

Enhancing Japanese Kanji Acquisition

In Non-Native Readers

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Abstract

This research shows the effects of a 4-session literacy-acquisition program for non-native readers of Japanese through development of cognitive processes and morphological awareness. This includes an assessment of logographic vs. non-logographic morphemes, description of the training and testing processes, statistical results, and an overview of necessary metalinguistic skills to encourage a functional level of literacy for cognitively mature learners of Japanese.

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Chapter 1: Introduction

Study Goals

This study was a collaborative project in which we explored methods of aiding students of Japanese courses at Carnegie Mellon in learning to read the Japanese written characters, or *kanji*. Specifically, our research group's goals were to measure the efficacy of metalinguistic training for students learning Japanese as a second language. By metalinguistic training, we mean that we hoped to bridge the learning gaps that exist between native and non-native readers of Japanese by expanding the linguistic awareness of second-language learners. Our hypothesis was that certain cognitive processes take place at an unconscious level for literate Japanese readers, and that these processes can be explicitly taught to non-native readers in order to aid them in their endeavors of reading comprehension and meaning extraction. We planned to measure the efficacy of this training and see if it is in fact possible to truly help students of Japanese learn how to learn to read.

Statement of Problem

Struggling through the written aspects of the Japanese language seems to be a reoccurring issue with students without a history in a logographic language. A logographic

language has, rather than letters which form words as an alphabetic language does, characters that represent a meaning rather than just a sound. As many students come from an alphabetic background, we assumed that the major problem encountered by these students is a lack of understanding of the structural regularities of kanji; that is, learners don't realize that there are 'pieces' of the whole that hint at a categorical meaning of a kanji character. Kanji proves to be more challenging as literacy becomes a more important factor of being an educated learner of Japanese, and reading kanji is frustrating enough that it can cause second-language learners of Japanese to cease their study of the language because they think the only possible way to conquer literacy is through rote memorization. Thus it is important to promote the fact that there are alternate methods of learning Japanese. Just as not every word in English must be memorized and suffixes such as "-like" and "-ing" give meaning to words, Japanese can also be broken down into meaningful parts that can be indicative of a character's meaning.

Study Motivation

Having learned the difficulties of Japanese both first-hand and having heard the struggles of my friends, I requested aid from graduate students studying second-language acquisition for assistance in researching how understanding kanji can be made easier and more

intuitive for non-native readers. Making Japanese more accessible to students outside of a logographic background is important because without assistance, it's easy to reach a 'ceiling,' beyond which it is difficult for a learner to progress. But in order to reach a functional level of literacy, one must approach kanji as in any other language, and seek patterns of meaning in order to map the writing to the spoken words. For example, rules such as "i before e, except after c" exist to help English readers remember the traits of a particularly difficult aspect of the language—vowel interaction. Similarly, helping Japanese learners understand the system of radicals that native Japanese students utilize in learning and recognition of kanji will serve the purpose of providing a minimal framework, even if it does have a significant set of exceptions.

Study Contribution

By isolating the radical compounds that make up Japanese characters, we developed a program to enhance the student's inference capabilities through repeated exposure to multiple compound characters containing a shared radical. These radicals are meaning-bearing segments that give indication of the kanji compound's overall denotation and have been shown to be an important part of literacy and character recognition for native readers. But as learning the morphology of the language is an unconscious element learned subconsciously by Japanese

youth, kanji is often taught to foreign language learners in a similar manner and they are expected to simply pick up the radical meanings over time. But given the different learning environments and backgrounds and the limited exposure that foreign language learners experience, this is not always the best approach to developing a more sophisticated metalinguistic awareness. This program is designed specifically with students from an alphabetic-language background in mind, ideally helping develop skills for cognitively mature learners in order for them to make their own linguistic connections—essentially to teach themselves how to learn.

Chapter 2: Literature Review

A characteristic of written languages is that they are made of components that join to create a larger whole. In English, sentences can be broken down into words, which can be broken down into smaller, meaning-bearing segments: prefixes, roots, and suffixes. The smallest meaning-bearing segment in a language is called a morpheme. The cognitive process of seeking meaning in parts is natural for native readers, and recognizing morphemes makes reading unfamiliar or uncommon words a more analytical process. Reading traditional Chinese characters, called kanji when used in the Japanese language, can be similarly broken down into morphemes, but as with English, one must be familiarized with the morphemes before their meanings can be used to interpret the meanings of the words in which they are found.

