Retention of katakana as foreign scripts: The effects of mnemonics and spatial ability

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Abstract

This paper reports the results of an experiment, which showed that: (a) regardless of their L1 script type (Roman or non-Roman), learners of Japanese as a foreign language did not benefit from the conventional mnemonics for the short-term or long-term retention of katakana (introduced after hiragana); (b) only the spatial ability of the Roman group (whose L1 employed Roman scripts) had significant correlations with their immediate recall performances. By comparing these results with those of Matsunaga's (2003, 2005) studies on hiragana, this paper discusses: (a) changes in learning strategies, (b) the role of the spatial ability, (c) the possibility of L1 script recognition strategy transfer, (d) the role of practice, and (e) pedagogical implications and suggestions for future studies.

Retention of katakana as foreign scripts: The effects of mnemonics and spatial ability

When learning a large amount of new information or a foreign language, mnemonics are said to be a useful tool, for they function as "memory aids" (Higbee, 1977) that relieve the burden on learners' short-term memory by associating the new information with something familiar (Ericsson, Chase, & Faloon, 1980). There are various mnemonic techniques employed in foreign-language learning (Paivio & Desrochers, 1981, for review), but the one that is most widely used is called the "keyword method," originally developed by Atkinson (1975) to teach foreign language vocabulary.

The process involved in the keyword method is best explained by the "three Rs" (Mastropieri & Scruggs, 1991, p. 10), which stand for "reconstructing," "relating," and "retrieving." For example, when English speakers learn an Italian vocabulary item "ranid" meaning "frog," a similar-sounding keyword "rain" which is concrete

and familiar to the learners, is first reconstructed. Once the keyword (rain) has been reconstructed and learned, it must then be related to the to-be-learned information (frog). This is done by combining "rain" and "frog" in a sentence, a visual image, or a picture (e.g., a frog sitting in the rain). When the learners attempt to retrieve the English definition of "ranid," they think of the keyword (rain), think back to the interactive picture that contained the keyword and its definition (a frog sitting in the rain), and then retrieve the definition from the information in the picture (frog).

Empirical support for the effectiveness of mnemonics including the keyword method, however, is mixed not only in learning European languages (Cohen, 1987, for review), but also in learning non-European languages such as Chinese, especially on long-term retention of the learned information. Lu, Webb, Krus, and Fox (1999) and Wang and Thomas (1992), for example, investigated the effectiveness of imagery-based mnemonics (i.e., presenting an English explanation of a character construction [e.g., 明 'bright' = 日 'sun' + 月 'moon']) in teaching Chinese characters to native speakers of English. Whereas Lu et al. found their effectiveness in contrast to the rote memory method (presenting a character with English translation [e.g., 明 'bright']) on both immediate and delayed recalls of the English meanings of the characters, Wang and Thomas found the same only on immediate recall (Experiment 1). As Cohen has pointed out, because in most of the mnemonic studies including those by Lu et al. and Wang and Thomas, the participants were not actual learners of the target language, the motivation factor might have played a role in producing different results.

In Japanese, the use of mnemonics is a common method in teaching kana (hiragana and katakana) as a second language (L2) or a foreign language (FL). In fact, there are many books (e.g., Hijirida & Dung, 1992; Makino, Hatasa, & Hatasa, 1998; Ogawa, 1990; Quackenbush & Ohso, 1983; Rowley, 1995) as well as a computer program (Hatasa, Kaga, & Henstock, 1992) that provide picture-plus-sound mnemonics (e.g., a picture of a key that simulates the shapes of き and キ, which stand for /ki/) with sound cues (e.g., /ki/ as in /key/) to teach kana to L2/FL learners of Japanese. Despite the popularity of this mnemonic method in teaching the symbols, however, there is no published study that investigated its effects on learning katakana.

Among the very few studies that investigated its effects on learning hiragana are those done by Quackenbush, Nakajo, Nagatomo, and Tawada (1989) and Matsunaga (2003).

In Quackenbush et al.'s study, two groups of L2 learners of Japanese at the beginning level (16 nonnative but proficient speakers of English) were taught 46 hiragana in two different methods. One was the conventional mnemonic method described above, and the other was a flashcard method in which on each card a hiragana symbol was written with colored lines signaling its syllabic sound. For example, on a card on which the hiragana that stands for /ka/ was written, a brown horizontal line was drawn above the hiragana and a black vertical line on the right side of it; apparently the brown line was to be associated with the consonant /k/ and the black line with the vowel /a/. These lines seem to have allowed learners to locate the symbol in the mentally imagined hiragana chart (see Appendix) and attempt to recall the sound by using the order information.

In the Quackenbush et al. study, these two methods were employed with two groups of students, and three sessions were completed with each group within 50 minutes in class. There was an introductory session of 46 hiragana (explanation of the syllabic nature of hiragana), a teaching session of these hiragana (in two different methods with two different groups), and a practice session (reading practice with flashcards and the hiragana chart). Both groups were given a pretest (writing the sounds of hiragana in Romanization) before class, a recall test (the same as the pretest) immediately after class, and a recognition test (matching between the sounds and the hiragana) four days after class with practice allowed between the tests. The pretest showed that both groups had known at least half of the 46 hiragana, and the immediate recall test showed that both groups gained equally from the two methods. It is only on the delayed recall test that the mnemonic method group performed significantly better than the flashcard method group.

