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THE EFFECTS OF ONLINE KATAKANA WORD RECOGNITION TRAINING AMONG NOVICE LEARNERS OF JAPANESE AS A FOREIGN LANGUAGE

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ABSTRACT

Tashiro, Yumiko. Ph.D., Purdue University, December 2015. The Effects of Online Katakana Word Recognition Training among Novice Learners of Japanese as a Foreign Language. Major Professors: Kazumi Hatasa and Mariko Moroishi Wei.

Because word recognition processes differ depending on orthographic systems, second language learners with different orthographic backgrounds need to acquire new word recognition strategies suitable to the orthography in their second language. Japanese is a multi-script language and one of the scripts, *katakana,* is mainly used to transcribe Western loanwords. Due to the sound alternations resulting from the process of borrowing, learners of Japanese often experience difficulties in reading and writing *katakana* loanwords. Thus, this study investigates the effectiveness of online *katakana* word recognition training among novice learners of Japanese. Thirty-one students from a first-semester Japanese course at a large research university in the Midwest were randomly divided into three groups and assigned different online training programs outside of the class for four weeks designed to establish sound-letter correspondences of *katakana*. The first experimental group (Scrambler Group) put the randomly scrambled letters in the right order to form a target *katakana* loanword by listening to the vocalized word, while the second experimental group (Reading Group) practiced with the same set of the words solely by enunciating and listening to the model reading. The participants took pre- and post-tests before and after the training so that the improvement resulting

from the training was observed. The test was composed of two tasks, naming and providing the English meanings of *katakana* words. The number of correct answers was counted and the response time for a participant to process each word was measured. The test included words practiced in the training and unpracticed words in order to test whether the training effects was transferred to processing unpracticed words.

The results demonstrated that each exercise yielded different effects on the *katakana* recognition process, although no significant difference between the groups was observed. The Scrambler Group showed positive improvement on the speed of processing of both practiced and unpracticed words, while the Reading Group demonstrated significantly better accuracy in reading of practiced words. Both the experimental groups showed significantly better performance in retrieving English meanings of both practiced and unpracticed words after the training. Moreover, the Scrambler Group partly exhibited the acquisition of new word recognition strategies; however, further investigation is necessary due to the limited data set. In conclusion, it is better to provide a variety of online *katakana* word recognition exercises at the early stage of learning for the purpose of cultivating efficient *katakana* word recognition skills of language learners of Japanese.

CHAPTER 1. INTRODUCTION

1.1 Introduction

Japanese is considered a unique language because it employs two different orthographies and three sets of scripts: *hiragana* and *katakana* (syllabary) and *kanji* (logography). Given the complexity of *kanji* structures and a great number of the characters, extensive research (e.g., Matsumoto, 2013; Mori, 1998, 1999, 2003; Mori, Sato, & Shimizu, 2007) has dealt with *kanji* acquisition in both reading and vocabulary research contexts. Compared to the number of studies related to *kanji*, fewer studies (e.g., Hatta, Katoh, & Kirsner, 1984; Komendzinska, 1995; Tamaoka, 1997; Tamaoka & Miyaoka, 2003) have observed how native speakers and learners of Japanese process two different types of orthographies in reading. Although the difficulties of reading and writing *katakana* words among Japanese learners as a second/foreign language (L2/FL) have been discussed for over 30 years by scholars and instructors in the field of Japanese language and linguistics (e.g., Kess & Miyamoto, 1999; Jinnouchi 2008; Nakayama, Jinnouchi, Kiryuu, & Miyake, 2008; Preston & Yamagata, 2004; Quackenbush, 1977), to date no single widely accepted *katakana* teaching method has been established.

Recent questionnaire studies (Jinnouchi, 2008; Nakayama et al., 2008) regarding attitudes of both instructors and language learners in Japan toward *katakana* education

have addressed learners' growing demand for *katakana* word instruction. Almost half of the instructors (46.6%) in the study reported that they believed they do not provide sufficient time for *katakana* instruction and practice. In addition, because most of the *katakana* loanwords have originated from English (Daulton, 2008; Shibatani, 1990), Japanese instructors may overestimate the learnability of *katakana* among their learners when in autonomous learning contexts (Kess & Miyamoto, 1999; Nakayama et al., 2008; Quackenbush, 1977).

The current study investigates the effect of online *katakana* training designed to increase Japanese language learners' awareness of associations between *katakana* letters and sound representations. It aims to observe learners' improvements in *katakana* word recognition skills by providing them with either a cognitively demanding spelling task or an increased amount of reading exercise as the training. Because the exposure to *katakana* loanwords among L2 Japanese learners is limited, the study examines whether the training can promote their development of *katakana* recognition and identification abilities.

1.2 Issues That Learners of Japanese Face When Processing *Katakana* Words

Cognates are actually helpful in L2 reading, especially within the same language family, but *katakana* loanwords in Japanese do not always contribute to learners' lexical access (Daulton, 1998; 2008). First of all, the differences in phonological structures between English and Japanese produce significant sound alternations. Because Japanese does not allow consonant clusters, extra vowels are inserted inside the clusters so that the *katakana* loanwords usually contain more syllables than the original English words.

When an original English word includes sounds that do not exist in Japanese, they have to be substituted by similar sounds that exist already in Japanese. For example, because /θ/ as in "bathroom" does not exist in Japanese, it is pronounced as /s/ like /basɯɾɯ:mɯ/. Therefore, *katakana* words and their English original words do not sound similar due to the modifications. In addition, because *katakana* spellings are based on either L1 Japanese speakers' phonological perception or spellings of English words (Daulton, 2008), both printed letters and sounds are new elements to L2 learners of Japanese, which is similar to learning *kanji* vocabulary, particularly at the beginning stage. L1 English knowledge, therefore, does not always help L2 Japanese leaners comprehend novel Japanese *katakana* words as L2 learners of romance languages with L1 English background benefit, even though Shibatani (1990) reported 80.8% of foreign loanwords came from English based on National Language Institutes' report in 1964.

Katakana, however, is devalued in language instruction, compared to *hiragana* and *kanji*, although it is one of the Japanese scripts representing mostly content words. From the point of view of corpus studies, *katakana* words account for 10% of the entries in a database of Japanese vocabulary (Matsushita, 2011). Moreover, the number of *katakana* words has been increasing continuously because of a flux of foreign terminologies in advanced technology and Western cultures (Daulton, 2008; Kay, 1995; Shibatani, 1990). Nation (2001; 2006) has researched the relationship between vocabulary size and text comprehension in English. According to this research, readers should know 98% of words in the text in order to read fluently without any external support. The necessary vocabulary size is equal to about 9,000 word families, while the 3,000 most frequent word families on the British National Corpus covers around 85% in

most academic texts. The high-frequency word families' coverage of academic texts looks relatively high, but L2 readers still need to expand their vocabulary size by knowing low-frequency word families to read independently. According to Matsushita (2014), "In (L2) Japanese, 93% coverage with vocabulary size of 11,000-12,000 lemmas seems to be a critical stage for around 70% of comprehension and independent reading with a little help of from dictionary etc." Although his study did not control *kanji* level, the text coverage in Japanese necessary for independent reading is lower than that of Nation's studies. Matsushita also states that vocabulary knowledge accounts for over 40% of reading comprehension in Japanese because two-thirds of content words are written in *kanji* and its ratio is higher than other European languages including English. As his study shows, *kanji* vocabulary is a key component explaining reading comprehension in Japanese. However, *katakana* is also used to write content words originated from foreign languages so that *katakana* vocabulary contributes to text comprehension as well. The proportion of *katakana* words in reading material varies to some extent depending on the field or discipline, but L2 readers should be equipped with a skill of *katakana* reading besides two other scripts. They could more easily gain access to meanings of low-frequency *katakana* words if they can accurately sound them out with understanding of sound alternations happening in the course of borrowing. Hence, the *katakana* instruction and practice should be provided as a part of language curriculum, considering the portion of the entire Japanese vocabulary in the corpus.

In response to interests in *katakana* instruction from instructors and learners, in recent years a number of *katakana* workbooks (Kawano, 2009; Takahashi, Watanabe, Ooba, & Shimizu, 2009) have been newly published. They are independent workbooks

and are not affiliated with Japanese language textbooks widely used. The fundamental purpose of these books appears to train learners to become able to transliterate English words into *katakana*. In fact, some studies (Lovely, 2011; Preston & Yamagata, 2004) dealing with *katakana* transliteration have addressed that teaching transliteration rules based on differences between original English words and Japanese loanwords could help learners write *katakana* words correctly. In line with their suggestions, these workbooks attempt to develop an awareness of how English sounds are transformed into both Japanese spellings and sounds. Taking into consideration the characteristics of these *katakana* supplementary workbooks and the results of the questionnaire studies (Jinnouchi, 2008; Nakayama et al., 2008), a lack of *katakana* reading ability seems to result from a failure to establish associations between letters and sounds, which refers to grapho-phonological awareness (Koda, 2008a). L2 learners of Japanese will never be able to read unknown *katakana* words without knowledge of the association between printed letters and sounds in *katakana,* which will help them to identify the meanings.

Yet teaching transliteration rules might not be a comprehensive solution as the rules are numerous and complicated with some individual variations, as indicated in Quackenbush (1977) and Quackenbush and Fukada (1993). Teaching each of the rules is unrealistic given the limitations of class time and the number of the rules -- more than 60 on their list. Due to the lack of the established association between letters and sounds, L2 Japanese learners with English backgrounds are strongly influenced by original English pronunciations when reading Japanese loanwords. When they come across unknown *katakana* words, their reading speed tends to slow down; this phenomenon is not limited to beginning Japanese learners. In their questionnaire study, Nakayama et al. (2008)

stated that Japanese language instructors have already realized that they could not allocate adequate time in the classroom for teaching and practicing *katakana* words as for the other two types of scripts, *hiragana* and *kanji*. Practicing and memorizing scripts have been entrusted to individual students' efforts to date. Consequently, *katakana* literacy has not been successfully achieved due to the "let-alone" principle.

1.3 Rationale for Improving Word Recognition Efficiency through Exercises

Although they focused on word recognition in English as a foreign language (EFL), some recent articles of reading and vocabulary (Crawford, 2005; Grabe, 2009; Grabe & Stoller, 2011) have explained the necessity and usefulness of word recognition training as one of the basic sub-skills of reading. According to the cross-linguistic L2 word recognition studies (Chikamatsu, 1996; Hamada & Koda, 2008; Mori, 1998; Muljani, Koda, & Moates, 1998), L2 language learners can make use of the strategies they have developed in their L1 when reading in L2, if L1 and L2 share some orthographic features. What is better, they can develop new strategies suitable to process newly learned writing systems as they get more experience reading in the L2 (Akamatsu, 2002; Chikamatsu, 2006.) Although accumulated L2 reading experiences have positive influences on development of lower-level skills, there are only a few studies (Akamatsu, 2008; Fukkink, Hulstijn, & Sims, 2005) that have explored the effects of word recognition training in second language reading research. The subjects of the two studies were L2 learners of English with different orthographic language backgrounds, yet their training improved word recognition performance in terms of speed and accuracy. Some of the researchers in word recognition studies (Segalowitz & Segalowitz, 1993;

Segalowitz, Segalowitz, & Wood, 1998) have been intrigued particularly by the word recognition processing speediness and they have claimed that the coefficient variability of the response times (the variability of speed efficiency) can be an indication of automatic processing, which is different from the state of speed-up as a result of practices according to their explanations. Since the practicality of the index as an automaticiation needs further investigation (Hulstijn, Gelderen, & Schoonen, 2009), the development of word recognition efficiency resulting from the training of the current study will be analyzed by the coefficient variability of the response times in order to determine whether the word recognition processing becomes automatic or not.