If a learner treats every new printed word that they encounter as “a new visual configuration without discovering the underlying regularities of the script,” it will become increasingly difficult for them to learn to read (Ho, Ng, & Ng, 2003). Yet second-language learners of Japanese are rarely given alternative methods of learning kanji aside from rote memorization, which prevents the creation of a cognitive meaning-to-radical mapping schema. Each character is instead treated as an isolated whole, which is inconvenient for the learner. According to Koda, Lü, and Zhang (2008), “morphemes provide grammatical, syntactic, and

semantic information,” and being able to “analyze a word’s internal structure to identify its morphological components...is essential in identifying a word’s grammatical category, inferring the meaning of an unfamiliar word, and accessing stored lexical information.” A considerable amount of research on Chinese logographic characters has been performed, and seeing as Japanese characters are primarily derived from the traditional Chinese written characters, it’s practical to apply the same assumptions to Japanese as well. Therefore the following information comes from studies about the Chinese written language, but also holds for Japanese unless otherwise indicated.

Our hypothesis is that kanji characters can be broken down into meaning-bearing radicals, and that instructing subjects in these radicals will help them semantically categorize kanji; over 80% of modern Chinese characters consist of a semantic and phonetic radical (Koda, Lü, & Zhang, 2008; Ho, Ng, & Ng, 2003). Phonetic radicals traditionally hint at the pronunciation of a Chinese character, where semantic radicals hint at the meaning. Japanese learners can’t truly take advantage of the phonetic component of the characters, although even in Chinese, “the predictive accuracy of the pronunciation of an ideophonic compound character from its phonetic radical is about 40%” (Ho, Ng, & Ng, 2003). And while it’s true that radicals can’t give you the exact meaning of a character, they can hint at a semantic

category that's useful for readers to use when given in context (Shen & Ke, 2007). But over time, Chinese characters have changed, and “the inevitable result is that there are irregular characters whose meanings are unrelated to the meanings of their radicals, or only indirectly related. In regular cases, the meaning relation between the radical and the character can be called *transparent* while in irregular cases it can be called *opaque*” (Shu & Anderson, 1997).

Our goal was to take the knowledge of the transparent relationships and train the non-native minds to make these semantic associations. Like Shu and Anderson (1997) assumed, “analyzing an unfamiliar character into its parts, accessing the semantic information in the radical, and using the information in the radical to figure out the meaning of the word are required for productive morphological analysis of Chinese words.” Not having the advantage of growing up in an environment that would teach students this intuitively and through repeated exposure to transparent radicals in school and at home, we feel it's necessary to emphasize this information to students enrolled in Carnegie Mellon's Japanese program, but we first had to perform tests to see how effective it would be to teach this information to subjects from a non-logographic background. The next chapter explains these painstakingly produced testing methods in great detail.

Chapter 3: Testing Methods

Research Questions

Our research questions revolved mainly around the concepts of awareness and sensitivity to Japanese characters' physical appearances and the interactions of meanings.

When the meaning of a semantic radical is emphasized throughout the training, does it enhance the subject's ability to infer the meaning of the character containing that radical?

Is it possible to improve radical awareness through repetitive segmentation practice?

Do students from a non-logographic background show difficulty in understanding segmentation, and if so, is there significant improvement following the training?

Will the reading strategies of the subjects change if they become metalingustically more sophisticated through explicit training?

Training Description

The program consisted of four sessions that spanned roughly thirty minutes each. The timeline was as follows:

Session 1: Orientation; Pre-test

Session 2: Training (Lessons 1 & 2)

Session 3: Training (Lessons 3, 4, & 5)

Session 4: Post-test; Questionnaire

Orientation introduced the target semantic radicals, and then the student's current knowledge of segmentation and semantic radicals was tested by the pre-test. Each lesson built upon the information given before the training started, and the pre- and post-tests were the benchmarks used for measurement purposes. For feedback, an answer key was provided at the end of each lesson with the exception of Lesson 2, which was computer-based and had feedback scores at the end of the activities, but did not have individual feedback for each question.