Matsunaga's (2003) study, on the other hand, utilized computer-generated tutorial sessions, and obtained different results from those found by Quackenbush et al.; Matsunaga found only short-term effects of mnemonics for the learners who had no or little previous experience with learning non-Roman scripts in their first lan-

guage (L1).[1] The difference in results between the two studies appears to come from the difference in the size and background of the participants (Matsunaga had a larger number of participants including native speakers of English [see Note 1]), in the amount of the participants' previous knowledge of the symbols (Matsunaga's participants had little or no knowledge), in the consistency of the short-term and long-term test tasks (they were consistent in Matsunaga's study), and in the experimental method (Matsunaga used a computer program and blocked the potential use of order information during the experimental sessions and the potential influence of practice between the sessions).

As Matsunaga (2003) pointed out, in order to test the sole effects of mnemonics for the short term and long term, it is necessary to exclude the influence of practice outside the experimental room (unless the amount and manner of practice can also be controlled), and to use consistent tasks on immediate and delayed tests. Thus, the present study followed the experimental method used by Matsunaga in order to see whether the same results could be obtained on katakana. This study had FL learners of Japanese as participants, used a computer program and consistent tasks on the short-term and long-term tests, and blocked the use of order information on the katakana chart (see Appendix) and the influence of practice between the tests.

Another motivation for conducting mnemonic research in teaching and learning katakana as FL is to know whether there would be any performance difference between those whose L1 employs Roman scripts (the Roman group) and non-Roman scripts (the non-Roman group).[2] In this respect, prior research on the role of transfer

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[1] In her analyses, Matsunaga (2003) had a group of 29 participants (the Roman group) without prior experience in learning non-Roman scripts in their first language (8 monolingual speakers and readers of English, and 21 bilingual speakers of English and Spanish, Italian, Chinese, Korean, Vietnamese, Cambodian, or Thai), in addition to another group of 21 participants (the non-Roman group) with that experience (native speakers of Chinese characters [15], Korean Hangul [5], or Arabic script [1] who were also fluent in English). The difference between the two groups was whether they knew a non-Roman alphabet or not.

[2] Grouping of Roman (monolingual speakers of English and bilingual speakers of English and Spanish or Italian) versus non-Roman (native speakers of Chinese or Korean who were also fluent in English) was used in this study in order

of strategies from participants' L1 learning experience has shown that it plays a positive role in word recognition at the beginning stage of learning Japanese as FL. For example, Chikamatsu (1996) asked elementary-level learners of Japanese, whose native languages were Chinese or English, to perform kana-word (words written in hiragana and katakana) identification tasks. Her hypothesis was that due to the difference in the type of L1 orthography between Chinese and English, these learners' recognition strategies of kana words would differ. The results indicated, in support of her hypothesis, that Chinese speakers, being "logographic readers," relied more on visual information than did English speakers who are "alphabetic readers" (p. 412). Similar results were obtained by Mori (1998), whose data indicated different strategies employed by learners of Japanese with and without kanji (Chinese characters) background for storing artificial characters in short-term memory; and also by Koda (1989), whose data showed the advantage of beginning learners of Japanese with kanji background, over those learners without kanji background, in recognition of kana words and kanji words.

Given this evidence of L1 strategy transfer in written word recognition, it would certainly be interesting to further investigate a possibility of L1 strategy transfer in individual kana recognition by hypothesizing that those who have experience with learning non-Roman scripts in their L1, being "logographic readers" or "[non-]alphabetic readers" (Chikamatsu, 1996), would not need to rely on the provided mnemonics as much as those who lack that experience would, in order to remember the symbols well at least for the short term.[3] In fact, Matsunaga (2003) found that in contrast to the Roman group's immediate recall performance, that of the non-Roman group (non-alphabetic readers) was excellent even without mnemonics (the

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to be consistent with Matsunaga's (2003) study, based on which the hypotheses were formed.

[3] Since individual kana recognition requires assigning their sounds (through mediation of pictures or not), the nature of L1 strategy (which could be transferred) may not be the same as the strategies found to be transferred in the previous studies, whose tasks (e.g., lexical decision) did not require assigning sounds like naming. These studies are cited simply as evidence of the occurrence of L1 strategy transfer.

flashcard method), and cautiously suggested a potentially advantageous role of L1 transfer as a possible explanation.[4]

Matsunaga's (2003) speculation about a possibility of L1 strategy transfer or existence of the non-Roman group's own strategies appears to be indirectly supported by Matsunaga's (2005) finding that only the non-Roman group's short-term recall of hiragana occurred irrespective of spatial ability; this group did not have to rely on spatial ability to do well even when no mnemonics are provided. Spatial ability is said to influence coding strategies for preserving information about configuration of a picture (Cooper, 1982), and the degree of reliance on iconic imagery when interpreting graphs (Kozhevnikov, Hegarty, & Mayer, 2002); it is also found to help to create or utilize visual images upon learning and recalling materials (e.g., Liu, Zhang, & Shu, 1996; Hannafin & Truxaw, 2008; Huk, 2006; Sanchez, 2007).[5] Matsunaga (2005) hypothesized that if non-Roman scripts like kana are treated as pictures when they are learned, spatial ability can possibly be related to learning strategies such as the use of mnemonics and recall performances on hiragana by learners of Japanese as a FL, and found that only for the Roman group, spatial ability played an important role, particularly in immediate recall performance; when it was combined with effective mnemonics such as the picture-plus-sound method, immediate recall performance was found to be especially effective.[6]

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[4] One might argue that the non-Roman group would be more tolerable than the Roman-group with foreign scripts, being bilingual. However, the Roman group in Matsunaga's (2003) study included many bilingual speakers as well, particularly in Spanish and English.

[5] Spatial ability was found to be related to the extent to which people benefit from pictures in reading comprehension (Liu, Zhang, & Shu, 1996; Sanchez, 2007), from Sketchpad (computer software that allows users to "click and drag" geometric shapes) in geometry achievement (Hannafin & Truxaw, 2008), and from three-dimensional visualization in understanding cell biology (Huk, 2006).