Reflecting the recent rapid progress of modern technology, integrating digital technology into foreign language learning is a welcome development, given bright prospects in curriculum development and design. Lately, many researchers (e.g., Hirschel & Fritz, 2013; Sadeghi & Dousti, 2014) have examined the efficiency of vocabulary learning through digital media in contrast to traditional classroom learning. They have found variances to some degree in foreign language acquisition depending on tasks, but computer-assisted language instruction (CALI) has produced relatively positive outcomes thus far (Evans, 2009). According to Warschauer (1996), making use of computer-assisted language learning (CALL) drills is reasonable because being exposed to the same materials repeatedly is essential to learning and exposure has a positive effect. Learners can freely choose a time to practice and work at their own pace with online practice. In addition, a computer is an ideal tool for drills because the machine can continuously present the target materials and provide immediate non-judgmental feedback.

Although previous studies (Lovely, 2011; Preston & Yamagata, 2004; Quackenbush, 1977) have unanimously highlighted the need for *katakana* conversion rules instruction, no studies have yet conducted any experiment to investigate the effects of *katakana* instruction. The current study involves an experiment to determine whether online *katakana* training positively affects *katakana* word recognition, targeting novice learners of Japanese as a foreign language. Most published *katakana* workbooks focus on developing learners' transliteration ability from English origin words into Japanese *katakana* words in writing. This study, however, focuses solely on recognition as a result of the training because the target participants are still at the novice level and recognition skills should be focused on before production skills. In addition, Japanese language learners encounter *katakana* loanwords receptively in written forms more often than writing them on notes or documents. They often need to write down their own names and names of their hometown or country in *katakana* to fill in administrative forms, but they first need to read the given *katakana* words not only in printed materials, but also on signs and in advertisements all around them in their real lives. The current study compares two online *katakana* recognition exercises that aim to raise L2 learners' awareness of the association between sounds and *katakana* letters in Japanese. One requires the learners to put the scrambled letters into the correct order to establish the relationship; the other requires learners to read *katakana* words aloud. If the online exercises could improve *katakana* word recognition skills among novice learners of Japanese, they could be easily implemented in the current Japanese course curriculum as well as in the online course curriculum.

1.4 The Purpose of the Present Study and Research Questions

1.4.1 Purpose of the Present Study

The present study will examine the effect of online word recognition training among novice learners of Japanese in a foreign language environment. The efficiency will be determined based on their word recognition performances in terms of speed and accuracy. The study will also examine qualitative differences in the improvement of word recognition performances with respect to word familiarity. It will also investigate whether reading accuracy has a positive influence on the comprehension of *katakana* words. Therefore, the following research questions are proposed.

1.4.2 Research Questions

In order to investigate the efficiency of online *katakana* word recognition practices, the current study will address the following questions.

RQ1: Can novice learners of Japanese noticeably improve their *katakana* word recognition efficiency after training?

RQ2: If yes, will the Scrambler Group noticeably outperform the Reading Group in terms of speed and reading accuracy?

RQ3: Will the Scrambler Group and the Reading Group show similar improvement in the performance of processing unpracticed words?

RQ4: If the Scrambler Group read both practiced and unpracticed words faster after the treatment, is the *katakana* reading process of the Scrambler Group

qualitatively different depending on the practiced or unpracticed words word types? In other words, do they process practiced words via automaticity?

RQ5: Can novice learners of Japanese retrieve more accurately the meanings of practiced words after the training?

RQ6: If yes, will the Scrambler Group and the Reading Group retrieve more accurately the meanings of unpracticed words after the training than the Control Group?

1.5 Overview of Chapters

Chapter one provided issues that language learners of Japanese experience when processing *katakana* loanwords and rational for implementing online word recognition exercises to improve *katakana* processing efficiency. Then, it presented research questions in the current study. The following chapter will survey the previous studies of reading and word recognition of English and Japanese as L2 in order to discuss the importance of lower-processing skills, the Japanese writing system and *katakana* loanwords, current *katakana* teaching instruction, word recognition efficiency and training, and online exercises in foreign language instruction. In Chapter three, the methodology of the present study will be presented and its results will be provided in Chapter four. The final chapter will discuss its analysis, interpretations, implications for teaching, limitations of the study and future directions.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter is composed of nine subsections. It starts with describing the background of reading research in L1 and L2 in order to demonstrate how the importance of lower-level processing in reading has drawn more attention recently in the field of L2 reading research. Then, the discussion of the relationship between the orthographies and word recognition process is followed. Section 4 specifically describes the Japanese writing system and *katakana* loanwords, including discussion of current *katakana* instruction and some issues that Japanese language institutions have dealt with are presented based on questionnaire results. From section 5 to section 8, selected literature on L2 word recognition is surveyed to demonstrate the positive transfer and inhibition of L1 word recognition skills to L2 reading process and developmental aspects of L2 word recognition skills. Data exploring the qualitative change of word recognition process and the relationship between reading aloud and meaning making are included as well. The last section discusses the effective use of computer-assisted language learning to enhance vocabulary learning by reviewing the related previous studies.

2.2 Background of Reading Research in L1 and L2

Reading is a complex task that requires readers to process different levels of information, such as semantic, syntactic, and phonological knowledge, simultaneously. A proficient reader extracts linguistic information from a written text with sufficient speed, activates prior knowledge, and develops appropriate expectations from contextual information while reading in order to comprehend the text. Reading is thus a cognitive activity in which bottom-up processes, such as word recognition and syntactic parsing, and top-down processes, such as inference and prediction, interact simultaneously (Grabe, 2009).

Unlike oral skills, literacy has to be taught even in the first language (L1). Considering the complexity of reading per se, reading in L2 must be a challenging task for language learners. Although L1 skills related to the top-down processes can be transferred to reading in L2, reading instruction, such as demonstrating useful strategies, is necessary as the organization of a text varies depending on the language. Readers' prior knowledge could be culturally oriented, which could positively influence their comprehension when they are familiar with the content (Steffensen, Joag-Dev, & Anderson, 1979). In contrast, lower-level processing is text-specific; therefore, language learners have to develop an association between spoken forms and printed words (Grabe, 2009; Koda, 2008a).

Languages in the world use different orthographies, and extensive research (e.g., Akamatsu, 1999, 2002; Chikamatsu, 1996, 2006; Everson, 2011; Koda, 1990, 2005; Mori, 1998) has shown that the orthographic difference between L1 and L2 can be problematic in learning to read in L2 as word recognition processes differ depending on the

interaction of prior and new learning, i.e., the orthographic systems involved. Everson (2011) reported that non-alphabetic languages take longer to be acquired by learners whose L1 uses an alphabet; this could be due to the complex writing system of L2 and the distance between their L1 and L2. Thus, to learn a new orthography is an additional challenging task for those language learners. They are also expected to acquire new strategies to process printed information accurately and trigger the meanings quickly from their mental lexicons. The lack of automatic lexical access could lead the learners to have poor reading comprehension. Successfully achieving lower-level processing will enable them to make use of limited processing skills or automaticity to perform top-down processing in the L2 (Koda, 2005, Nassaji, 2014).

L2 reading research has a relatively long history among the subfields of second language acquisition and has noticeably developed, synthesizing topics in L1 reading literature as a result of the rapid internationalization of business and industry. Goodman (1967) proposed the "Psycholinguistic Guessing Game Model" of reading, which perceives reading as generating hypotheses about the content of forthcoming text and then confirming expectations. This top-down processing was a dominant view in reading research in the 1970s and early 1980s, meaning that lower-level processing, such as word recognition, did not receive much attention during that time. Much of the subsequent research (e.g., Gough, 1974; Gough & Wren, 1999) has accumulated evidence during the last couple of decades that suggests the model that emphasized top-down abilities is limited and problematic for learners (Grabe, 2009; Koda, 2005). Eye-movement studies (e.g., Balota, Pollasek, & Rayner, 1985) have shown that readers fixate on every content word, and additional reading studies (e.g., Perfetti, 1985; Stanovich, 1988) demonstrate

that readers who are not good at deriving linguistic information from texts do not comprehend the texts well. Currently, efficient text-information processing is treated as one of the fundamental competencies for successful comprehension (Koda, 2008a; Nassaji, 2014).

As much of the earlier reading research was conducted with English or European languages, like other subfields of second language acquisition (SLA), research involving non-European languages is scarce. Koda and her colleagues (Fender, 2008; Geva, 2008; Park, 2008; Wang & Yang, 2008; Zehler & Sapru, 2008) have actively conducted cross-linguistic L2 reading studies with non-European languages, but she pointed out that more research involves Chinese and Hebrew rather than other non-European languages, such as Arabic and Korean (Koda, 2008b) as well as Japanese; thus, it is necessary to further investigate the reading mechanism in Japanese.

2.3 Orthography and Word Recognition

This section discusses the fundamentals of writing systems currently utilized in the world and how influential a writing system is for us to process written scripts while reading, providing several established principles.

2.3.1 Writing Systems

The major writing systems currently used in the world are alphabetic, syllabic, and logographic (Perfetti & Dunlap, 2008). Languages are categorized into these three groups according to how their writing systems map graphic units to sounds. Alphabets, such as those utilized in English, French, and Spanish, are sound-based scripts; each letter

is supposed to represent a phoneme, although this is not always the case. In English, for example, there is no single, one-to-one letter–sound correspondence. One letter can indicate more than one sound, and two letters sometimes indicate a single sound. A syllabary, such as *kana* in Japanese, is another sound-based script in which each grapheme represents a syllable. Japanese *kana* scripts represent five vowels and 40 combinations of a consonant and a vowel. For example, "あ" denotes one of the vowels, /a/, and "さ" indicates /sa/. Although Chinese is often classified as logographic, DeFrancis (1989, as cited in Perfetti & Dunlap, 2008, p. 20) claims that it is morphosyllabic because the graphemes are mapped on spoken Chinese words that represent morphemes and syllables. For instance, "马" means "horse" and its pronunciation is /ma3/. (The number after the syllable indicates one of the four tones that are part of Chinese syllables.) It is an example of pictographs, but the character is rather abstract and its shape does not convey any phonological information. Thus, it represents a Chinese spoken syllable meaning 'horse'. Most of the Chinese characters are not pictographs or ideographs. Some languages use a purely alphabetic (e.g., Greek and English), syllabic (e.g., Cree), or logographic system; others use mixed systems, such as Japanese (syllabary and logography) and Korean (alphabet and logography) (Taylor & Olson, 1995).

2.3.2 Word Recognition Process

As reading is carried out through visual representations, how visual comprehension processing is regulated is an important matter in L2 reading research.