The participating subjects were recruited from the Carnegie Mellon Japanese program from various levels of the courses, which accounts for the wide spread of initial experience and knowledge. From an initial pool of 88 candidates, we narrowed the eligible subjects down through an online survey of their language history. With that, we were left with 33 by excluding students who had too much experience with written logographic languages. This means that students who could speak a logographic language (such as Chinese or Japanese) were eligible to participate excepting those who could read it. In total, 21 students completed the training.

The sessions were spaced out over a span of two weeks, so subjects had differing spans of time between their sessions which may or may not have had an impact on their knowledge

retention and the efficacy of the training. After the lessons and post-test were completed, a questionnaire was distributed to collect paper feedback on the training from the perspective of the test subjects. It was originally to be a face-to-face interview, but due to a lack of researchers, we were unable to spare people to conduct the interviews and opted for a paper-based questionnaire instead.

Training Procedure: Lesson 1

Lesson 1 was a series of activities presented online. Participants first read through a short PowerPoint presentation that explained the basics of kanji segmentation. This included the fact that characters can be split into two main pieces, and indicated the common locations of the semantic radicals. It also explained the use of the semantic radical as a meaning-bearing piece of information.

For Activity 1, the subject was shown a radical for 1000 milliseconds, and then was shown a kanji. She was asked if the kanji contained the radical that she had just been shown, and was to click on “yes” if she thought the semantic radical of the kanji was the same as the radical she had been shown. She was instructed to click on “no” if the kanji did not contain the radical. For illustrative purposes, an explanatory image is displayed below.

Radical		Kanji	Answer
木	->	横	yes
金	->	松	no

There were 80 questions, and the characters and radicals were randomized in the event the subject wanted or needed to retake the activity. Approximately 30% of the characters did not contain the radical that was shown. The purpose of Activity 1 was to encourage the subject to pay close attention to the structure of characters and to recognize semantic radicals as an important segment of kanji. In retrospect, perhaps it would have been more appropriate to structure this exercise backwards, showing the kanji first then the radical. This would force the subject to dissect the kanji and find the appropriate radical within the 1000 milliseconds, which would be more challenging and relevant than the exercise as it is presently.

Activity 2 consisted of asking the participant whether or not a kanji could be segmented into two main parts. If the subject thought the kanji could be segmented, she selected “yes.” If she did not think it could be segmented, she chose “no”. The image below is an illustrative example of this activity.

Can this character be segmented?

飼

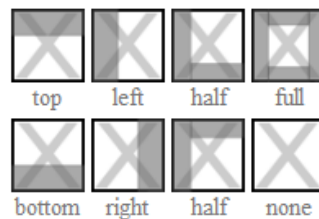
Yes No

This exercise attempted to strengthen a subject's concept of segmentation and when it is appropriate, as some of the 60 characters were standalone lexical radicals and could not be further broken down into meaningful semantic segments.

Activity 3 was very similar to Activity 2, consisting of 90 characters that needed the participant to make a decision about segmentation characteristics, specifically radical location. The subject was asked to choose one of the 8 graphics that best represented the location of the semantic radical in the given kanji. A screenshot of this activity is displayed below.

Choose the graphic that best represents the location of the radical in the displayed kanji.

建



This tested not only the subject's concept of when to segment a character, as some were non-segmental (making the appropriate answer "none"), but also tested the subject's

knowledge of radical location, as there were no characters presented that had semantic radicals on the right or on the bottom. This is due to the common kanji structures in Japanese consolidating semantic radicals on the left and on the top in those particular formations.

Training Procedure: Lesson 2

Lesson 2 consisted of two activities, 22 and 20 questions long respectively. Unlike Lesson 1, Lesson 2 was entirely paper-based. Activity 1 was a radical meaning inference task that mirrored Part 3 of the Pre-test, asking the subject to write in the meaning of a semantic radical based on the English meanings of five Japanese characters that shared that radical.

Activity 2 was a lexical inference task that asked the subjects to circle the Japanese character that meant the same thing as an English word that they were given.

Circle the kanji that corresponds to the meaning of the English word given in each question.