[6] Matsunaga's (2005) finding that spatial ability had no effects on the non-Roman group's recall performance seems compatible with the result of the Matsunaga and Crosby (1997) study that discovered no effect of spatial ability on reading kanji (Chinese characters) by native speakers of Japanese. If spatial ability is needed to create or utilize iconic images in script processing, this could mean that in general non-alphabetic readers do not process non-Roman scripts as pictures, whereas many alphabetic readers initially do. If true, it would not be

Matsunaga (2003) also found the mnemonics' lack of effects on both groups' long-term recalls of hiragana, and explained that it was because practice outside the experimental room was prohibited in her study in order to examine the sole effects of mnemonics used in the introduction of the symbols. Matsunaga (2005) additionally offered her finding that spatial ability mattered for the Roman group's long-term recall of hiragana only on flashcards (while it mattered for their short-term recall of the symbols in all conditions), but their recall performance in this method was poor for the short term and long term. This could mean that without provided mnemonics, using their spatial ability, an attempt was made to picturerize the foreign symbols when possible, but its effect on retention did not seem strong enough. In fact, in the flashcard condition, Matsunaga's (2003) Roman group reported to have created their own mnemonics (e.g., ろ /ro/ looks like 3) 12 percent of the time, perhaps using spatial ability; however, these were not as effective as the provided mnemonics for the short term, and after a while effects of all mnemonics (provided or not) disappeared without practice.

The above studies produced interesting results, but because there are two types of syllabic symbols (i.e., hiragana and katakana) used in writing Japanese, it is necessary to see if Matsunaga's (2003, 2005) results on hiragana can be obtained on katakana.[7] The present study will thus take on this task, and attempt to answer three specific questions by having two groups of participants with equal spatial abilities: the Roman group without prior experience in learning non-Roman scripts in their first language, and the non-Roman group with that experience. One question is whether the Roman group would still benefit from the mnemonics at least for the short term when

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surprising to find in Matsunaga's (2005) study that only the Roman group (or alphabetic readers) exhibited effects of spatial ability.

[7] Hiragana and katakana are together called kana, and were developed based on Chinese characters (e.g., か and カ based on 加). Katakana are used for writing Western loanwords and emphasized words (cf. italics in English); hiragana are used for writing grammatical inflections, particles, many high-frequency words, and many native proper nouns (e.g., names of vegetables). There are 46 basic symbols in both types of kana (plus one special symbol to indicate a repeated vowel in katakana) and two diacritics.

learning katakana after hiragana.[8] A replication of Matsunaga's (2003) results in this respect means that only on the immediate recalls, the Roman group benefits from the mnemonics. The second question, in relation to the finding from L1 strategy transfer studies (e.g., Chikamatsu, 1996), is whether the non-Roman group and the Roman group would perform differently at least on the short-term recalls. That is, the conventional mnemonic method would have immediate effects not for the non-Roman group but for the Roman group. The third question is whether spatial ability affects only the Roman group's use of mnemonics and recall performances, as observed in Matsunaga's (2005) study. The affirmative answer to this question would strengthen the argument that the non-Roman group is using strategies (that do not require mnemonics or spatial ability to a significant extent), which may not be possessed by the Roman group, and that could potentially include transfer of L1 script recognition strategy (that is used to process non-Roman scripts as non-pictures).

Hypotheses were as follows. First, the Roman group would perform better with the conventional picture-plus-sound mnemonic method than with the flashcard method on the immediate recall test, while the non-Roman group would perform equally well with both methods on the same test. Second, neither group would benefit from the conventional mnemonics on the delayed recall test without practice. Third, a relationship exists between the spatial ability of only the Roman group, and (a) their use of mnemonics and (b) their short-term and long-term retentions of katakana.

The present experiment, whose results are reported below, incorporated two additional control conditions to the flashcard method by separating the two types of cues from the picture-plus-sound mnemonics: sound only and picture only conditions (as seen in Table 1 in the Method section below).[9] Creation of these conditions was made possible by modifying the computer freeware program devel-

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[8] In many American universities, hiragana are introduced before katakana, as evidenced in widely used textbooks such as *Nakama* (Makino, Hatasa, & Hatasa, 1998) and *Genki* (Banno, Ohno, Sakane, & Shinagawa, 1999).

[9] The purpose was to see how these two conditions play out in relation to the conventional mnemonics and the flashcards. However, for the purpose of this study, a focus of discussion will be placed on the effects of the picture-plus-sound method in contrast to the flashcard method.

oped by Hatasa et al. (1992).[10] The modified program was used in all sessions of the experiment.

Method

Participants

Participants were 59 beginning learners of Japanese at a university in Southern California: 28 were male and 31 were female, with the average age of 22.6 years. These participants were highly proficient in English and enrolled in the second quarter of an elementary Japanese course at the university, and at the time of the experiment, they had mastered hiragana but not yet been introduced to katakana in class.[11] Among the 59 volunteer participants: 35 had little or no previous knowledge of non-Roman scripts except hiragana, among those were monolingual speakers and readers of English (13) and bilingual speakers of English and Spanish (21) or Italian (1) (the Roman group); 24 had prior experience with learning non-Roman scripts as their L1, among them were native speakers of Chinese (17) or Korean (7) who were also fluent in English (the non-Roman group).[12]

Procedure

Each participant was scheduled to come individually to the investigator's office two times per week (either Monday and Wednesday sessions or Tuesday and Thursday sessions) to attend

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[10] The modification was done by Dr. Jan Stelovski of the University of Hawaii, to whom the author is thankful.