Differences in orthography, phonology, and morphology affect a reader's word recognition. The Orthographic Depth Hypothesis (ODH), proposed by Katz and Frost (1992), states that each of the alphabetic orthographies has a different degree of transparency between the phonological codings and written symbols of the languages. According to the hypothesis, Serbo-Croatian, Italian, and Spanish can be considered to have "shallow" orthographies because they have a highly or relatively consistent sound–spelling correspondence. Meanwhile, English and Hebrew are considered to have "deep" orthographies because their sound–spelling correspondences are not consistent and are less clear. The ODH predicts that learners of shallow languages perform very well even in the early stages of reading development whereas those of deep languages experience reading difficulties in the beginning and require a longer time to master literacy than learners of shallow languages. The ODH further posits that phonological coding is more involved in the shallow orthographies because phonological information is readily available to readers. On the other hand, readers of deep orthographies tend to depend more on whole-word reading or need to look at how the graphemes appear within a word because letter-to-sound correspondences are inconsistent. Chinese and Japanese *kanji* are not exactly under this hypothesis, but they are more opaque than deep alphabetic orthographies because the graphic form is not always transparent with phonological code (Grabe, 2009; Perfetti & Dunlap, 2008).

Phonological information is important for successful comprehension as well because phonological coding enhances information storage in working memory (Koda, 2005). Learning to read essentially involves making a connection between visual word labels and oral vocabulary; thus, converting visual representations into the phonological

form is fundamental for learning new words and recognizing unfamiliar words. As mentioned earlier, phonological coding is more involved in the shallow orthographies, but it is also essential in the deep orthographies, in which phonological coding can be activated through lexical access. The Universal Phonological Principle (UPP), established by Perfetti, Zhang, and Berent (1992), postulates that phonological information in words is primarily activated in all languages including morphosyllabic Chinese regardless of orthographic depth. In addition, semantic processing is necessary to integrate lexical and contextual information as word meanings have to be retrieved appropriately in context in order to comprehend texts. Morita and Matsuda (2000) conducted a study on phonological and semantic activation in reading *kanji* compounds among Japanese native speakers and revealed that phonological information is activated automatically even in semantic judgment of two-*kanji* compounds, which substantiates the UPP.

As shown above, the type of orthography greatly affects how words are processed. Although the strong version of the ODH claims that word recognition processing occurs either phonological route or orthographic route, even the readers of deep orthographies, such as Chinese and Japanese, activate phonological as well as orthographic codes. The phonological route is also called assembled phonology because each visual representation is converted to its equivalent sound and the set of letters composing a word produces its sound representations. In contrast, the visual route is called addressed phonology because the meaning of written representation is retrieved directly without phonological mediation. The assumption that there are two means to read printed letters is based on dual-route theories (Coltheart, Rastle, Perry, Langdon & Ziegler, 2001).

2.4 Japanese as a Written Language

This section starts with the characteristics of Japanese orthography and the formation of *katakana* loanwords in Japanese. Then, the current *katakana* instruction in L2 Japanese classroom is described by analyzing major published Japanese textbooks, examining the issues arising from the survey targeting Japanese language institutions and their language learners, and reviewing some studies regarding transliteration rules of *katakana* loanwords.

2.4.1 Japanese Writing System

Japanese uses a logographic script known as *kanji* (which originated from the Chinese script) and a syllabic script known as *kana* (which was derived from Chinese characters). There are two kinds of *kana*, *hiragana* and *katakana*, and they share the same syllabic references so that the same syllabic sound can be transcribed by either system. *Hiragana*, however, is used for grammatical or function words as well as for some content words whereas *katakana* is used to write foreign words, mostly from Western languages, and onomatopoeias. Approximately 80% of the foreign words are English origin (Shibatani, 1990) and the number is still growing under the explosion of computer technology (Daulton, 2008; Kess & Miyamoto, 1999). *Kanji* is used for content words and usually has more than two readings: *on*-reading (Chinese pronunciations) and *kun*-readings (Japanese pronunciations). When *kanji* was brought to Japan, Chinese pronunciations came along with it. In addition to the Chinese pronunciations, Japanese spoken forms that had been used before were attached to the corresponding Chinese characters. This explains why each *kanji* usually has more than two readings, the choice

of which is determined by how it appears in the context. For example, the Chinese character indicating "mountain" was brought to Japan and is pronounced /san/ in the *on*-reading, and /jama/ in the *kun*-reading. The *kanji* "山" by itself is used to denote the native word "yama" /jama/, but the well-known Mt. Fuji is called "Fujisan" / ɸɯdʒisan/. Most content words are written in *kanji* in authentic materials, but difficult *kanji* are presented with *hiragana* that represents the phonetic interpretation of the *kanji* in reading materials targeting children or less frequent *kanji* usage in authentic materials. According to Shafiullah and Monsell (1999), native Japanese readers process *kana* and *kanji* differently due to the different transparency of the scripts as they have found a tiny but significant cost of switching between the two types of scripts in terms of processing.

2.4.2 Japanese Sound System and Transliteration of *Katakana* Loanwords

Although Japanese employs syllabary, Japanese words are divided into morae, not syllables, in order to account for some phonological phenomena, such as speech errors and accentuation (Tsujimura, 2007). A mora is a phonological unit like a syllable. A syllable traditionally has three internal units: onset, nucleus, and coda. Onset is the syllable-initial consonant(s); nucleus refers to a vowel, and coda corresponds to the syllable-final consonant(s). In contrast, Japanese *kana* is basically either a vowel or a combination of a consonant and a vowel. Thus, one letter is counted as a mora. In addition, "the first part of a long consonant (or the first part of a geminate)" and "syllable-final, or 'moraic', nasal /n/" (Tsujimura, 2007, p.59) are considered to be distinctive sounds, and each of them is counted as a mora. Only these two sounds can be a syllable-final consonant in Japanese.

When loanwords are transcribed into words in *katakana*, the original sounds are often lost and altered into Japanese sounds. Some words sound very similar to original English or foreign words; others become distinctive sounds that are difficult to recognize without knowing the sound alternation systems. One of the typical changes is a vowel insertion. As previously described, a Japanese sound is composed of a consonant and a vowel; hence, a vowel is inserted after a consonant although it is not followed by a vowel in English. Furthermore, Japanese has only five vowels and 23 consonants, so it has fewer sounds than English. For example, /θ/ does not exist in Japanese; it is substituted by [s] in Japanese. Many languages around the world tend to keep original pronunciations and spellings of loanwords as they regard them as foreign; however, a large number of Japanese loanwords are transliterated based on their original written forms. For example, "スタジオ" /sɯtadʒio/ for studio (Daulton, 2008). Another demonstration of difficulties in comprehending *katakana* loanwords is the case when two different words in English become one identical word as a result of transliteration into Japanese. For instance, "track" and "truck" are two different words in English, but both words are transcribed exactly the same in Japanese—"トラック" /toɾak:u/ —because the two vowels are not discriminated in Japanese. On the other hand, one English word can be transliterated into multiple words depending on the meanings. "Glass" can be "グラス" /gɯɾasɯ/ as a drinking glass or "ガラス" /gaɾasɯ/ as a transparent material used for making windows and bottles. Considering these characteristics, native Japanese instructors have to recognize that loanwords in Japanese are not easily processed by L2 learners of Japanese due to the

problematic phonological alternations, although *katakana* letters are phonetically transparent.

2.4.3 Current *Katakana* Instruction

This subsection covers how *katakana* is taught in a foreign language classroom in the U.S. by analyzing major Japanese published textbooks. Then, the questionnaire studies about *katakana* instruction and learning responded by instructors and students at Japanese language institutions are examined to understand the actual circumstances. This subsection then ends with reviewing the studies exploring the strategies L2 language learners employ in transliterating *katakana* loanwords.

2.4.3.1 *Katakana* in Published Textbooks

Here I would like to examine the major published Japanese textbooks used at colleges and universities in the United States. Most textbooks introduce both *hiragana* and *katakana* at the beginning. Because *hiragana* is taught as the first set of letters in Japanese, *katakana* tends to be recognized as a secondary set.

In *Yookoso*, one of the most widely used Japanese textbooks in the U.S., (Tohsaku & Hamasaki, 2005), both *hiragana* and *katakana* are introduced in the preliminary chapter, which is slightly larger than other main chapters. It presents a *katakana* chart and a list of examples of foreign sound words, but does not mention any transliteration rules at all. It is followed by an introduction to *kanji*, and *kanji* learning

starts from chapter 1. The Romanization that helps learners read *kana* and *kanji* given in the preliminary chapter disappears in chapter 1.

Like *Yookoso*, *Genki I* (Banno, Ikeda, Ohno, Shinagawa, & Tokashiki, 2011) introduces the two sets of letters in the beginning of the textbook, before the first chapter. A *katakana* chart is presented with Romanization, and only a few points are given distinct from *hiragana* writing rules, such as the use of a bar for long vowels and combinations with small vowel letters that are especially unique in *katakana* loanwords. The textbook is divided into two sections: (1) Dialogue and Grammar and (2) Reading and Writing. The second chapter of Reading and Writing includes some *katakana* practices, which are mostly recognition based, except for writing students' own names. *Katakana* words in the Dialogue and Grammar section are presented with small *hiragana* as reading help up to the second chapter.

Nakama I (Hatasa, Hatasa, & Makino, 2014) introduces *katakana* between chapters 2 and 3, which is later than the other two major textbooks. Each letter is presented with a mnemonic and picture in addition to the *katakana* chart, and the textbook provides eight main transcribing rules that are helpful for converting English words into *katakana*. A list of *katakana* words categorized by types of items, such as food, sports, and music, is also presented. Like *Genki I*, small *hiragana* as a reading help for *katakana* words is provided until chapter 2.

These three major Japanese textbooks utilized in American college classrooms do not devote many pages for *katakana*, but Jorden and Noda (2005) published a *katakana* textbook accompanied with Japanese language textbooks targeting American adults studying in a foreign language setting. Their textbook introduces 16 conversion

tips from Japanese sounds to equivalent English sounds. It is necessary to note that their teaching method proposes a delayed introduction of *hiragana* and *katakana* as they believe that oral and aural language has to be developed before scripts are taught (Hatasa, 2002). Among the four Japanese textbooks discussed herein, only Jorden and Noda devoted a whole textbook to teaching *katakana* scripts; the other textbooks, which propose the early introduction of scripts, seem to rely on learners' exposure to Japanese scripts, unless each instructor supplies extra practice materials for *katakana* learning.

Generally speaking, native-speaking Japanese instructors tend to think that *katakana* is much easier for learners to memorize than *kanji* because *katakana* is considered a second set of Japanese letters. Once the two sets of letters are learned in class, *kanji* is introduced. Because *kanji* learning continues until an advanced level, a certain amount of time for *kanji* instruction is provided in class, especially in the first two years, in addition to learning new grammatical features and language for communicative interaction, but no more *kana* practice is afforded. The students are expected to learn *katakana*, including distinctive sounds of foreign words that do not appear in *hiragana* learning, by being exposed to teaching materials, such as textbooks and assignments.

2.4.3.2 *Katakana* Instruction in Classroom

Being concerned about the language learners who need to deal with increasing *katakana* loanwords, Nakayama et al. (2008) reported on the results of a survey regarding the current *katakana* instruction in Japan. Although their questionnaire was conducted in Japan, the results should be taken into consideration when we design course curriculums

of and syllabi for American classrooms. According to their results, sufficient *katakana* instruction is not provided and the students' mastery of *katakana* has not achieved as well as *hiragana* at two-thirds of the institutions that responded to the survey, although the Japanese language instructors have acknowledged that their students have difficulties in learning *katakana*. Consequently more students feel that reading and writing *katakana* is difficult than *hiragana* (*katakana*, 69.2%; *hiragana*, 24.6%). In addition, nearly 80% of the students have experienced difficulty in their daily life because of not being able to understand *katakana* words, and almost 60% of the students wish to receive thorough *katakana* instruction. Another study (Jinnouchi, 2008) based on the questionnaire responded to by language learners in Japan also revealed what components made it difficult to learn and master *katakana*. His results were analyzed by native language of the learners. The native speakers of Chinese perceive difficulties of *katakana* learning most and their major difficulties involved guessing the originated meaning of *katakana* words and not being able to find entries in their dictionaries. It is because Chinese language has very few comparable loanword expressions. Native English speakers do not seem to have as many difficulties as Chinese speakers, but they point out the meaning and pronunciation differences between *katakana* words and their equivalent original words as the bases for a reason of their difficulties in learning *katakana*.

