. I observe the character (or word) carefully and pay attention to stroke order. (Stage 1)	88	3.93	1.08
23. I usually say the character (or word) to myself as I write it repeatedly. (Stage 3)	88	3.93	1.16
5. I try to visualize the character in my head. (Stage 1)	88	3.89	1.12
19. I see if the character in a new word has been used in previously learned words or phrases. (Stage 2)	88	3.89	0.99
57. I review characters by writing the characters many times. (Stage 5)	88	3.86	1.13
15. I find out how they are used in conversation. (Stage 2)	88	3.77	1.03
13. I try to use the character or (words) in sentences orally. (Stage 2)	88	3.77	0.88
24. I say the word over to myself and try to picture what the characters look like in my mind. (Stage 3)	88	3.77	1.13
1. I listen carefully to the pronunciation and the explanation of how the sound or meaning of the character is derived and take notes when necessary. (Stage 1)	88	3.73	0.87
59. I review characters by reading over notes, example sentences, and the lesson in the textbook. (Stage 5)	88	3.70	1.22
4. I look carefully at the strokes and try to make associations with a similar character (or word) previously learned. (Stage 1)	88	3.68	1.25
33. I quiz myself during memorization; for example, given the sound, I try to think of the character's shape and meaning. (Stage 3)	88	3.66	1.15
14. I ask how the words could be used in different sentences if I don't understand them. (Stage 2)	88	3.57	1.14
42. I make sentences and write out sentences. (Stage 4)	88	3.52	0.99

As mentioned in the Method section, the survey divided the 59 strategies into five parts in a sequence consistent with the character/word learning stages (Shen, 2005). Table 1 shows the particular stage when the participants used the strategies. It appears that the participants reported using more strategies to learn characters at the first learning stage – when a new character or word was first introduced to them. Eight of the ten strategies in the first part (items 1–5, 7, and 9–10) were reported as frequently used by the participants. These strategies include the learning of pronunciation, tone, meaning, stroke order, character used in context, and association between sound and *pinyin*. The participants also reported frequently using a considerable number of strategies (items 11, 13–15, 17, and 19) in the second learning stage – increasing their understanding of new characters/words after they had been introduced. These strategies helped the participants to confirm characters' meanings, how they are used in sentences or conversation, their translation in the participants' native language, and if a character in a new word has been used previously. In the remaining three learning stages, the reported use of strategies seems to diminish. For instance, the participants only frequently used three strategies (items 23, 24, and 33) at the third learning stage – memorizing newly learned characters/words. These strategies include writing or saying characters/words repeatedly, visualizing them while repeating, and quizzing themselves during memorization. In the fourth stage – practicing new characters/words, the participants reported only frequently using one strategy (item 42), which is making sentences and writing out sentences. Finally, the participants reported frequently using two strategies (items 57 and 59) to review new char-

acters. One reviewing strategy involves writing characters repeatedly and the other focuses on reviewing sentences in the notes and lesson textbook.

6.1 Factor analysis

Factor analysis was conducted to identify underlying dimensions that explain the correlations among the 20 most frequently used strategies reported by the participants. With respect to the appropriate sample size, Malhotra (2009) recommended the rough guideline of having at least four or five participants per survey item in order to yield reliable research results. Following Malhotra's (2009) recommendation, the total number of participants (N=88) in this study exceeded the minimum requirement (N=80) to run factor analysis using the 20 most frequently used strategies.

The Kaiser-Meyer-Olkin measure of sampling adequacy used to examine the appropriateness of factor analysis has a high value of 0.60, indicating that the factor analysis is appropriate. The significance level of the Bartlett test of sphericity = .000 indicated that each variable in these data correlates perfectly with itself but has no correlation with the other variable, suggesting that the data were approximately multivariate normal and acceptable for factor analysis. The output of factor analysis revealed seven components with eigenvalues exceeding 1. However, this study adopted the traditional construct for interpretation in which only components shown on the steep portion of the scree plot generated by the factor analysis are selected and rotated. Three components were identified on the steep portion of the scree plot, and hence were selected and rotated.