Example:

I; me

☒ 私 ☐ 仏 ☐ 払

This is actually a poor example, since it is a morphologically opaque compound. The character 私 has the radical 禾, meaning ‘rice’, and the one directly to its right has the radical

人, which means person. 人 is, however, a high-frequency character that most, if not all, of the participants should have recognized and known even if it is inappropriate due to its lack of semantic transparency.

Assuming the majority of the kanji in the exercises were unfamiliar to the subjects, it tested their knowledge of radical meaning categories since only one character would have a radical semantically related to the English meaning shown.

Training Procedure: Lesson 3

Lesson 3 was comprised of three activities. Activity 1 was a categorical meaning inference task that directly tested the subject's knowledge of semantic radicals. Subjects were given a character and asked to write out the categorical meaning of the semantic radical.

Write what you think the general categorical meaning of the kanji is in each question. There may be more than one possible answer. For example, the general categorical meaning of *dog* could be *animal* or *pet*.

<p>Example: What is the general categorical meaning of 明? Answer: <u>Sun; day</u></p> <p>(明 means bright.)</p>
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As the meaning of the character was not provided in the exercise as it was here in the example, the focus was less on the character meanings and instead focused on the subject's

ability to determine the semantic radical, and also tested her knowledge of the radical meanings.

There were 20 of these questions in this activity.

Activity 2 was comprised of 36 questions, each showing an English word with six corresponding Japanese kanji below. The subject was then asked to choose the kanji that meant the same thing as the English word.

Circle the kanji that corresponds to the meaning of the English word given in each question.

Example:

Which kanji means the same thing as the English word below?

younger sister

海 語 妹 曜 場 経

This was a lexical inference task designed to train the subject to focus on the semantic radical's meaning category. The subject had to look for the radical best associated with the English—in this case, the character 妹 has the radical 女, meaning “female.” The other categories are 氵 “water”, 言 “words”, 日 “sun, day”, 土 “dirt, earth”, and 糸 “thread,” none of which logically connect to “younger sister.”

Activity 3 was a more detailed version of Activity 2, using images in conjunction with words. Given the nature of using the images and setting up situations appropriate for the learners, there were only 5 questions in this section.

Training Procedure: Lesson 4

Lesson 4 was only one activity, 30 questions long. The subject was asked to choose the most appropriate English meaning for a Japanese word shown in the context of a sentence.

Directions: Circle the English word that means the same thing as the Japanese word in each question.

Example: としょかんで、本を読みました。

What does 読みました mean?

a. checked out

b. said

☒ c. read

d. picked up

This serves as a lexical inference task with kanji in context, which sets it apart from the previous lessons which all had the kanji isolated from any contextual clues. The sentence is “At the library, I _____ a book.” 言 is indicative of the category meaning “words.” So while b. could feasibly be the meaning of an unfamiliar character with 言 as its semantic radical, it makes little sense contextually. The other options make sense in context, but not with the added meaning of the radical.

Training Procedure: Lesson 5

The entirety of Lesson 5 is much like the previous lesson in that it is a lexical inference task with kanji in context. However, rather than using just sentences for the context,

the subject was presented with 6 whole paragraphs and was asked to identify multiple target radicals from each passage.

Efficacy Measurement

The efficacy of the training was measured primarily by the results of the pre- and post-tests, comparing the two scores of a subject. We also measured it through the self-reported confidence increase that the subjects described on their final questionnaires, though that statistic is less concrete and therefore less convincing of the training's effectiveness. However, given the nature of the study and that the effects of the training are partially internalized as a cognitive process, the increase in confidence and self-reported change in study habits also serve as a measurement of the training's effects because it indicates a change in radical awareness. Measurements and results are addressed further in Chapter 4.