These two questionnaire studies unfortunately revealed that the Japanese language institutions have not provided a satisfactory level of *katakana* instruction. In addition, Nakayama et al. (2008) pointed out that *katakana* words appear in these students' learning environment much less frequently than those in reading materials targeting native speakers. The length of each word is relatively short, and distinctive

sounds of foreign words do not appear often. Although they are only exposed to a limited vocabulary, the learners are expected to inherently obtain the abilities to read and guess the meanings of English loanwords. Nakayama et al. argue that it is necessary for all the instructors to acknowledge that *katakana* should be treated as equal as other Japanese scripts in terms of instruction. However, they also admitted the difficulty of spending more time teaching *katakana* in class considering the time spent teaching *kanji* in current Japanese language classrooms. Thus, the current study proposes online word recognition exercises that can be easily implemented outside classroom without scarifying any class hours.

2.4.3.3 Teaching Transliteration Rules

As mentioned earlier, workbooks (Kawano, 2009; Takahashi et al., 2009) solely aimed at providing *katakana* learning have been published recently in response to the *katakana* instruction demand. In addition, several scholars (e.g., Lovely, 2011; Nishi & Xu, 2013; Preston & Yamagata, 2004) have advocated teaching language learners transliteration rules. Preston and Yamagata (2004) asked both native speakers of Japanese and four different levels of Japanese learners of native English speakers to transliterate English words that had not been transcribed yet into *katakana* words and explored what strategies were used by the learners of Japanese to compensate for their lack of intuitive transliteration knowledge. Although Japanese language learners have trouble transliterating *katakana* loanwords, Preston and Yamagata found that their participants were sensitive to the number of morae. They also seemed to struggle with the perception

of geminates and long vowels and tended to use vowel lengthening, instead of gemination. Their sensitivity to morae indicates that they were aware of the necessity of modification in converting English sounds into Japanese ones at least, and the study demonstrated that the learners' usage of germination increased as the level advanced. Thus, these two weak points should be reinforced in the current *katakana* recognition exercises. They also suggest that explicit instruction of some transliteration rules could mitigate students' difficulty in writing *katakana* loanwords from classroom teaching experience.

Lovely (2011) also had the first year Japanese students at an Australian university transliterate loanwords into *katakana* and investigated their strategies by conducting interviews with think-aloud procedures. Although the study utilized only 10 loanwords, she identified five common strategies used among the participants; 1) precedent (making use of previous encounters with the target words), 2) English pronunciation (imitating English sound), 3) English spelling (referring to original English spelling), 4) no rule, (no relevant reason for a certain letter choice) and 5) inductive rules (based on the rules they formulated internally). Her study showed that the more successful strategies among them were precedent and inductive rules, and the participants who received a higher score usually made use of the multiple strategies, while the ones with a lower score tended to rely on a single strategy. Lovely also hypothesized that "greater aural exposure to Japanese language gives learners a more reliable system of internalized rules for transliteration (p.119)" by analyzing the participants' learning background and exposure to Japanese outside of classroom. She noted that not all learners are good at formulating the inductive rules that exist between *katakana*

loanwords and original foreign words. Thus, she proposed that further investigation of the efficiency of teaching transliteration rules is necessary.

Although the two studies reviewed above suggest teaching L2 learners of Japanese transliteration rules, these advocates unanimously state as the drawbacks that the number of rules is numerous and some of them cannot be explained systematically due to some irregularities. However, Nakayama et al. (2008) revealed that language learners have experienced difficulties in not only writing but also even reading *katakana* words aloud. Therefore, the present study focuses on recognition efficiency, but not transliteration skills. It is necessary to revise our understanding of *katakana* lexical access as Japanese language instructors before teaching how to Japanize English words.

2.5 Word Recognition Studies in L2

The research of two major disciplines, second language acquisition and reading, has already illustrated that L1 transfer can either facilitate or interfere with L2 word recognition development (Koda, 2005; Prefetti & Dunlap, 2008). When L1 and L2 share orthographies, learners can rely on their L1 word recognition skills. On the other hand, when the orthography of L2 is different from that of L1, learners need to acquire new word recognition skills that are appropriate for the L2 orthography. Past research on word recognition has also revealed that word recognition skills might be naturally developed through extensive exposure and experience. This section discusses selective literature on the word recognition of L2 studies in English and Japanese as a second language to demonstrate the influence of L1 word recognition skills on reading in L2 and the developmental nature of L2 word recognition strategies.

Muljani et al. (1998) examined whether structural consistency within a word and word frequency affect word recognition skills in ESL, comparing ESL learners whose primary language was Indonesian (alphabet) and Chinese (logography). The English words used in their lexical judgment task, including nonwords, were controlled for frequency and spelling patterns. The incongruent words consisted of letter patterns specific to English, which contained consonant clusters, while the congruent words had the same letter patterns as Indonesian. The study found that the Indonesian group was significantly affected by the structural consistency of words, but the Chinese group was not because their L1 orthographic system is not alphabetic and letter patterns did not affect their word recognition processing. In addition, both participant groups processed high-frequency words faster than low-frequency words; this frequency effect demonstrates that more experience with L2 orthography translates into more development in associations between scripts and meanings.

Hamada and Koda (2008) also conducted a study with ESL students and examined whether L1 orthographic experience promoted efficiency in L2 decoding and word learning. Their subjects were college-level ESL learners whose L1 was either Korean or Chinese. In terms of orthographic description, Korean is similar to English because both are alphabetic, whereas Chinese, that is, logography, is different from English. The materials used in their experiment were two types of pseudo-words; one was the regular type of pseudo-words constructed with a regular spelling pattern, which was consistent between grapheme and phoneme. The other was the irregular type of pseudo-word composed of irregular spelling patterns, which had low bigram frequencies. Their results demonstrated that Korean ESL learners pronounced pseudo-words significantly

faster and more accurately than their counterparts, and both ESL groups pronounced the regular types faster than the irregular ones. In their following word learning experiment, Korean subjects again outperformed Chinese subjects on the three recall tests; a spelling test, a picture recognition, and a word recognition. Thus, the study shows that L1 decoding skills of Korean students facilitated in both L2 decoding efficiency and word learning. The study's findings also demonstrate the effects of L1 and L2 congruency of word recognition process.

The study conducted by Akamatsu (2002) investigated word recognition procedures among fluent ESL learners with different language backgrounds. His subjects were mostly graduate students who had finished their bachelor's degrees in their home countries. A naming task was employed in the study and the test stimuli were controlled by frequency and word regularity (grapheme-to-phoneme correspondences). Although his subjects had three different languages backgrounds, Chinese (logographic), Japanese (logographic and syllabic), and Persian (alphabetic), the three groups did not exhibit any differences in word recognition procedures. They processed regular words more quickly than exception words in recognizing high-frequency words. However, they took longer time in processing low-frequency exception words than regular words. Akamatsu explained that this absence of L1 effects was supported by the universal direct access hypothesis (Sidenberg, 1992, as cited in Akamatsu 2002, p. 119), which claims that familiar words are processed visually whereas unfamiliar words are processed phonologically. These high-proficiency ESL learners demonstrated that they have already acquired word recognition strategies suitable for English and did not exhibit any discrepancies despite their L1 differences. Thus, L1 negative transfer seems to weaken as

learners' proficiency levels improve, although this is not clear from studies of fluent bilinguals (Gholamain & Geva, 1999; Koda, 2005). It is important to note that word recognition skills and oral proficiency develop independently. Exposure to the target language in written forms is a prerequisite for nurturing automaticity in word recognition.

According to the past studies reviewed herein, L2 learners with an alphabetic background in L1 are at an advantage in recognizing words in English, but even the L2 word recognition skills from those with a non-alphabetic language are developmental as L2 learners have more exposure to the target language. However, L2 Japanese learners seem to take a much longer time to concur with the difficulties of *katakana* recognition. Having described word recognition studies in ESL, the studies that deal with the Japanese writing systems will now be reviewed. These findings are often cited in word recognition articles because there are only a few studies of Japanese word recognition available. These studies compared word recognition behaviors between learners with different L1 orthographies.

Chikamatsu (1996) investigated the strategies used by learners with different native languages for word recognition of *kana* scripts in Japanese. The participants were native English speakers and native Chinese speakers enrolled in a second-semester Japanese language course at an American university. Chinese has a meaning-based script, so recognition occurs less through phonological coding. English, on the other hand, has a sound-based script, and recognition often occurs through phonological coding. As the author anticipated, each group utilized different strategies based on their native language processes when they processed Japanese word stimuli. The Chinese participants slowed down more noticeably in visually unfamiliar word conditions compared to familiar

conditions than the English participants because the Chinese participants depended more on visual orthographic information in words than the English participants. The English participants, however, slowed down more than Chinese participants as word length increased. This behavior was more significant in the *hiragana* condition than in the *katakana* condition because phonological coding was consistently involved in their processing. Interestingly, L2 Japanese learners need to acquire new skills to visually process *kana*, the syllabic scripts, which are sound-based scripts like alphabets. It is because *kana* scripts do not directly provide phonological information unlike Roman alphabets.

In the early stage of word recognition research it was believed that *kana* was processed phonetically (Allport, 1979; McCusker, Hillinger, & Bias, 1981; Morton & Sasanuma, 1984). However, Besner & Hildebrandt (1987) called into question the traditional belief that *kana* processing requires phonological mediation to access its meaning. They conducted an experiment in which the native speakers of Japanese were asked to name three different types of *katakana* words, visually familiar words, visually unfamiliar words, and non-words, as quickly as possible. Because the subjects took less time reading aloud visually familiar words than the other two types of words, it was revealed that familiar *katakana* words could be processed visually as a sequence without relying on the phonological processing route. Moreover, Feldman and Turvey (1980) compared latency differences in naming *kanji* and *hiragana* of six color names. Although the *kanji* version of the color names was familiar to the native speakers of Japanese, the words in *hiragana* were processed faster than ones in *kanji*. Thus, Feldman and Turvey posit that Japanese readers process *kana* words more quickly than the same meaning

kanji words because both addressed phonology route and assembled phonology route are available for *kana* processing, but *kanji* allows only addressed phonology because it does not provide phonological properties.