[11] Since the author was their instructor, she was able to control the timing of the introduction of katakana.

[12] Chinese is written entirely in Chinese characters (simplified or traditional depending on the region and the purpose). Korean in South Korea is written entirely in Hangul for daily use, but Chinese characters are still used in formal writing, such as academic papers, high-level corporate reports, government documents, and some newspapers, though their proportion has decreased to 10-20 percent of Sino-Korean words (Osvath, n.d.). This group could directly transfer their L1 script knowledge, as the non-Roman group in Matsunaga's (2003) study did 12 percent of the time (e.g., 世 for 廿 /se/). Whether transfer of L1 script recognition strategy occurs is yet to be determined.

five 15 minute (on the average) meetings. At the first meeting, a questionnaire and a pretest were given to the participant. On the questionnaire, the participant was asked to provide his or her background information including his or her previous experience of learning non-Roman scripts. On the pretest, the participant was asked to provide, on a sheet of paper, Romanization for the katakana that he or she knew at that time. If the result of the pretest indicated that the participant knew ten or more katakana, his or her data were excluded from data analyses.

In the first four meetings, four computer-generated tutorial sessions of 40 symbols were given to each participant. As mentioned above, the computer program used in this experiment was a modified version of the freeware originally created by Hatasa et al. (1992). The modification of the program was done so that there would be four versions in which each symbol could be introduced with: (a) a picture cue and a sound cue (P+S), (b) a picture cue only (P), (c) a sound cue only (S), or (d) no cue (i.e., a flashcard) (F). The steps in which each symbol was introduced in these four methods can be seen in Table 1. It should be mentioned that in all four of the teaching conditions, each step was viewed only once and the learner pressed the return key to move to the next step when he or she is ready.

Table 1
Steps in Which Each Katakana Was Introduced in Four Teaching Methods

	Teaching methods			
	P+S	P	S	F
Step 1				
Participants saw:	a picture of a key	a picture of a key	キ	キ
heard:	/a key/	/ki/	/a key/	/ki/

Step 2				
Participants				
saw:	the same picture with the shape of キ highlighted	the same picture the shape of キ highlighted	キ	キ
heard:	/ki/ as in /key/	/ki/	/ki/ as in /key/	/ki/
Step 3				
Participants				
saw:	キ	キ	キ	キ
heard:	/ki/	/ki/	/ki/	/ki/
Step 4				
Participants				
saw:	キ	キ	キ	キ
typed:	ki	ki	ki	ki

Note. P+S = a picture and a sound cue; P = a picture cue only; S = a sound cue only; F = no cue (a flashcard).

In each tutorial session, one of the four sets of ten symbols was introduced in one of the four teaching methods. The four sets of ten symbols represented: (a) </a/, /i/, /u/, /e/, /o/> and </ka/, ki/, /ku/, /ke/, ko/>, (b) </sa/, /si/, /su/, /se/, /so/> and </ta/, /ti/, /tu/, /te/, /to/>, (c) </na/, /ni/, /nu/, /ne/, /no/> and </ha/, /hi/, /hu/, /he/, ho/>, and (d) </ma/, /mi/, /mu/, /me/, /mo/> and </ra/, /ri/, /ru/, /re/, /ro/>. The five symbols (grouped between brackets above) in each set were introduced in a random order. The four sets of symbols as well as the four methods of introduction were counterbalanced across participants.

Before each experimental session, a practice session was given to the participant with three symbols that stand for /ya/, /yu/, and /yo/, using the teaching method of the day. This was done in addition to an oral explanation of the procedure illustrated on a sheet of paper, in order to make sure that the participant understood the

experimental procedure (how each symbol would be presented, reviewed, and tested) when using the computer program.

After the practice session, the experimental session began. The experimental session, which took no more than 10 minutes, consisted of (a) a learning phase (without time limit), (b) a review phase (without time limit), and (c) a self-test phase (with time limit). In the learning phase, five of the ten symbols in one set were randomly introduced (one at a time) in the same teaching method as the one used in the practice session (see Table 1). In the review phase, the participant reviewed the five symbols by typing the sound of the randomly presented symbol (one at a time) until he or she typed the sounds of all five of the symbols correctly. After five more symbols in the same set were introduced and reviewed in the same manner, the self-test phase started. In this phase, the participant had five seconds to type the sound of each of the ten symbols, which were also randomly presented (one at a time). The experimental session ended when the participant typed the sounds of all of the ten symbols correctly.[13] The computer program for data analyses recorded every mouse click and keystroke made by the participant during the practice and experimental sessions.

The experimental session was followed by an oral interview, in which the participant was asked about the extent to which he or she utilized the provided mnemonics, and any other learning strategies he or she employed during the experimental session. When done, the participant was asked not to study the symbols elsewhere. The participant was told that there would be a recall test at the next meeting, but the result of the recall test would solely reflect the effectiveness of the tutoring session, and would not affect his or her course grade. If the participant admitted at the following meetings that he or she had reviewed or previewed the symbols, his or her data were excluded from data analyses.