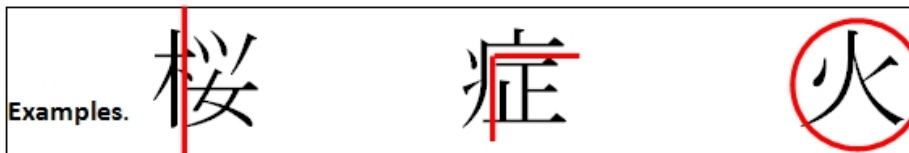
Testing Procedure: Pre- and Post-tests

There were two versions of the pre-test and post-test created. Subjects who took version 1 as the pre-test took version 2 as the post-test, and subjects that took version 2 as the pre-test took version 1 as the post-test. The pre-test and post-test had 5 parts, each designed to

test the subjects' radical awareness and intuition abilities differently. Though the types of exercises and the length of each part were the same, the contents were slightly modified between versions so that the participants would avoid direct repetition.

Part 1 tested the subject's kanji segmentation skills by requiring her to draw a single line to segment the semantic radical. If no segmentation was possible, then the subject was to draw a circle around the entire character. A sample of this exercise is shown below.

Can the following kanji be split into two main pieces? If yes, for each kanji, draw a line between the semantic radical and the other half of the kanji. Note that the lines you draw may not always be straight as in the examples. Draw a circle around any kanji that cannot be divided (i.e. do not contain a radical or is itself a radical).



There were a total of 60 characters for the subject to segment, comprised of kanji with various structures, including top-bottom, left-right, and non-segmental structures.

Part 2 was an exercise in category meaning inference. The subject was instructed to circle the word that best corresponded to the category indicated by the target radical of the character. This exercise checked whether the subject had accurately integrated the radical meanings into their memory, and whether that knowledge could be used to infer the meanings of the whole kanji character. A sample of this exercise is shown below.

Circle the English word that corresponds to the meaning of the kanji given in each question.

Example

What do you think 鱒 means?

a. ocean b. elbow c. oak ☒ d. trout

In this example, the subject is expected to know that the left side of the character 鱒 is the radical 魚, meaning 'fish'. If the subject knows that much, then d. is the only logical answer, as it is the only word that is in the meaning category of 'fish.' There were 18 questions in total, each testing various semantic radicals.

Part 3 was significantly more difficult, aimed at exercising the subject's critical thinking abilities and checking to see how aware she was of the morphology of the given characters. The exercise consisted of a series of 5 characters with the same semantic radical, as well as their English meanings. Based on the meanings of the characters, the subject was to theorize the meaning of the radical itself.

In each question below, you will be shown five kanji that all contain the same radical. Each kanji has an English translation provided. In the space provided, write down what you think the target radical means based on the kanji shown.

Example:

What do you think 疒 indicates based on these kanji?

疹 rash

痛 pain

痘 pox

痺 paralysis

痣 bruise

Answer: ailment, disease

These 8 questions tested the subjects' morphological awareness, and were also aimed at enhancing their radical awareness and meaning inference abilities. However, due to the open-endedness of the activity, it left quite a bit of leeway for ambiguous answers, as will be further explained in Chapter 4.

In Part 4, an English sentence was given, but the target character was shown in Japanese. Subjects were asked to both judge the appropriateness of the character, checking their understanding of the semantic radical, and if they deemed the character appropriate they were then asked to write down what they thought the character meant.

Indicate whether each sentence makes sense or not by circling yes or no. The kanji used either logically fit in completely or they do not fit at all. There are no borderline examples. You do not need to know the exact meaning of the kanji to determine if the sentence is logical or not.

If you think the answer is yes, write down what you think the kanji in each sentence means.

Example: 猫 like to eat fish, chase mice and drink cream.	
<input checked="" type="radio"/> Yes	No <u>I think it means "cats".</u>

This tested the subject's ability to derive the meaning of a character from both English contextual clues and the radical of the Japanese character. The radical 犛 means 'animal,' making it an appropriate category. If the character had been 電, with the 雨 radical at the top meaning 'precipitation,' it would instead be deemed an inappropriate kanji for the sentence. There were 15 of these questions.