The study conducted by Chikamatsu (1996) dealt with word recognition processing of two types of *kana*, but Mori (1998) investigated the strategies used by the same language groups as Chikamatsu for the recognition of *kanji* in Japanese. The phonological processing of printed materials plays an important role in reading comprehension due to the involvement of working memory in interpreting incoming information from a text. Therefore, the study examined whether L2 learners from phonographic and morphographic languages utilize different strategies for deriving phonological representations for new *kanji* characters. It additionally explored the relationship between phonological inaccessibility of new characters in L2 and short-term memory performance of learners of Japanese from two types of orthographic backgrounds. The difference between phonographic and morphographic languages is the basic unit of representation; each grapheme indicates a sound unit in a phonography, while the basic unit in a morphography is a morpheme that denotes a certain meaning. This study used 20 pseudocharacters: 10 phonologically accessible characters and 10 phonologically inaccessible characters. After displaying cards depicting the five characters as a set, the investigator presented one of the five cards and asked the participants which character followed it in the sequence they had just seen. The result of this study showed that the Chinese and Korean groups performed well, and their performance did not decline in the phonologically inaccessible condition. However, with the absence of *katakana* from the symbols, the phonological language background group

(English) could not process the information well. This outcome also supported the fact that learners from different language backgrounds process L2 information differently. Mori has also suggested, based on the post-experimental questionnaire, that learners from phonographic language backgrounds are sensitive to the phonological accessibility of logographic representations and have fewer flexible strategies for remembering new words without overt clues for its readings when compared to L1 Chinese and Korean learners of Japanese. Although the study has shown that participants from morphograhic languages were able to make use of *katakana* as phonological supplemental information in this experiment, it did not confirm that these participants were good at reading *katakana* scripts.

Most of the research on word recognition in any language has been conducted with words in isolation. Only a few studies on Japanese word recognition have dealt with passage reading. Chikamatsu (2006) investigated whether the word recognition skills in L2 were developmental in two different settings: context-free and contextual settings. She referred to the study conducted by Segalowitz, Segalowitz, and Wood (1998) and stated that second language learners could demonstrate quantitative change for development of recognition strategies through practice. If novice L2 learners have been restructuring the processing model, their performance efficiencies should decline much more than those of learners who still rely on L1 recognition skills in visually unfamiliar conditions. Hence, Chikamatsu conducted two experiments—one with words in isolation and the other in reading passages—in an attempt to observe any developmental changes in word recognition strategies. The participants were students from first- and second-year Japanese college courses in the United States. Chikamatsu confirmed that second-year

learners deteriorated more than first-year learners in lexical judgment task; however, she was not able to detect similar trends in her contextual word recognition test.

As Chikamatsu (2006) pointed out in her discussion, the material she used could be problematic. Her experiment focused on *kana* recognition; thus, her stimuli were written entirely in *hiragana* and *katakana*, even in the passage readings. However, Japanese is written in not only *kana*, but also *kanji*. Thus, passages written entirely in *kana* are unrealistic and difficult to read, even for native speakers of Japanese. With reference to Japanese textbooks widely used in the United States (e.g., *Nakama, Yookoso,* and *Genki*), all three types of scripts are introduced in the first semester—or, at the latest, the first year of Japanese learning—and intermediate speakers should already be getting familiar with regular writing conventions of Japanese. Thus, problems in the materials used in the study could be the reason why the intermediate participants in her study did not exhibit her expected result in the contextual reading. On the other hand, novice learners did not worsen in their comprehension in reading; this trend indicates that those learners still heavily rely on phonological coding—an influence from their L1 reading strategies.

Although Chikamatsu (1996; 2006) created visual familiarity by switching the scripts, *hiragana* and *katakana*, Tamaoka (1997) utilized real Japanese words to compare the efficiency in processing two-*kanji* words, Japanese original words written in *hiragana*, and *katakana* loanwords among students whose native languages were either Chinese or English and native speakers of Japanese. Regarding the processing speed, Chinese participants were at an advantage in processing *kanji* stimulus, but not in *kana*. Tamaoka reasoned that this is because *kana* is a new script to learn for both groups of learners. One

of his students from Germany, who studied Japanese for eight years both in Germany and Japan, participated in the same experiment as a sample and processed *kana* words in a similar way as L1 Japanese participants. He then speculated from this sample that it seemed to take approximately eight years for L2 learners to establish *katakana* orthographic representation.

In order to understand the foundations of reading, it is important to acknowledge various lower-level processes that promote fluency and comprehension. Recognizing a *katakana* word is a unique task as Japanese mixes multiple letter systems. When a reader accesses the meaning while reading, phonological information is extracted; it should then be matched with the meaning in his/her mental lexicon. The same series of phenomena, however, are not likely to occur among learners of Japanese because the Japanese sound information of *katakana* words does not always match original English phonological information that reside in their lexicon.

2.6 Qualitative Differences of Word Recognition Processing

As discussed above, L2 language learners demonstrate improvement of word recognition speed and accuracy as a result of development of word recognition skills. This section further discusses word recognition process from the point of view of automaticity. First, the term of automaticity is clarified and then the concept of qualitatively discriminating between automatic and speed-up processes is discussed.

2.6.1 Operationalization of the Automaticity

Automaticity can be interpreted in various ways, but in general, it means "the absence of attentional control in the execution of a cognitive activity, with attentional control understood to imply the involvement among the consumption of cognitive resources, all in the service of dealing with limited processing capacity" (Segalowitz & Hulstijn, 2005, p. 371). As DeKeyser (2007) explains, skill acquisition theory is where adults perform a variety of actions in daily life that share a commonality that we initiate consciously while learning representations of declarative knowledge and then develop it into natural, rapid, and skillful performances through repetitive actual practices. While practicing, the declarative knowledge becomes procedural knowledge. Eventually the time taken to perform the task and the error rate of completion decrease over the course of the acquisition period.

Automaticity in word recognition processes is necessary to become a fluent reader. In order to examine the efficiency of the process, cognitive tasks, such as lexical decision tasks or naming tasks, are usually employed in such experimental studies. The current study investigates *katakana* word recognition adeptness as a result of the online training by employing a naming task, which measures response time and error rate of each participant. Reduction of both measurements between pre-test and post-test indicates improvement of processing *katakana* words. Additionally, the measurement of qualitative differences over a period of skill acquisition is utilized to differentiate speed-up and automatic processing, which is explained in the next subsection.

2.6.2 Coefficient of Variability as an Index of Automaticity

As previously mentioned when discussing Chikamatsu's (2006) study, Segalowitz and Segalowitz (1993) introduced a quantitative measurement to distinguish between fast and automatic processing word recognition. According to their explanation, quantitative change is merely a practiced effect called the speed-up model whereas automaticity can be observed based on the qualitative changes of the process. This is because automatization has an association with restructuring a word recognition procedure, and once L2 readers' word recognition ability reaches their optimal levels, no quantitative changes can be observed. The authors proposed that the relative variability of performance is a valuable index of automatization. Their formula for this relationship is the coefficient of variability (CV_{RT}), which is "the standard deviation of response time (SD_{RT}) divided by the mean latency (RT)" (Segalowitz & Segalowitz, 1993, p. 369). They employed a lexical decision task with L1 French students learning L2 English in the study to demonstrate that the index is useful for showing that automatization has taken place. They found that faster participants showed less variability than slower participants, and both groups showed improvement in their word recognition performance with repeated targets.

In the subsequent study performed by Segalowitz et al. (1998), reaction speed in the lexical judgment task of fast and slow L1 English readers in a first-year college French course was compared during two semesters. By examining the reaction times and the coefficients of variation for reaction times, they found qualitative differences between the two groups in early training and postulated that the faster readers' reductions of reaction times were due to their ongoing restructuring of L2 word recognition

mechanisms. Moreover, the initially slow group that did not show a significant correlation in the beginning showed changes in scores over the eight-month period. This state indicated that the individual learners improved their word recognition through automatization. Therefore, the two studies manifested the validity of correlation between SD_{RT} and RT as an indication of automatization by using different populations and different language contexts.

However, Hulstijn et al. (2009) casted down on using the coefficient of variability to indicate automaticity after Hulstijn conducted a study (Fukkink et al., 2005) with his other colleagues to investigate an efficiency of word recognition process of young English learners in the Netherlands by utilizing the CV_{RT}, which will be reviewed in the following section. They reviewed seven studies that employed the CV_{RT} including the studies conducted by Segalowitz and his colleagues mentioned above and one by Fukkink et al., to discriminate automaticity from speed-up processing and then pointed out that none of the seven studies comprehensively provided the data satisfying all the three criteria indicating automatization. Those three criteria are a reduction of RT, a positive correlation between a CV_{RT} and RT, and a reduction of a value of CV_{RT}. They also discussed the concept of the automatic processing and then expressed that knowledge building and processing automaticity cannot be separated. They concluded that further studies were necessary and proposed that the future research should inform detailed description of data cleaning process, such as how to deal with outliers, in order to validate the use of the coefficient of variability

indicating automaticity. Thus, the current study will report how to deal with the data collected from the experiment.

2.7 Relationship between Naming and Meaning

Word recognition process has two major functions; one is gaining a meaning of word, the other is to derive its sound (Koda, 2005). The studies regarding word recognition often employ either lexical decision task or naming task in order to measure efficiency of phonological and orthographic processes. The researcher of the current study has speculated that the major reason many Japanese language learners are not good at reading and writing *katakana* words is because they have not acquired efficient decoding skills due to lack of practice opportunities. Even though transliteration of *katakana* loanwords undergo a considerable modification of sounds in originated English words, the sound information decoded from a string of *katakana* letters is the necessary clue that language learners of Japanese could access to its meaning.

There is a set of studies comparing efficiency of *kana* word processing of L1 and L2 speakers of Japanese with contradicting results. Komendzinska (1995) used Japanese words and loanwords as stimuli in her naming task and examined how visual familiarity affected their reading speed. She argues L2 Japanese learners with average three years of learning experience read the loanwords written in *katakana* (familiar condition) significantly faster than the same words written in *hiragana* (unfamiliar condition), and the Japanese words written in *hiragana* (familiar condition) faster than the same words written in *katakana* (unfamiliar condition). The Japanese subjects, however, processed all the words at a similar speed independent of stimulus type. Thus, word familiarity did not

affect in naming, as shallow orthography necessarily involves a phonological processing without accessing to lexicon to match its meaning (Aro, 2006). This result indicates that the native Japanese participants could automatically assign syllabic characters of written words to phonetic representations, while the foreign subjects apparently had not mastered the skill. She concluded that Japanese readers possess one lexicon which processes representations of both *hiragana* and *katakana* written words, while learners of Japanese use two separate lexicons which process the two different kinds of *kana* respectively.

Another study conducted by Hatta et al. (1984) employed a lexical judgment test of *kana* words with the same four conditions as Komendzinska's (1995) experiment. In their study, the L1 Japanese speakers took significantly longer time processing words in unfamiliar condition than ones in familiar condition for both letter types. On the other hand, the L2 Japanese learners (median 4.6 years of learning experience) took significantly longer time only in unfamiliar condition for *katakana* words, but not *hiragana* words. Thus, they have proposed that native speakers of Japanese possess two separate lexicons; each for *hiragana* and *katakana* vocabulary, while Japanese learners have one lexicon that covers both. They have also pointed out that the language learners' weakness in lexical access could result from their undeveloped spoken vocabulary.

Because the two studies reviewed above utilized different tasks, naming and lexical judgment, the word recognition processes the participants relied on during the tasks could have been different. Yamada, Imai, and Ikebe (1990) conducted a study to explore the efficiency of the addressed phonology and assembled phonology routes while reading *kana* among the native speakers of Japanese. The study controlled lexicality (words or non-words), length of word, *kana* type, and vocal interference (silent or

concurrent vocalization). They have found that frequent word shape was the most influential element in lexical access and that a type of *kana* itself was not an exclusive factor. They also demonstrated that those native speakers could be divided into two groups depending on the preference to one of the processing routes. Taking the findings of Yamada et al. into account, Kess and Miyamoto (1999) interpreted Komendzinska's (1995) unexpected finding in the following way, "This availability of both the assembled phonology and addressed phonology routes for fluent native users of the language may be what accounts for Komendzinska's (1995) findings (p.103)." Because the language learners have not fully developed the automaticity and speed of reading the *kana* scripts yet, there is not much difference between the speeds at which assembled phonology and addressed phonology routes arrive at the correct pronunciation. These two studies prove that language learners lack significant amounts of time to develop *katakana* word recognition efficiency, and that it is necessary to familiarize themselves with both letter-level and word-level of orthographic shapes in order to use the two processing strategies effectively depending on the orthographic frequency and familiarity.