At the next meeting (two to five days after the previous meeting), a recall test was given, on which the participant had to write, on

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[13] The time limit of 5 seconds applied to responding (typing of the sound) to each stimulus (a kana symbol) in the self-test phase. When a mistake was made, it was tested until it was responded to correctly. Therefore, those who did not make any mistakes ended the experimental session earlier than those who made many mistakes.

a sheet of paper, the Romanization for the ten symbols he or she had learned in the previous meeting. When done, a different set of ten symbols was introduced in a different teaching method. The same procedure was repeated until the fourth meeting was completed. At the fifth meeting, the participant was asked to take a recall test of the ten symbols from the previous session, and another recall test (the posttest) of 46 symbols including the three symbols that stand for /wa/, /o/, and /N/, which were not taught during the four experimental sessions. The posttest was given (on a sheet of paper) to ensure that the participant did not study katakana elsewhere during the two weeks of the experiment. In other words, the participant's knowledge or lack of knowledge of the symbols for /wa/, /o/, and /N/ shown on the posttest had to be the same as the pretest in order for his or her data on the four recall tests to be valid. If not, his or her data were excluded from data analyses.

The participant was also given the VZ-2 paper-folding test (Ekstrom, French & Harman, 1976) that measures spatial ability. This metric consists of two pages with 10 multiple choice questions on each page. Each question has five possible answers. The participant was given up to 3 minutes per page to find the correct patterns. Scoring of the test penalizes incorrect answers by using correct – (incorrect/4) to compute the score. The average scores for the two groups (Roman 11.08; non-Roman 10.15) were confirmed to be statistically the same: $F(1, 57) = .556$ ($p = .4588$), so as to avoid a possibility of this variable being accountable for any main effect of group type that might be found in the use of mnemonics or recall performances.

Results

Use of Mnemonics and Other Strategies Reported in The Oral Interview

First, the extent to which the participants orally reported to have utilized each of the three mnemonic devices (i.e., the average percentage of mnemonic usage for ten symbols) shown in Figure 1 was analyzed.

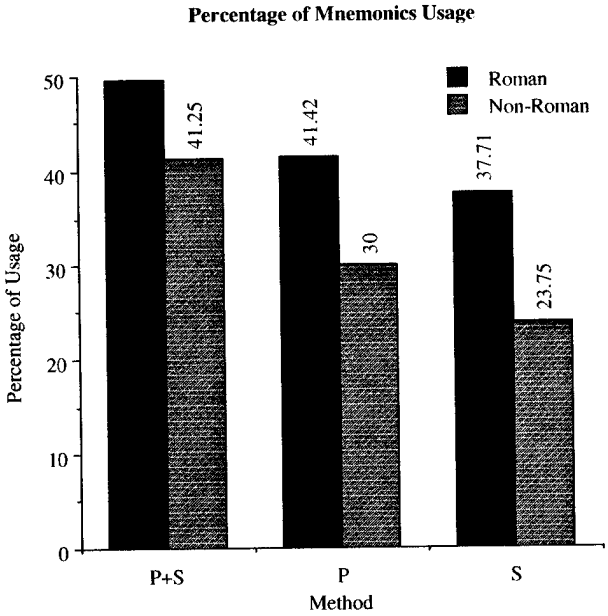

Figure 1. Comparison of Usage of Three Types of Mnemonics by Roman and Non-Roman Groups to Learn Katakana

With the average percentage of mnemonic usage as a dependent variable, a two-way Analysis of Variance (ANOVA) was run with the group type as a between-participant independent variable and the type of mnemonics as a within-participant independent variable. The results showed that the Roman group reported to have utilized the provided mnemonics to a greater extent than the non-Roman group, $F(1, 57) = 4.418$, $p < .05$; both groups reported to have utilized the P+S method significantly more than the P method, $F(1, 58) = 5.289$, $p < .05$, and the S method, $F(1, 58) = 14.030$, $p < .0001$.

As seen in Figure 2, the oral interview also revealed that on average when no mnemonics were provided (the F method): (a) the Roman group and the non-Roman group purely memorized the symbols 65.25% of the time and 69.97% of the time, respectively; (b) the Roman group and the non-Roman group reported to have used their hiragana knowledge 12.74% of the time and 12.5% of the time,

respectively; (c) the Roman group reported to have created their own mnemonics (e.g., フ/hu/ looks like a "hook") 22.01% of the time; (d) the non-Roman group reported to have used knowledge of their L1 scripts and other methods 10.87% of the time and 6.66% of the time, respectively.

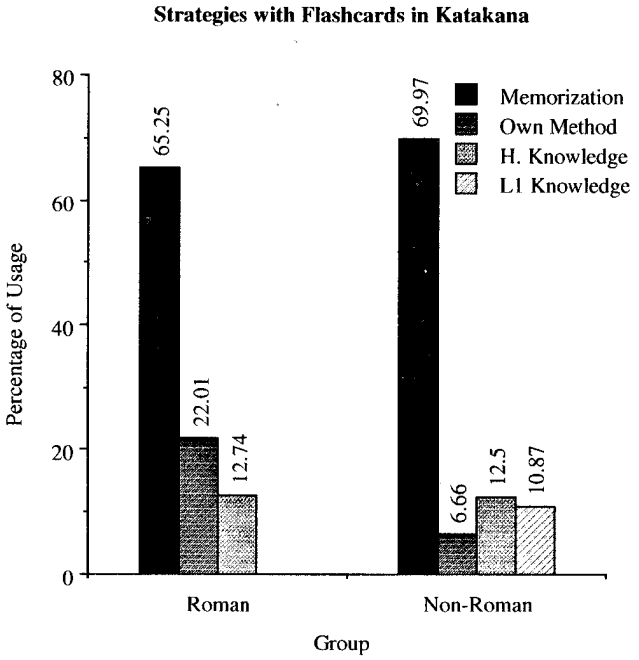

Figure 2. Average Percentage of Learners' Own Strategy Usage with Flashcards

Immediate Recall

After eliminating invalid data, the rest of data from the self-test taken by 57 participants (33 in the Roman group; 24 in the non-Roman group) that are shown in Table 2 (i.e., the average percentage of correct recall of ten symbols for each of the four teaching methods) were then analyzed. It should be mentioned that for those who had known some of the respective symbols (but not as many as ten of the 46 symbols, as indicated on the pretest), the percentage of

correctness was calculated out of the number of symbols they had not known.