The 10 questions of Part 5 were similar to Part 4, with the exception of the sentences being entirely in Japanese rather than just the target character. The subject was asked to read a Japanese sentence, and then pick the best answer from a selection of 4 choices. She did not have to determine the appropriateness of the character as before, but was forced to use contextual clues from the Japanese sentence to choose the correct answer, as there was at least one distracter in the answer choices that fit the semantic category indicated by the radical, but was not the appropriate fit for the sentence. For example, the participant may have been given the sentence “肘がよいから、テニスをしません” then asked the meaning of the character 肘. The provided answers were “ears” “elbow” “racket” and “ball”. Since the target kanji has the radical 月, it means it’s a body part. Though the sentence translates to, “My ____ isn’t good, so I can’t play tennis,” the category of the radical means that “racket” and “ball” are not logically appropriate, even if they fit the context. “Ears” fits the category, but not the context, making “elbow” the correct answer. Given the wide background experiences of the subjects, we knew that this exercise would be simple for students familiar with working with Japanese sentences, and would be more challenging for students in the elementary level who were still becoming accustomed to the Japanese syllabary. For this reason, all grammar

presented in the exercise was part of the Elementary Japanese curriculum to avoid comprehension difficulties in the subjects at lower levels of Japanese education.

Procedure: Interviews and Feedback

As we were unable to do interviews as we had originally planned due to being somewhat short-staffed during the completion period, the user feedback was presented as a short questionnaire. Our questions focused primarily on the subjects' feelings and confidence in regards to their skills and character awareness, and asked for statements on improvement and how they'd use the skills obtained in the training in the future. We also asked how useful they perceived the training to be, and whether it improved their knowledge of radicals and their function, or whether the subject had already been taught or intuited the things taught in the training. We asked the following questions:

How have these exercises influenced your knowledge of kanji?

Do you feel this training increased your confidence in learning Japanese/kanji?

Why or why not?

What part of kanji learning makes you anxious? Meanings? Visual intimidation?

Stroke order?

What did you know about radicals before this training?

Has this training influenced the way you'll approach unfamiliar kanji? How?

Which activities were the most helpful? Were activities too difficult/too easy?

We then asked if the subjects had any additional comments, gave them their monetary compensation for their participation and thanked them. The results of this questionnaire will be further articulated in Chapter 4.

Chapter 4: Results and Discussion

Test Results

We based our measurement of test efficacy on the aforementioned pre- and post-test score discrepancies. Presumably, an improvement in the overall scores of the test parts, measured by the means and the standard deviations of the scores, would be indicative of some success of the testing. ‘Success’ can be defined as either a greater radical awareness on the part of the participant, or that training can positively influence a subject’s radical awareness.

As researchers, our task was to find an appropriate way to ‘grade’ the tests. Parts 2 and 5 were not difficult, as they consisted of multiple choice questions. A score of 1 was given for a correct answer and 0 if the subject circled the incorrect answer.

For Parts 1, 3, and 4, numerical values were assigned to answers based on their ‘correctness.’ For instance, an incorrect answer that demonstrated an understanding of semantic radicals was given a value different from a completely correct answer. These values were then converted to numerical scores. Based on those grading schemes, we were able to calculate figures for each part of the pre- and post-tests. Listed below are the minimum, maximum, mean, and standard deviations for each test.

	Total Possible	Pre-test ($n=21$)				Post-test ($n=21$)			
		Min	Max	Mean	StDev	Min	Max	Mean	StDev
Part 1: Segmentation	60	35	60	53.76	6.66	57	60	58.67	1.06
Part 2: Category Meaning Inference	18	11	18	14.67	1.77	16	18	17.67	0.66
Part 3: Radical Meaning Inference	8	1	6	4.29	1.27	2.5	7.5	4.6	1.06
Part 4: Character Meaning Inference (English Context)	15	9	12.5	10.9	1.12	5	14	12.48	1.91
Part 5: Character Meaning Inference (Japanese Context)	10	5	10	8.24	1.64	9	10	9.76	0.44
Total	111	74.5	100	91.86	8.05	95	107	103.2	2.77

After running paired sample t-tests, we found that every section had a statistically significant improvement between the pre-test and the post-test with the exception of Part 3. Part 3's lack of significance could be attributed to the relatively low number of questions in the section, making it difficult to determine the true gains of the participants. Another interesting characteristic of the scores is the change evident in Part 4. The maximum scores and the means increased, but the minimum dropped from 9 to 5 points, widening the spread of the scores and causing a fairly large increase in the standard deviation—it jumped to 1.91 from 1.12. This could be attributed to the differing levels of Japanese experience of the various subjects, to a discrepancy in the test versions, or just random chance. This may indicate that the scores for this section were not indicative of a sure inference ability enhancement.