Although his studies are about learning Chinese *hanzi*, Everson (1998) conducted a study to investigate the strategies of learning Chinese characters used by novice learners of Chinese. Learning Chinese characters is challenging to the learners especially with alphabetic orthographic background. He found highly significant correlation between being able to read and being able to identify Chinese two-character words among his subjects. He disclosed that the beginning Chinese learners stored both meaning and pronunciation of a word together as a package because they did not possess a skill of visually analyzing each character at this level. Hence, they relied more on

phonological code than visual code when learning new Chinese vocabulary. Unlike L1 leaners, L2 learners do not possess rich vocabulary before staring to learn written forms. Thus, they strategically memorize both written and spoken forms together at the same time when learning vocabulary.

As mentioned earlier, *katakana* loanwords should be treated as Japanese words in foreign language curriculum. For L2 learners, *katakana* is a completely new set of scripts and its transparency of sound information is not as clear as alphabets until the association between scripts and letters are established. Thus, *katakana* loanwords could be introduced as a set of orthographic and phonological information and meaning together like how *kanji* is taught. However, we have noticed from our teaching experience that L2 learners can be immensely influenced by the original pronunciations when pronouncing *katakana* words. Therefore, it is necessary to provide samples of pronunciation that reinforce learners' perception of Japanized sounds in the exercises.

2.8 Word Recognition Training

Word recognition studies in the past have demonstrated that L2 word recognition skills improve through exposure and experience. However, they did not investigate whether instruction can promote natural development. A few researchers have questioned if word recognition training can accelerate language learning. Thus far, only two studies have aimed to increase L2 learners' speed of word recognition, and both employed the index proposed by Segalowitz and Segalowitz (1993) for the verification of the L2 word recognition restructuring.

Akamatsu (2008) conducted one of the studies and investigated whether seven-week word recognition training had an effect on the automatization of word recognition processes. His participants were L1 Japanese university students (with six years of English learning experience) studying L2 English. The training was given as a part of a regular reading class and included a word-chain task in which participants were asked to draw separator lines as rapidly and as accurately as possible between words that had not been printed with any separations within 90 seconds. Lexical decision tasks of high- and low-frequency English words that appeared in the training were conducted before and after the training as the pre- and post-tests. Although the training did not require semantic processing, both accuracy and reaction time improved significantly from pre-test to post-test. Significant reduction of CV_{RT} value was observed for the processing of low-frequency words, but not for that of high-frequency words. The correlation between RT and CV_{RT} of low-frequency words was detected, but the strength was weaker after the training. The author speculated that the participants had already restructured the word recognition models for high-frequency words since they studied English for six years before entering college.

The other training study was conducted by Fukkink et al. (2005), with participants being L1 Dutch learners of EFL. In their first experiment, they provided each participant with two computer-controlled word recognition training sessions: a translation task and a cloze task. Before and after training, the participants completed lexical decision tasks as word recognition tests. The results showed that both accuracies and reaction times for trained words significantly improved, a significant reduction of CV_{RT} value of trained words was observed, and a significant correlation between CV_{RT} and RT was observed in

the post-test. This correlation suggests that the mechanism for restructuring word recognition took place after the training.

The authors' second experiment included more participants and more training sessions that required the semantic processing of familiar and unfamiliar words. In addition to word recognition tests before and after training, participants completed an English reading comprehension test after training because the researchers wanted to study the specific effects of training on reading comprehension. The results showed that, although the training's effects on lexical access skills in L2 were observed, significant training effects were confirmed in the accuracy score of unfamiliar words only due to the ceiling effects for familiar words. The training effects on automatization were also observed for unfamiliar words only. The second experiment sought to determine the relationship between training effects and reading comprehension, but a positive relationship was not found. Considering the complex nature of the reading process, the authors concluded that the small improvement of lower-level processing built during a short period of training would not have a significant impact on higher-level reading comprehension.

The two preceding training studies reviewed targeted intermediate EFL learners, but each of the participant groups had a different L1 background. In one study, L1 and L2 shared the same orthography; in the other, they did not. Although the tasks assigned in their training and the lengths of the training differed from one another, the studies showed parallel results. Their training improved EFL word recognition performances in terms of speed and accuracy and showed qualitative differences in the improvement of EFL word recognition performances with respect to word frequency. The present study

targets novice L2 Japanese learners, and their *katakana* literacy level is considered to be the early beginning level. Like the studies of Akamatsu (2008) and Fukkink et al. (2005), the current study hypothesizes that the effects of the training will differ in improvement of the efficiency of word recognition processing. As the participants will have just been introduced to *katakana* scripts right before the experiment, only practiced words are expected to be associated with automatization, while unpracticed words would be associated with simple speed-up. It is assumed that the participants will need much more practice to process even unpracticed words with automatization.

Grabe and Stroller (2011) explained the importance of bottom-up processes for fluent reading and introduced different types of exercises that would help rapid and automatic word recognition. Word recognition skills are simply a prerequisite for fluent reading; unfortunately the exercises designed to promote these skills require a simple action carried out over and over again, such as finding an exact match from a group of letter strings beside a target word, as Crawford (2005) pointed out. Crawford also addressed the difficulties inherent in adopting them in the classroom due to such simplicity; therefore, he incorporated some additional varieties into the word recognition exercises so that learners could find them practical and meaningful. Although the training involves basic, sometimes monotonous exercises, it is apparent that novice Japanese students still need practice to establish strong relationships between letters and sounds. Hence, this study employs word recognition exercises with the aid of online programs, so that learners can practice word recognition exercises in an interactive manner such as receiving instantaneous feedback. As previously mentioned, speeding up and promoting accuracy are two important elements of lower processing, and they can be easily achieved

if learners are repeatedly engaged in the multimedia-mediated exercises with positive attitudes.

2.9 Online Language Instruction

More and more attention has been paid to the language instruction mediated by online technology as a result of the rapid development of computer software and technology. Consequentially, the number of studies (e.g., Allum, 2002; Blake and Delforge, 2006) comparing traditional classroom instruction and online instruction has been increasing. At the same time, there are many studies that investigate the capability of computer-based vocabulary learning activities in traditional foreign language classroom environment. Sadeghi and Dousti (2014) conducted a study that compared vocabulary gain of young Iranian EFL learners who had different length of exposure to computer-mediated vocabulary exercises. The experimental group used computer software accompanied with the textbook they used. The exercises were used in class after target vocabulary was taught. In contrast, the control group participated in paper-based activities instead. Although they did not find any significant differences of the vocabulary gain on the immediate post-test among the groups including the control group that studied with the textbook, the experimental group engaged in computer-based activities for 30 minutes performed significantly better than the other experimental group engaged in the same activities for 15 minutes and the control group on the delayed post-test.

A similar study was conducted by Hirschel and Fritz (2013) with subjects being university freshmen in Japan who studied English as a foreign language. It had two experimental groups; one is the group practicing a CALL program with spaced repetition

and the other is the one using traditional-style vocabulary notebook. The CALL treatment group individually practiced online at least 30 sessions for two months and the program provided 14 different types of tasks besides introducing the target vocabulary. The vocabulary notebook treatment group created their own notebook outside of class and they were asked to include lexical information, such as part of speech, L2 definition, L1 translation and so forth. The control group was not given any assignment outside of class, but they were exposed to the target vocabulary in class materials. Their result revealed that both experimental groups showed statistically significant vocabulary gain after the treatment, compared to the control group, which did not receive any treatment; however, the gains of the two experimental groups were not significantly different. On the delayed post-test, the CALL group showed better performance than the second experimental group.

Therefore, the two studies reviewed above showed that the computer-assisted vocabulary exercises can provide better long-term effectiveness than traditional vocabulary learning. These findings could help convince language instructors to consider implementing computer-assisted exercises into their curriculum. One of the advantages of the activities mediated by computer technology is to present teaching materials together with images, sound and texts. They can be stimulating enough to enhance learners learning as well as make current practice resources better (Kalyuga, Mantai, & Marrone, 2013). Similarly, you can easily find a great number of Japanese *kana* and *kanji* learning websites and applications online. Although they have been popular and recognized as convenient studying tools by both language learners and instructors, the efficiency of those materials has not been fully demonstrated by empirical research yet. The current

study employs the online word recognition training to develop proficiency in processing *katakana*.

2.10 Summary of Chapter 2

This chapter surveys selected literature of word recognition in L2 reading mainly related to development of word recognition skills in English and Japanese as L2, considering the relevance to the current study. The importance of lower processing of reading has received increasing attention in the area of L2 reading because readers fail to comprehend contents of a text without the competent decoding skills. As evidenced above, L2 language learners are able to cultivate efficiency in decoding skills with experience of being exposed to written materials in their L2. However, the research investigating effectiveness of the word recognition training aimed to improve the skills is scarce. Japanese is considered one of the difficult languages for L1 English speakers to learn because of its complex multiscript writing system as well as non-alphabetic orthographies. It is necessary for L2 learners of Japanese with alphabetic language background to restructure their word processing strategies suitable for Japanese orthographies, which is to process printed letters visually, not phonetically.

Katakana is a set of sound-based syllabaries and has one-to-one correspondences between written forms and sound representations. Since it shares the same sound representations with *hiragana*, a lot of Japanese language instructors surmise that it is not difficult for L2 learners to master. As a consequence, to date methodical *katakana* instruction is not typically provided, although the difficulties of learning *katakana* among language learners have been recognized for at least 30 years. The current study has

created online *katakana* word recognition exercise by exploiting computer-mediated technology so that L2 Japanese learners can receive more opportunities to practice *katakana* outside of Japanese language classrooms at their own pace in the hopes that this will accelerate the efficiency of their lower-level processing skills. The main aim of the exercises is for language learners to establish strong associations between sound representations and *katakana* written forms and to familiarize themselves with Japanized sound systems of loanwords. The exercises are expected to assist them in processing *katakana* words quickly and accurately as well as achieving lexical access. In the following chapter, the research design and methodology of the current study will be described.

CHAPTER 3. METHODOLOGY

3.1 Introduction

This chapter explains the methodological design of the study. The overview of the experimental design, the description of participants, the test materials, the treatments, the measurements, and the analysis are discussed.

3.2 Overview of the Experimental Design

The present study investigates whether online *katakana* word recognition practices have significant effects on the processing of *katakana* loanwords among novice learners of Japanese in a foreign language setting. It also examines whether the training effects are applicable to unpracticed words in reading and inferring the words' meanings. Considering the difficulties of the conversion from English original words into *katakana* and the fluency level of the participants, this quasi-experimental study aims to identify the improvements in enunciation of *katakana* words and retrieval of the meanings, not their transliteration skills, as a result of online exercises. In addition, a post-experimental survey is conducted to elicit learners' perceptions and attitudes toward *katakana* learning experiences with online exercises. Figure 3.1 summarizes the design of the study.