With the average percentage of correct recall as a dependent variable, two-way ANOVA was run with the group type as a between-participant independent variable and the type of teaching methods as a within-participant independent variable. The results indicated that there was no significant main effect of teaching method or group type; nor was the interaction significant ($p > .05$ in all cases).[14]

Table 2

Average Percentage of Correct Recalls of Ten Katakana by Roman and Non-Roman Groups With Four Teaching Methods

	Teaching methods			
Group	P+S	P	S	F
	Immediate Recall			
Roman[a]				
M	63.25	60.65	68.18	62.31
SD	22.68	20.12	18.44	25.13
Non-Roman[b]				
M	60.90	60.22	68.57	67.60
SD	21.92	24.08	20.91	23.14
	Delayed Recall			
Roman[a]				
M	38.97	33.60	34.24	33.13
SD	26.50	24.45	21.65	25.79
Non-Roman[b]				
M	48.85	34.72	35.83	40.41
SD	26.92	24.65	26.19	32.23

[14] One might argue that the non-significance was found for the non-Roman group because of the inclusion of the two additional mnemonic conditions (P method and S method) in the analyses; however, the comparison between the P+S method and the F method alone was also non-significant.

Note. P+S = a picture and a sound cue; P = a picture cue only; S = a sound cue only; F = no cue (a flashcard). [a]$n = 33$. [b]$n = 24$.

Delayed Recall

After eliminating the data from participants who did not attend the fifth session, the rest of the data on the delayed recall test from 57 participants (33 in the Roman group; 24 in the non-Roman group) that are shown in Table 2 were analyzed.[15] With the average percentage of correct recall as a dependent variable, a two-way ANOVA was run with the group type as a between-participant independent variable and the type of teaching methods as a within-participant independent variable. The results indicated that neither the main effects nor the interaction was significant ($p > .1$ in all cases).[16]

Spatial ability in relation to mnemonic usage and recall data

Correlational analyses of the spatial ability with (a) the mnemonic usage and (b) the recall data on katakana are shown in Table 3. The results indicated that the spatial ability of the Roman group had significant relationships only with their immediate recall performances; the higher the spatial ability, the better the short-term recalls with all teaching methods ($r = 451, p < .01$ [P+S]; $r = .423, p < .05$ [P]; $r = .568, p < .01$ [S]; $r = .362, p < .05$ [F]). As for the non-Roman group, the spatial ability had no significant relationship with their use of mnemonics or their short-term and long-term recall retentions of katakana ($p > .05$).

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[15] The 33 participants in the Roman group whose delayed recall data were analyzed are different from the 33 participants in the Roman group whose immediate data were analyzed. The difference comes from the fact that two participants failed to finish the self-test (therefore no immediate recall data), but took the delayed recall tests. There were also two participants whose delayed recall data were invalid or unavailable: one who admitted to have studied the previously introduced kana outside the experimental room, and the other who did not attend the fifth session; however, their immediate recall data were analyzable. Due to this difference, a three-way ANOVA was not performed.

[16] The comparison between the P+S method and the F method alone was also non-significant for both groups.

Table 3

Correlation Matrix for the Roman and Non-Roman group (Katakana)

	1	2	3	4	5	6	7	8
Short Term								
Roman group[a]								
1. VZ-2 score	----	.266	-.133	-.158	.451**	.423*	.568**	.362*
2. P+S use		----	.319	.317	.629**	.076	.347*	.083
3. P use			----	.582**	.099	.152	.166	.059
4. S use				----	.151	.282	.409*	.239
5. P+S recall					----	.272	.296	.218
6. P recall						----	.542**	.553**
7. S recall							----	.383*
8. F recall								----
Non-Roman group[b]								
1. VZ-2 score	----	-.117	-.183	-.163	.133	.077	-.034	.266
2. P+S use		----	.243	.378	.361	-.198	-.239	.035
3. P use			----	.198	.126	.096	-.094	.310
4. S use				----	.089	-.121	.110	-.051
5. P+S recall					----	.269	.159	.438*
6. P recall						----	.571**	.185
7. S recall							----	.263
8. F recall								----
Long Term								
Roman group[a]								
1. VZ-2 score	----	.297	-.102	.144	.166	.096	.074	.296
2. P+S use		----	.303	.246	.421	.114	.253	.367*
3. P use			----	.527**	.078	.088	.173	-.039
4. S use				----	.246	.151	-.085	.101
5. P+S recall					----	.581**	-.038	.346*
6. P recall						----	.040	.497**
7. S recall							----	.141
8. F recall								----

Non-Roman group[b]							
1. VZ-2 score	----	-.117	-.183	-.163	-.043	-.129	-.047	-.073
2. P+S use		----	.243	.378	.096	-.248	-.031	-.066
3. P use			----	.198	.020	.303	-.141	.084
4. S use				----	-.489*	-.143	-.269	-.345
5. P+S recall					----	.266	.592**	.482*
6. P recall						----	.136	.516**
7. S recall							----	.555**
8. F recall								----

*$p < .05$; **$p < .01$. [a]$n = 33$. [b]$n = 24$.

Discussion

Hypothesis 1 (Immediate Recall)

The results of the immediate recall test (Table 2) indicated that the first hypothesis was only half supported. Overall, the Roman and non-Roman groups performed equally well; they also did equally well with all four methods (the performance pattern for the non-Roman group was predicted, but not that for the Roman group). Interestingly, these results were obtained despite the fact that the two groups reported to have utilized the P+S method significantly more than the P method and the S method, and that the Roman group reported to have utilized the provided mnemonics more than the non-Roman group (Figure 1).