Overall, the result analysis indicates that segmentation skills and category meaning inference are the easiest aspects of kanji learning to train, while inferring the semantic categorical meaning of a radical itself and of a kanji character in context are more difficult for students learning Japanese as a foreign language.

Questionnaire Results

When the results of the questionnaire were compiled and analyzed, it appears that many of the participants perceive a large increase in their kanji skills, even more than the test results would indicate.

The subjects indicated varying degrees of understanding of radicals and segmentation, but it appeared that not many knew the meanings of the radicals, or even where the radical was located. When asked, “What did you know about radicals before this training?” answers varied from “nothing” to “just as much as this training [has] taught.” Others said they “knew very little,” or had enough radical awareness to recognize that “lots of kanji have the same radical.” This shows that with the skills taught in class and with some basic intuition, many students recognized the patterns inherent in Japanese kanji, even if they were unable to use the patterns

to their full potential, while others saw visual patterns but were cognitively unaware of their metalinguistic function.

When asked “What part of kanji learning makes you anxious?” there were a variety of answers, which were classified into 4 categories: recalling the strokes and writing, figuring out meanings, figuring out pronunciations, and anything else that they mentioned. As some subjects reported more than one area of difficulty, the numbers of reported difficulties totals to a number larger than the total number of participants. Thus of the 21 respondents, 11 claimed to have difficulty remembering the appearance and strokes, 9 had severe troubles with memorizing and remembering meanings, 5 made note of pronunciation memorization, and 5 had other difficulties, including the interactions of characters and ensuring neatness of handwritten characters. Unfortunately, our exercises focused exclusively on semantic radicals and there was no training dedicated to phonetic components of kanji. This meant that we were not training the pronunciation aspect of kanji. However, as mentioned in Chapter 2, this was not practical to include in this study, given the low predictive ability of the phonetic radicals. In the other areas, though, people had some interesting responses that illuminated their difficulties in reading Japanese. For instance, one student reported that he had “a large vocabulary from being exposed to the spoken language,” but struggled to recognize words that

he knew because he wasn't familiar with the meanings or appearance of the character, even if it was a familiar word. It appears that some students lack a schema to map meanings to kanji, even if the meaning is a known or familiar one. Others said that learning kanji in a foreign language classroom environment is difficult because, "needing to learn so many kanji so fast" proves to be difficult, presumably out of environmental context.

Of the areas of concentration on which the testing focused, there were several in which that the subjects reported a significant increase of confidence. As before, some subjects reported an increase in more than one area and therefore the total number of responses is larger than the number of total participants.

Increased Confidence in:	# of subjects
Meaning Inference	9
Memorization (any way)	8
Categorization Abilities	5
Contextual Interpretation	4
Segmentation	1

The participants' responses varied across these fields, but only one respondent said the training did not increase her confidence in learning kanji. She claimed there "wasn't enough direct feedback to produce any confidence-level changing," though she didn't feel that the

training was at all detrimental to her learning abilities, either. Given that hers was the only response indicative of no confidence advancement, it's safe to say that the kanji training did not intimidate or otherwise impair subject's confidence in relation to learning to read Japanese. Other responses included "I know now that even without memorizing kanji words, I can get a general idea of the meaning and increase my overall meaning through radicals—and that makes it much easier," and "I am no longer completely lost when it comes to the meanings of the radicals, so I am more confidently able to understand kanji based on context and the radicals within them."

In addition to memorization skills, subjects also seemed to indicate that the training would aid them in production skills such as writing kanji. Almost all participants also indicated that they would use this awareness of semantic radicals in the future when encountering unfamiliar kanji, especially in context. For example, one participant said he would "rely on context clues in conjunction with radicals," and another said she now knew "to look for radicals as a clue to the [kanji's] meaning." One student had an interesting response:

"I may use the technique projected in the activities I've done where I try to deduce meaning by looking at a top or left radical. Sometimes, though, you just don't have a clue. I would probably still look words up in a dictionary because I wouldn't be confident in my predictions."