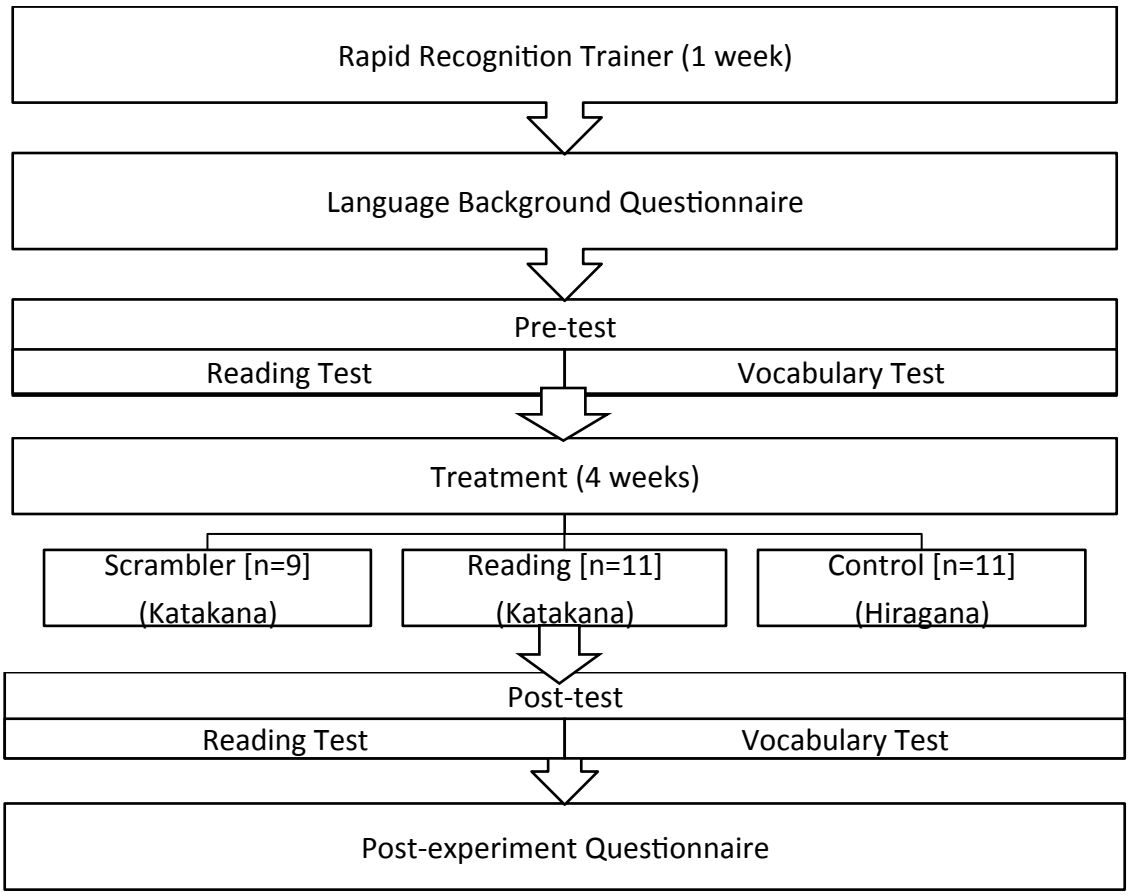

Figure 3.1 Overview of Experimental Design of the Current Study

First of all, all the participants were asked to open an account at CourseSites (http://www.coursesites.com), which is a free online course management system provided to individual educators by Blackboard. Once the learners agreed to participate in this experiment, an invitation to the course website created for the current study was sent by the researcher. All the procedures and communications were conducted online after individual accounts were set up so that the participants were able to access to the links to two questionnaires, training, and test materials though the course website when they were

available online. The participants were allowed to contact the researcher by e-mail whenever there were any questions or technical problems.

When the recruitment ended, 68 students expressed their interest in participating. They were then randomly divided into three different groups: the Scrambler Group, the Reading Group, and the Control Group. Prior to the pre-test, all participants in all three groups were asked to practice with the online *katakana* flashcards ("Rapid Recognition Trainer") for around one week, making use of the time for the participants to set up an account on CourseSites and get accustomed to using it to communicate with the researcher.

After the preliminary week ended, all participants were asked to complete the language background questionnaire (see Appendix A) and the pre-test during the designated four-day period. Upon completion, the participants of each group were assigned to do different exercises as the treatments for four weeks. After the term of treatments (4 weeks) ended, the post-test and post-experiment questionnaire (see Appendix B) were available to all the participants online for four-day period. The participants were asked to complete them, following the same procedure as the pre-test. The details were discussed in the section on materials.

3.3 Participants

Participants of the study were recruited from first-semester Japanese language courses (JPNS 101) at a large public university in the Midwest. The learners who volunteered to participate received monetary compensation (25 dollars) upon completion of the study. Originally, there were 68 students who agreed to participate in the current

experiment when recruiting. Although half of them withdrew from the study upon taking a post-test, a comparable number of participants remained in each group. One of the main reasons that many of them dropped out was that the four-week commitment could have been an extra load during the academic semester. Another possible reason was that the online communication between the participants and the researcher was not always successful both personally and technologically. Thus, the total number of participants was 31 (Male=14 Female=17), and the numbers of participants in each group were the following: the Scrambler Group consisted of nine participants, the Reading Group 11, and the Control Group 11. However, two participants in the Control Group did not complete the post-experimental questionnaire and three participants in the Control Group did not complete either the pre-test or the post-test of the vocabulary test.

According to the language background questionnaire that the participants filled out in the beginning of this study, their ages ranged from 18 to 25, and 27 out of 31 were between 18 and 20. Twenty participants were born in the U.S. and their native language was English. Nine participants were from China; their native language was Chinese and English was their second language. One participant was from Malaysia and her first language was Malay. One was born in the U.S., but his native language was Spanish (See Table 3.1).

Table 3.1 The Gender and L1 Information for Each Group

Group	Sex	Language Background
Scrambler (N=9)	Male (2), Female (7)	English (7), Chinese (2)
Reading (N=11)	Male (6), Female (5)	English (7), Chinese (3), Spanish (1)
Control (N= 11)	Male (6), Female (5)	English (6), Chinese (4), Malay (1)

Twenty-one participants started learning Japanese for the first time after registering for the JPNS101 course. Ten participants studied Japanese at their high schools or by themselves before taking the university course. The length of their studies varied, and so did their mastery of *hiragana* and *katakana*. The participants who studied Japanese for 3-5 years self-evaluated that they had mastered both *hiragana* and *katakana*, but those who studied for less than two years reported that they had mastered only *hiragana* or neither of them yet. Those participants registered themselves for the first-year Japanese course; thus, the researcher considered them as beginning learners and kept them in the current study. A participant who lived in Japan for five years and studied Japanese at a secondary school in Japan was excluded from the study because her background was distinct from other participants. She seemed to master both *hiragana* and *katakana* fairly well. Except for this participant, no one had studied in Japan before this study.

The institution used *Nakama I,* Third Edition (Hatasa et al., 2014), and the present study started after the participants had learned the *katakana* letters, which appeared after the second chapter of the textbook. The participants met for a 50-minute class five times a week, Monday through Friday. They received the same instruction based on shared lesson plans and teaching materials provided by their different instructors. At the point when the data were collected, the students had been receiving Japanese language instruction for approximately two months.

3.4 Materials and Procedures

3.4.1 Pre-test Training

Because the participants had newly learned *katakana,* they were first asked to practice outside of the class for one week with an online preliminary exercise called Rapid Recognition Trainer (http://scratch.mit.edu/projects/10737142/), which was created by Dr. Kazumi Hatasa. The purpose of this exercise was to establish the basic *katakana* letter recognition skills before the treatments were given, because the researcher assumed that some of the participants had not yet mastered all the *katakana* scripts by that point.

This exercise is an online version of *katakana* flash cards and randomly shows *katakana* letters one after another. It allows the participants to choose not only the shuffling speeds (from 0.4 to 1.0 second), but also whether to include model pronunciations. The creator tested this exercise with native speakers to observe their performance speed, and the speed of 0.4 second seems to be the fastest interval native speakers can keep up with when vocalizing each letter. Therefore, the participants were encouraged to start with the 1.0 second interval and speed up by 0.1 second if they wanted to challenge themselves, depending on their level of mastery of *katakana* letters. Figure 3.2 shows the screen of Rapid Recognition Trainer.

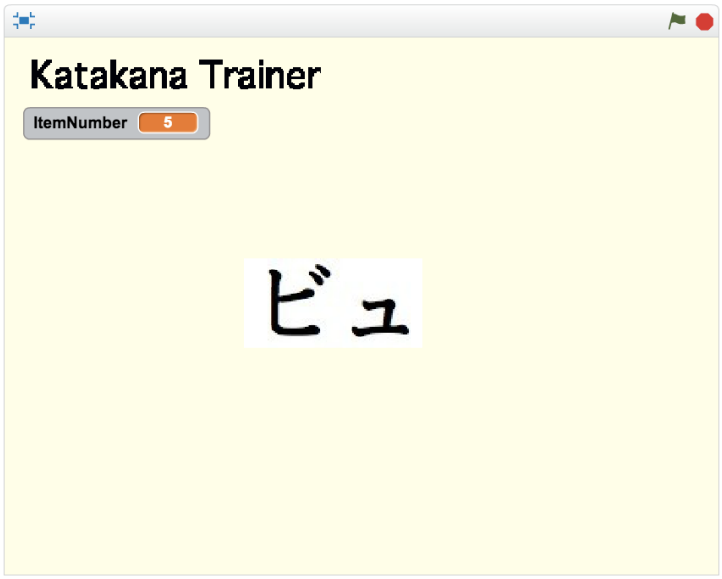

Figure 3.2 Screen of Rapid Recognition Trainer

(Scratch is developed by the Lifelong Kindergarten Group at MIT Media Lab. See http//scratch.mit.edu)

3.4.2 Pre-test and Post-test

Participants then took a pre-test online and completed an introductory questionnaire to enable the researcher to determine the participants' language background information (See Appendix A for the introductory questionnaire). The pre-test consisted of two parts: a reading test and a vocabulary test. In the reading test, participants were asked to read aloud *katakana* words that appeared on a computer screen. An oral training computer application called Speak Everywhere (Fukada, 2013) was employed to collect the data for this task. It enables participants to record their voice on the computer connected to the Internet outside of their classroom. The instructions for the test were shown on the left side of the screen. Figure 3.3 shows a screen of the reading test.

Figure 3.3 Screen of the Reading Test

(Compliments of Dr. Atsushi Fukada, the director of Center for Technology-Enhanced Language Learning)

In the reading test, 60 *katakana* words (30 practice words and 30 unpracticed words) appeared one at a time on the left of the screen. Each word was designed to appear with a recording function with a fixed time limit (10 seconds), and the participants read each word aloud within the time limit. The actual test started with 30 *hiragana* words; thus, the participants were required to read 90 words in total. The words were divided into blocks of three, each of which contained 30 words without mixing *hiragana* and *katakana* words. The whole reading test lasted around 10 minutes, although this depended on the individual participants. The participants were allowed to click the "next" button located at the lower right of the screen when they were ready to move forward; thus, they did not need to wait until the next word appeared.