If their oral reports are valid, these results seem to suggest two things. One is that as in the case of hiragana (Matsunaga, 2003), the non-Roman group employed other strategies besides using the provided mnemonics to remember katakana as well as the Roman group. In other words, it seems possible to assume, as in the case of hiragana, that the non-Roman group did not, or perhaps did not have to use the provided mnemonics so much to perform equally well as the Roman group.[17] While whether this is due to L1 script recogni-

[17] Assuming that the non-Roman group's use of its own mnemonics (6.66%), hiragana knowledge (12.5%), and L1 script knowledge (10. 87%) seen in Figure 2 (30.03% in total) are accountable for the successful short-term retention (67.6%) with the F method (Table 2), 37.57% (= 67.6 – 30.03) of such retention

tion strategy transfer could not be said based on the present data, it could at least be said that in terms of overall recall performances, even if L1 transfer had been employed, it would not have given the non-Roman group an advantage over the Roman group even for the short term once hiragana had been acquired; overall the two groups performed equally well with or without the provided mnemonics.

The other thing that the incompatibility between the pattern of the recall performance results and that of the mnemonic usages suggests is that the Roman group also employed other strategies besides using the provided mnemonics to perform as well with the P, S, and F methods as the P+S method (which they reported to have utilized the most). Perhaps this is because they were able to utilize hiragana knowledge and create their own mnemonics that were effective. In fact, their oral reports (Figure 2) revealed that with the F method, on average, they used hiragana knowledge for more than one per ten symbols, and compared to the results on hiragana (Matsunaga, 2003), the Roman group in the katakana sessions used 22% less pure memorization (lower than the non-Roman group this time while the reverse was found on hiragana), and created their own mnemonics to a greater extent (increased from 12% to 22%). Thus, the experience of learning hiragana can be said to have made a difference in the choice of strategies, particularly for the Roman group.

Comparison between the hiragana sessions (Matsunaga, 2003) and the present katakana sessions in the use of strategies other than the provided mnemonics further indicated that the non-Roman group changed their learning strategies as well. The non-Roman group in the katakana sessions used hiragana knowledge for more

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still needs to be explained by successful pure memorization. Similarly, assuming that the Roman group's use of its own mnemonics (22.01%) and hiragana knowledge (12.74%) seen in Figure 2 (34.75% in total) are accountable for the successful short-term retention (62.31%) with the F method (Table 2), 27.56% (= 62.31 – 34.75) of such retention still needs to be explained by successful pure memorization. Explanations for the 10% advantage that the non-Roman group has over the Roman group (37.57% vs. 27.56%) for successful pure memorization could possibly include transfer of L1 script recognition strategy (that they have acquired largely through memorization since childhood to learn to read more than one thousand L1 written symbols) used in memorizing kana (e.g., キ as /ki/ without any mediation). Of course this speculative possibility needs to be empirically tested.

than one per ten symbols, and compared to the hiragana sessions (Matsunaga, 2003), utilized about 14% less of pure memorization, about 1.2% less of their L1 script knowledge, and about 2.6% more of other methods. Hence, the experience of learning hiragana can be said to have made a difference in the choice of strategies for both groups; having learned hiragana, both groups replaced pure memorization with more effective strategies.

The difference in results between the two types of kana can also be seen in the percentage of short-term retention. The participants' correct recalls of hiragana (Matsunaga, 2003) were on the average less than 50%, whereas those of katakana exceeded 60%, despite the fact that each group reported to have utilized the provided mnemonics to a similar extent, particularly the P+S method, when learning the two types of kana.[18] Again, the better performances on katakana could be attributable to the participants' utilization of their hiragana knowledge. Having studied hiragana, moreover, the participants in the katakana sessions seem to have gained the ability to develop their own strategies that work well.

Hypothesis 2 (Delayed Recall)

The second hypothesis appears to be fully supported by the results on the delayed recall of katakana (Table 2), as in the case of hiragana (Matsunaga, 2003). Overall, the teaching methods did not make a difference for the Roman or non-Roman group. Nevertheless, an interesting contrast exists between the two types of kana; in the case of hiragana (Matsunaga, 2003), on the average, about 27% was recalled correctly, while on katakana, the average rate of correct recall was about 37%. This higher recall rate in the latter could be explained by various factors, including the participants' previous knowledge of hiragana and their greater use of other learning strategies (e.g., their own mnemonics) than the participants in the hiragana sessions (Matsunaga, 2003). Despite this improvement in delayed recall performances on katakana, however, it seems obvious that nei-

[18] In Matsunaga's (2003) study on hiragana, the participants reported to have used the P+S, P, and S methods about 50%, 40%, and 37% at a time, respectively (the Roman group), and 41%, 19%, and 34%, respectively (the non-Roman group).

ther group was able to sustain the memory of the learned symbols well for the long term without practice. As indicated in the Quackenbush et al. (1989) study on hiragana learning, practice would perhaps play a significant role for making the mnemonics lastingly powerful in katakana learning as well, particularly for the Roman group.