His frankness shows a particular realism that is appreciated in the testing group, given that not all kanji meanings can be linked to their radical. As mentioned in Chapter 1 and 2, only a small number of characters are transparent enough to have a radical whose categorical meaning directly correlates to the definition of the kanji. In many situations, this participant would be right to simply grab his dictionary and look up an unfamiliar kanji, especially with more complex characters with more abstract meanings and opaque morphological relationships.

We also asked the subjects which activities they considered the most effective. There was a wide variety of answers due to the varying levels of Japanese literacy proficiency, but the most commonly mentioned activities are listed below:

Most Useful Exercises	# of subjects
Kanji in Context	7
Radical Meaning Inference	6
Radical Identification	4

Others liked the list of initial radicals that we handed out, or liked the PowerPoint explanation of radical functionality. Interestingly, the radical meaning inference tasks were the tasks found to be least statistically significant in showing improvement between the pre- and post-tests. Nonetheless, the subjects found those activities to be helpful in furthering their

learning abilities. Activities the subjects were less partial to tended to be more spread out and appeared to reflect the subjects' personal choices and tolerances of repetition.

Other useful feedback we received included several requests to integrate phonetic explanations, and a request to add accelerated feedback to the computer-based portion of the training by showing the specific questions the subject answered incorrectly. Another subject noted that “many kanji seem to have more than one radical,” and that these seemingly extraneous components of kanji should at least be explained for the sake of clarity.

Overall, we feel that the responses given by the participants genuinely reflect the effectiveness of our training. If nothing else, it has given the subjects the confidence to approach kanji learning without fear, and we have given them additional tools of which they may take advantage.

Chapter 5: Summary and Conclusions

In conclusion, we've found that this project was successful in that we proved our primary hypothesis correct. Knowledge of Japanese morphemes and the structural regularities of kanji improved the mean scores of the participants in the basic exercises designed to test the efficacy of radical and character meaning inference. This was the expected outcome, as in Chapter 2 we made note of the well-documented role that morphological awareness plays in the literacy abilities of native logographic readers.

In regards to research questions found originally at the beginning of Chapter 3, we find that students from a non-logographic background did not have the morphological awareness of their literate peers in logographic languages, and thus struggled with the concepts of segmentation and the identification of morphemes.

There was a statistically significant improvement in the subjects' segmentation abilities, shown in Chapter 4. The significant reduction in deviation and the final means of Part 2 from the post-test show that the subjects' ability to recognize the semantic radical impacted the categorization of the kanji, though the reverse was shown to need more research, as Part 3 gave no conclusive results.

Similarly, the participants' abilities to segment characters into their composite radicals increased significantly. In fact some subjects showed significant difficulty segmenting characters on the pre-test, even drawing multiple lines when the instructions explicitly stated that a maximum of one line was necessary. By the post-test, no one drew more than one line, and the lowest score achieved was a 57 out of 60 points, showing a large improvement from the minimum of 35 on the pre-test.

The last research question was on the subject of the individual's reading strategies, and the impact of the training. Given that the majority of the subjects responded that their newfound knowledge of Japanese morphology would positively impact their reading abilities, it's safe to assume that the individual participants will seek to use these skills in and outside of the classroom.

The part of this study with the most powerful impact is truly the strength of the positive response from the participants. Other students enrolled in Carnegie Mellon's Japanese program had said before that a course dedicated entirely to kanji would be a benefit to the curriculum, and the feedback from the questionnaire and from the subjects themselves supported this idea. One participant wrote, "If there was a class like this or a program that helped us study kanji and made exercises like this for us, I would definitely take it." This

research has shown that the Japanese-studying community at Carnegie Mellon not only would accept a course on kanji, but is also actively seeking it. It would be in the best interests of both the students and the department if kanji learning could be relegated to its own class. That would lessen the burden of addressing kanji in the language courses, which have traditionally been more speech- and grammar-oriented.

While more research must be done into the most effective way to convey the structural regularities and irregularities of kanji, the efficacy of the knowledge and the ability to train this cognitive process has been proven by this training program. We know that rote memorization is neither the only nor the best way to approach kanji in a classroom, and thus the alternative methods should be further examined for the good of Carnegie Mellon's Japanese Department and for the students who have yet to reach their full literacy potential without the aid of this important morphological knowledge.

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