Table 2. Principal components analysis with Varimax rotation of three-factor solution for the most frequently used Chinese-character learning strategies

	Item-total correlation	Factor loading	h^2
Component 1 *Cronbach's alpha = .70*			
7. I pay attention to how the character (or word) is used in context. (Stage 1)	.664	.844	.756
15. I find out how they are used in conversation. (Stage 2)	.515	.629	.771
13. I try to use the character or (word) in sentences orally. (Stage 2)	.436	.574	.698
1. I listen carefully to the pronunciation and the explanation of how the sound or meaning of the character is derived and take notes when necessary. (Stage 1)	.417	.528	.670
2. I pay attention to the tone and try to associate the sound with *pinyin*. (Stage 1)	.269	.476	.594
Component 2 *Cronbach's alpha = .77*			
9. I write the character (or word) down. (Stage 1)	.563	.893	.905
10. I observe the character (or word) carefully and pay attention to stroke order. (Stage 1)	.583	.704	.765
4. I look carefully at the strokes and try to make associations with a similar character (or word) previously learned. (Stage 1)	.592	.639	.650
23. I usually say the character (or word) to myself as I write it repeatedly. (Stage 3)	.579	.558	.667
Component 3 *Cronbach's alpha = .70*			
59. I review characters by reading over notes, example sentences, and the lesson in the textbook. (Stage 5)	.562	.843	.786
57. I review characters by writing the characters many times. (Stage 5)	.595	.808	.822
42. I make sentences and write out sentences. (Stage 4)	.421	.522	.548

The Varimax-rotated result showed that 12 of the 20 most frequently used strategies strongly loaded on three components. The subsequent three-component solution explained 44% of the variance, with Component 1 contributing 25%, Component 2 10%, and Component 3 9%. Table 2 shows that Component 1, which includes five strategies items (1, 2, 7, 13, and 15), loads heavily on learning how a character/word is used in context or conversation, practicing using the charac-

ter/word orally, and studying the character's phonetic knowledge such as its pronunciation, tone, and *pinyin*. It seems that the participants used the strategies in Component 1 to enhance their oral ability.

The four strategy items (4, 9, 10, and 23) loaded in Component 2 are strategies related to re-membering a character's or a word's graphic information and its association with its sound. The three strategy items (42, 57, and 59) loaded in Component 3 are strategies used to practice and review how a character/word is written and used. In sum, the factor analysis results illustrated that the participants reported using strategies to learn both phonological and graphic knowledge of characters/words, and how they can be used in written sentences and orally in conversation. Fol-lowing the factor analysis, the analysis of internal consistency reliability was conducted in which Component 1 was 0.70 with $F (87, 4) = 3.667$, $p < .05$ indicating a respectable reliability of Com-ponent 1. The Cronbach's alpha for Component 2 was 0.77 with $F (87, 3) = 11.736$, $p < .000$ sug-gesting the internal reliability of Component 2. The Cronbach's alpha for Component 3 was 0.70 with $F (87, 2) = 3.666$, $p < .05$ illustrating a respectable reliability of Component 3. In conclusion, the internal consistency reliability level of the items included in the factor analysis is fair.

6.2   Multiple regression

This study has found the particular strategies that first-year learners of Chinese reported using frequently to study Chinese characters. It is important to investigate which of these strategies are effective in enhancing the participants' PC, GC, PP, and GP levels. Four regression analyses were conducted to answer this question. In regard to the sample size in a multiple regression test, Coo-lidge (2000) recommended that the total number of participants be at least ten times the number of predictor variables, which is three in this study. The total number of participants ($N = 88$) in this study exceeded the minimum recommendation ($N = 30$).

The results of the four tests showed that four linear trends exist. First, the result of the first test showed that a significant relationship exists between Component 1 and Part A (testing of PC level) of the test, $R = .27$ [$F (1) = 5.226$, $p < .05$]. $R2 = 0.071$ indicating that 7.1% of the variance in Part A of the test is accounted for by the strategies in Component 1. The direction of influence for the variable is positive. The B value shows that the participants who reported more frequently using the strategies in Component 1 scored higher in Part A of the test. Second, the result of the second test illustrated a significant relationship between Component 2 and Part B (testing of GC level) of the test, $R = .24$ [$F (1) = 5.178$, $p = .001$]. $R2 = 0.057$ indicating that 5.7% of the variance in Part B of the test is accounted for by the strategies in Component 2. The B value shows that the partici-pants who reported more frequently using the strategies in Component 2 scored higher in Part B of the test. Third, the result of the third test indicated that there is a significant relationship between Component 2 and Part C (testing of GP level) of the test, $R = .35$ [$F (1) = 12.333$, $p = .001$]. $R2 = 0.125$ indicating that 12.5% of the variance in Part C of the test is accounted for by the strategies in Component 2. The B value shows that the participants who reported more frequently using the strategies in Component 2 scored higher in Part C of the test. Finally, the result of the fourth test showed a significant relationship between Component 2 and Part D (testing of PP level) of the test, $R = .22$ [$F (1) = 4.423$, $p = .05$]. $R2 = 0.049$ indicating that 4.9% of the variance in Part D of the test is accounted for by the strategies in Component 2. The B value shows that the participants who reported more frequently using the strategies in Component 2 scored higher in Part D of the test.