Hypothesis 3 (Spatial Ability)

The results of the correlational analyses (Table 3) showed that the third hypothesis was supported with regard to the non-Roman group, for whom spatial ability did not make any difference in their use of mnemonics or their recall performances for the short term or long term. As for the Roman group, it was supported only for the relationship between their spatial ability and their short-term retention of katakana; the higher the spatial ability, the better the immediate recall performances with all teaching methods. As in the case of hiragana (Matsunaga, 2005), the total lack of effects of spatial ability only for the non-Roman group seems to support the interpretation that this group employed strategies that could potentially include transfer of L1 script recognition strategy (that does not require mnemonics or spatial ability to a significant extent, and that is used to process non-Roman scripts as non-pictures). But again, unlike hiragana (Matsunaga, 2003), these strategies do no seem to have given the non-Roman group an advantage over the Roman group in their recall performance even for the short term this time.

As for the Roman group, the results that the spatial ability mattered only for the short-term retention of katakana regardless of the teaching methods (including the flashcards), with all of which they performed equally well, and that it had no relationship with the use of provided mnemonics, seem to indicate that they may not have needed the katakana mnemonics. In other words, it could be the case that although they used some of the mnemonics when provided, their spatial ability might have been powerful enough to do well in combination with the ability that they gained to develop their own effective strategies (e.g., use of hiragana knowledge and own mnemonics mentioned above). By contrast is the case of hiragana (Matsunaga, 2003, 2005), in which the participants seem to have needed the provided mnemonics that were effective, and in combination with their spatial ability, they were able to produce better short-term

recall performance with the P+S method than with the flashcards. Although a further investigation is necessary to confirm this interpretation, it can at least be said that spatial ability plays an important role for the Roman group's short-term retention of katakana as well as hiragana.

Summary and Conclusion

As the first and sole empirical study on the effects of mnemonics in learning katakana, the present results seem to suggest three things. One is a speculative possibility that L1 script recognition strategy transfer might still have played a positive role in the non-Roman group's short-term retention of katakana even after learning hiragana. Their immediate recall performance, like that of the Roman group, was high with or without the provided mnemonics, but also irrespective of their spatial ability. In other words, even though their short-term retention pattern was the same as the Roman group, the fact that they performed as well as the Roman group without relying on the provided mnemonics or their spatial ability means they must have employed other strategies. In order to examine whether they include L1 strategy transfer, it is necessary, as Matsunaga (2003) suggested, for future studies to use a research methodology such as talk-aloud protocols (Trabasso & Suh, 1993, cited in Horiba, 1996). In addition, it is important to test the effects of mnemonics on learning katakana before hiragana; similar results will clarify whether learning experience with the first type of kana, instead of idiosyncratic features associated with a type of kana (hiragana or katakana), is what makes a difference in adapting effective strategies when learning the second type of kana.

Also suggested by the present results is the importance of the role that spatial ability plays in the Roman group's immediate recall of katakana; they appear to have combined this ability with other effective strategies that they developed to do well at least for the short term. Thus, pedagogically it would make sense to provide this group with specific training to enhance spatial ability by using material such as the VZ-2 paper-folding test (Ekstrom et al., 1976) while also encouraging them to develop their own effective strategies (e.g.,

フ/hu/ looks like a "hook").[19] Of course, the pedagogical effects of these will then be in need of further research.

The third implication is that the conventional mnemonics would not have long-term effects regardless of the L1 background. However, this does not mean that mnemonics are useless, but that practice using learners' own mnemonics or other materials that learners find effective, is important for long-term retention. As mentioned above, such practice would perhaps play a significant role for making the mnemonics lastingly powerful in learning both types of kana, particularly for the Roman group (Quackenbush et al., 1989). The role of practice should therefore be investigated as well.

Finally, the limitations of the present study should be mentioned for improvement. One is the sample size; more participants in each group are necessary in order to avoid having all participants receive all four treatments. With a greater number of participants, it may also be possible to compare the performances of monolingual English readers with those of native readers of Chinese who are fluent in English separately from learners with other backgrounds; such comparison might produce more contrastive results. In addition, there are factors other than spatial ability that can play a role in learning kana, such as learning styles (visual, auditive, and kinesthetic); thus, effects of these should also be investigated. It is hoped that future studies will incorporate the above-mentioned suggestions in order to better understand the acquisition and retention processes of kana and contribute to the enhancement of their instruction.

[19] Alternatively, a study by Chan (2007) suggested a way to compensate for low spatial ability by encouraging students to gain spatial experience in such fields as visual arts.

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Appendix A

Kana Chart

ん	わ	ら	や	ま	は	な	た	さ	か	あ
ン	ワ	ラ	ヤ	マ	ハ	ナ	タ	サ	カ	ア
N/n	wa	ra	ya	ma	ha	na	ta	sa	ka	a
		り		み	ひ	に	ち	し	き	い
		リ		ミ	ヒ	ニ	チ	シ	キ	イ
		ri		mi	hi	ni	ti/chi	si/shi	ki	i
		る	ゆ	む	ふ	ぬ	つ	す	く	う
		ル	ユ	ム	フ	ヌ	ツ	ス	ク	ウ
		ru	yu	mu	hu/fu	nu	tu/tsu	su	ku	u
		れ		め	へ	ね	て	せ	け	え
		レ		メ	ヘ	ネ	テ	セ	ケ	エ
		re		me	he	ne	te	se	ke	e
	を	ろ	よ	も	ほ	の	と	そ	こ	お
	ヲ	ロ	ヨ	モ	ホ	ノ	ト	ソ	コ	オ
	o	ro	yo	mo	ho	no	to	so	ko	o

Note. Two rows above Romanization are hiragana (the first) and katakana (the second). Both types of basic kana are traditionally read vertically from the upper right corner in the order of /a/, /i/, /u/, /e/, /o/, /ka/, /ki/, /ku/, /ke/, /ko/, and so on. The computer program used in this experiment accepted both types of Romanization (si/shi, ti/chi, tu/tsu, and hu/fu) when the participants typed the sounds of kana.