7   Discussion

In order to answer the first research question, "What Chinese-character learning strategies are reported as most frequently used by first-year Chinese language beginners?", 20 of 59 strategies listed in the Character Learning Strategy Inventory which had average scores higher than 3.5 on the Likert scale were selected as the most frequently used strategies. Among the 20 strategies, most of them were used when a new character or word was introduced to the participants and

when the participants needed to increase their understanding of the new characters or words after they have been introduced. The use of strategies diminished when the participants were at the learning stages of remembering, practicing, and previewing/reviewing the characters or words. It seems that the participants either did not value the importance of strategies in these learning stages or they simply did not know which strategies to use in these learning stages. For example, at the practicing stage, the participants did not frequently utilize potentially useful language resources described in the survey such as listening/singing Chinese songs, watching Chinese TV programs, talking to native speakers of Chinese, or using the language lab to practice the newly learned Chinese characters and words. According to the researcher's understanding, the Chinese program in which the participants were enrolled had a language lab, the instructors in the program occasionally taught them Chinese songs on YouTube, and the students were aware that there were native speakers of Chinese who volunteered to tutor the participants weekly. However, the availability of these free resources and the teacher's demonstration of a certain strategy use did not influence the participants' choice of strategies. The participants seemed to place emphasis on studying the aspects of characters and how they are used in sentences and conversation by themselves. This finding is in support of Shen's (2005) and Ke's (1998) studies in which the learners believed that learning the orthographic and phonological features, and meanings of characters are important to gain character knowledge. This finding is also aligned with Perfetti and Tan's (1998) visual Chinese character identification model which indicates that orthographical and phonological knowledge is important to assist one in recognizing characters. However, as the novice participants' character knowledge increases, using a wider variety of strategies, such as the types which give learners opportunities to test their language hypothesis and promote authentic interaction in both oral and written form, will be needed.

In response to the second research question, "What categories, if any, exist among the most frequently used strategies reported by the learners?", the factor analysis extracted three components, which explained 44% of the variance. The participants used the strategies in Component 1 to learn and practice phonological knowledge of characters. The strategies in Component 2 were used to memorize characters' graphic knowledge and their association with their sounds. Component 3 has strategies which helped the participants practice using characters or words in sentences and review how they are used. The strategies in Components 1 and 2 assisted the participants in acquiring phonological and orthographic features of characters. Perfetti and Tan's (1998) model identifies these two features as being important for activating the meaning system to comprehend characters. However, after the participants learned the characters' phonological and orthographical features, they used very few preview and review strategies. Moreover, these strategies only focused on writing and practicing by oneself, but not reviewing with others orally or in writing. It could be that the participants saw remembering how to write and use characters in sentences as the most difficult learning task as described in Lin's (2004) model of the conception of vocabulary continuum and did not think that using other types of strategies to review characters would be as effective as the ones they chose. Nevertheless, Everson (1998) claims that there is a strong relationship between knowing the meaning of a word and knowing its pronunciation. Everson states that perhaps remembering characters by "emphasizing a purely visual processing mode may be too random and arbitrary to deal with large amounts of characters" (1998, p. 200). If this is true, teachers need to guide learners to try more practicing or previewing/reviewing strategies which have an emphasis on characters' pronunciation, tones, and *pinyin*.

In answering the third research question, "Is there a relationship between the most frequently used strategies reported by the learners and their Chinese-character test performance?", four multiple regression tests were run. The results showed that Component 1, which consists of strategies which helped the participants learn phonological knowledge of characters, seem to be effective in aiding their performance in phonological comprehension in Part A of the test. Component 2, which includes strategies that helped the participants acquire graphic features of characters, seem to be effective in enhancing their performance in graphic comprehension in Part B, graphic production in Part C, and phonological production in Part D of the test. One might think that strategies which focus on learning phonological features, such as the strategies in Component 1, will enhance

learners' knowledge in phonological comprehension and production, while learning graphic information of characters, such as the strategies in Component 2, will help develop learners' knowledge in graphic comprehension and production. The multiple regression results of this study found it to be false. The results showed that Component 1, which contains five phonological strategies, only significantly helped learners to do well in phonological comprehension, but not phonological production. In contrast, Component 2, which has four orthographical strategies, aided the participants' performance in phonological production. The significant finding of the relationship between Component 2 and Part D can be explained by Perfetti and Tan's (1998) model of visual Chinese character identification which posits that one needs to know the orthographic information in order to activate the phonological information of a character. This is also in line with Everson's (1998) claim that there is a relationship between recognizing a character and remembering its pronunciation. The results of this study illustrated that studying a character's tone, *pinyin*, and pronunciation helped the participants to comprehend the words their instructors said to them, but did not help them read aloud characters shown to them. On the other hand, using particular orthographic strategies identified in the factor analysis of this study not only helped the participants do well on their graphic comprehension and production parts of the test, but also the phonological production part. The results imply that instructors should inform learners that the use of orthographic strategies may enhance their oral ability and encourage them to try wider varieties of strategies. Nevertheless, the percentage of variance accounted for by the predictor variable in each of the four multiple tests ranges between 4.9% and 12.5%, which means strategies other than the ones used in the multiple regression tests have effects on the participants' test performance. Future research will be needed to continue searching for strategies which are effective and other factors which affect learners' performance.

8 Implications

This study found that the novice learners' reported strategy use was more frequent at the initial learning stage, but diminished at the later learning stages of remembering, practicing, and reviewing. In particular, this study found a lack of strategies used to orally practice or review Chinese characters. However, Perfetti and Tan's (1998) model shows that phonological knowledge is one of the three required entities in processing a Chinese character and stressed that phonological knowledge is an important element in assisting readers to identify the meaning of a character. Hence, the apparent lack of strategy use to practice or review a character's tone, pronunciation, and *pinyin* implies that teachers need to be more active in promoting these important strategies to assist novice learners' study, which will prepare them to successfully advance to the next language level. For example, instead of merely demonstrating in class how to use the infrequently used strategies, a better way for teachers to encourage the learners to try the infrequently used strategies would be to explicitly identify, introduce, and stress the importance of these strategies.

This study also found that the use of certain phonological strategies (#1, #2, #7, #13, and #15) apparently helped the participants' performance in the phonological comprehension part of the test, while the use of certain orthographic strategies (#4, #9, #10, and #23) was apparently effective in enhancing their performance in graphic comprehension, graphic production, and phonological production parts of the test. One implication of this finding is that phonological strategies can help learners increase only their level of phonological comprehension, not phonological production. Another implication of the finding is that there seems to be a relationship between orthographic strategies and gaining knowledge in different aspects of a character (such as graphic comprehension and production, and phonological production). These implications propose new research questions and hypotheses for testing in future studies. For example, is it true that no phonological strategy can help learners gain knowledge in phonological production? What orthographic strategies other than the ones found in this study would help learners gain knowledge in different aspects of a character? What would be a good combination of strategies to use to learn Chinese characters? Will the combinations of strategies found in future studies be similar to the ones found in this study? Since this study used a particular character knowledge evaluation method and had its

own unique learning situation and participants, the findings cannot be generalized until multiple studies in other learning contexts are conducted. However, the findings of this study generated certain implications, which serve as a reference and a starting point for future research to look into and advance the field of Chinese-character learning.

9   Limitations

This study has several limitations. First, the study was limited in the number of participants and their language level. Future studies should expand it to include learners with different language levels and with more learners. Second, this study is limited geographically. Only learners in one university in the United States participated in the study. This has limited the inclusion of learners with different learning backgrounds who may use strategies differently. Future studies need to solicit learners in different parts of the country in order to do a more thorough study. Third, although the multiple-regression tests in this study found a total of 30.2% of variance accounted for by the participants' reported strategy use, which was higher than the 6.8% found in Sung's (2012) study, future research will be needed to continue searching for strategies which could explain the rest of the variance. Fourth, this study used learners' self-reported strategy use as the data for analysis. Future research should consider using other means to capture learners' strategy use, such as classroom observation or think-aloud protocols. Finally, this study used only a single language performance evaluation method. Future studies with better language evaluation designs, which can closely test learners' true language levels, will be needed to yield more accurate results.

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