The same word set used for the reading test was also used for the vocabulary test, but only *katakana* words. The test was provided through the university's Qualtrics system

(http://www.qualtrics.com), a web-based survey software tool. All 60 *katakana* words were listed on a single webpage, and the Figure 3.4 shows a part of the screen of the vocabulary test. The participants were asked to type an English equivalent for each word within a 20-minute time limit. They were allowed to close the page if they finished before the time limit ended. However, when the time limit came, the page was automatically closed. The participants were instructed not to consult any external resources such as textbooks or dictionaries during the tests. The format of the post-test was the same as that of the pre-test, but the orders of the questions were changed.

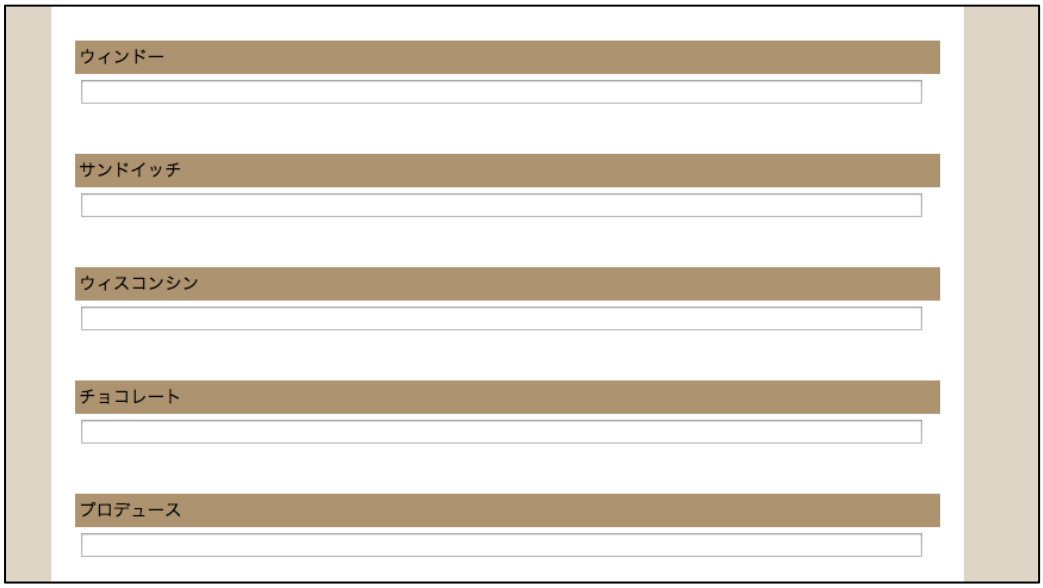

Figure 3.4 A Part of the Screen of the Vocabulary Test

(The screenshot was generated from Qualtrics software. Qualtrics and all other Qualtrics product or service names are registered trademarks of Qualtrics, Provo, UT, USA. http://www.qualtrics.com)

3.4.3 Selection of *Katakana* Words in the Pre- and Post-tests

As explained in the previous section, the pre- and post- tests contained 60 *katakana* words; 30 practice words and 30 unpracticed words (See Appendix C for the

list of the test items). The practice words for the tests were selected from the *katakana* chapter of *Nakama I* that the Japanese course had already covered at the time of the testing. The chapter introduced eight conventions applied in transcribing English words into *katakana* with example loanwords (See Appendix D for the rules and conventions of transcribing *katakana* from *Nakama I*) and presented a list of *katakana* words for practice on the following page. It includes around 80 words categorized into topics such as food, sports, countries and so on.

Practice words were chosen from those pages, and each word included at least one transliteration to which the transcribing rules presented in the chapter apply, so that a list for the 30 practice words encompassed the aforementioned rules of *katakana* transcription. Unpracticed words were selected from the Japanese Academic Word Data of the Vocabulary Database for Reading Japanese (VDRJ) Ver. 1.01 (Matsushita, 2011). Because the database contained an enormous amount of words, several steps were taken to select the 30 words. First, the words that included special sounds originating in foreign words, such as "ウィ," "シェ," and "フォ," were selected from the database. Then the researcher checked whether these words included transliterations to which the other conventions applied. The words that included more than two transliterations applicable to the conventions were moved to the next selection stage. In addition, they were referred to the English word frequency list (Corpus of Contemporary American English, http://corpus.byu.edu/coca/), and the words listed higher in terms of frequency were prioritized over other words if those two words included the same *katakana* letter of transliteration.

Each set of words was comprised of 5 four-letter long words, 10 five-letter long words, and 15 six-letter long words in order to control the length of the words, which could affect the participants' speed of processing the words. Moreover, 20 words out of the 30 started with unvoiced consonants and 10 words with voiced consonants. The detailed procedure of measuring response time will be described later in the section pertaining to scoring, but initial sounds were matched between two different conditions because voiceless obstruent consonants are not consistently visualized in the waveforms (Jiang, 2012).

3.5 Treatments

3.5.1 Procedure

Between the pre- and post-tests, the participants practiced outside of class for four weeks with online *katakana* word recognition practice programs. They were asked to go to the designated websites to practice individually for five to 10 minutes every day for four weeks. One exercise was assigned for each week and the participants practiced it repeatedly. Each exercise consisted of 15 words and those items were randomized every so often for the participants to practice them in a different order every time. The online exercises of this current study were created by using Scratch, a programming language developed by the Lifelong Kindergarten Group at the MIT Media Lab (See http://scratch.mit.edu). The exercises were uploaded on the Scratch website and the links were distributed to the participants through the CourseSites website.

The calendar of this training study was posted on the course site, and each participant was instructed to do the assigned exercise every day for five to ten minutes. The links to the exercises were posted on the course management site, and it was possible to keep track of those who logged in for the practice; however, students' participation was basically self-reported by the participants in the post-experiment questionnaire. The researcher occasionally checked their login history on CourseSites and sent a reminder by e-mail to the participants who did not seem to have logged in for a couple of days. The participants were told to practice with their own personal computers, tablet PCs, or computers in a lab on campus. Figure 3.5 shows the online calendar given to the participants.

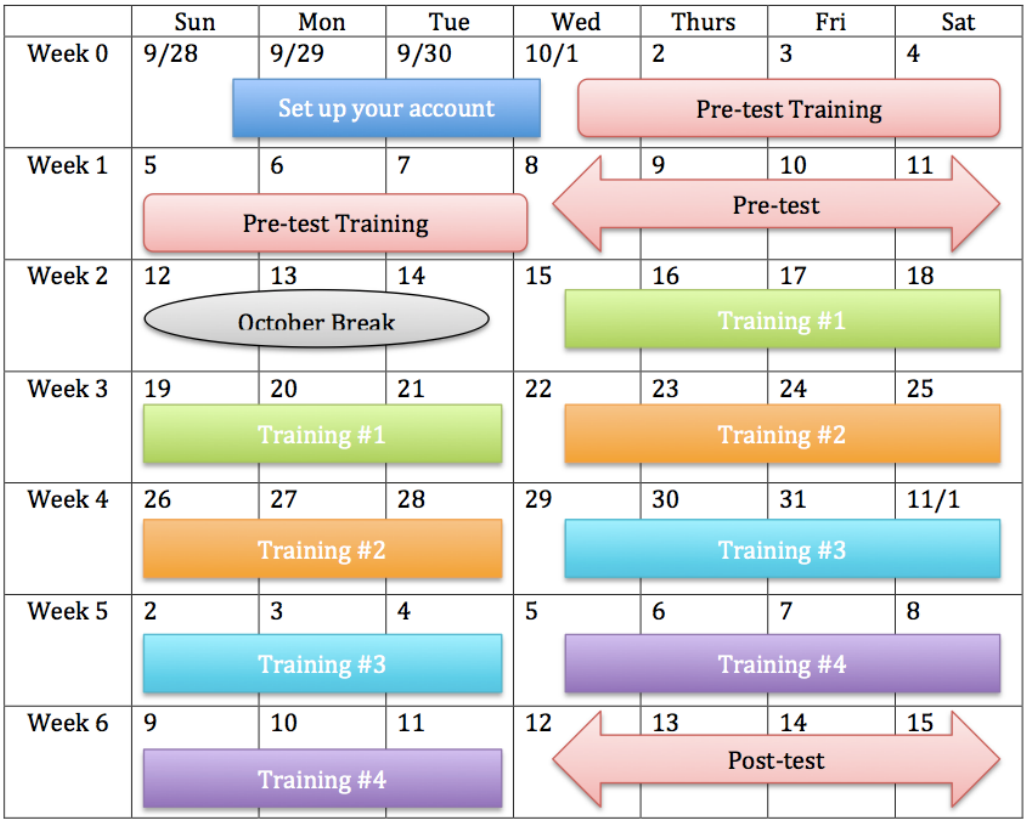

Figure 3.5 Calendar for the Current Study Given to the Participants

3.5.2 The Scrambler Group

The first experimental group, the Scrambler Group, practiced with the Katakana Scrambler (http://scratch.mit.edu/projects/11525889/). Katakana Scrambler is an online exercise in which learners put randomly scrambled letters of a *katakana* word into the correct order to create a real word by clicking each letter while listening to the sound file of the target word, which is played automatically. This process of unscrambling forces the participants to establish an association between sounds and letters by receiving aural information first and then placing the letters into an appropriate order. When a wrong letter is chosen, a cross sign (x) will be provided as feedback to indicate a mistake. Figure 3.6 shows a screen of Katakana Scrambler.

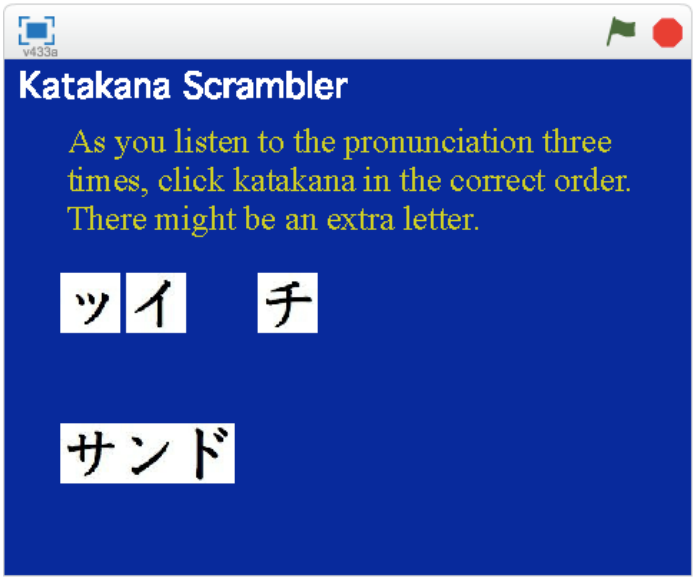

Figure 3.6 Screen of Katakana Scrambler

(Scratch is developed by the Lifelong Kindergarten Group at MIT Media Lab. See http//scratch.mit.edu)

The program has an option of adding an extra letter to a string of letters, making the unscrambling procedure more difficult by adding a letter that is problematic for Japanese language learners to recognize because of its unique Japanese sound or shape. The exercises during the latter two weeks of training used the function so that the difficulty of the task gradually increased over four weeks, although the same 30 practiced words were used in the third and fourth week. The words used for the exercises were the practice words mentioned in the previous section; thus, they appeared in both the pre- and post-test. The exercise can be considered a more cognitively demanding task than merely reading aloud, which is another treatment discussed in the next section.

3.5.3 The Reading Group

Meanwhile, the second experimental group, the Reading Group, practiced with the same set of the words solely by reading aloud. The format looks similar to that of Katakana Scrambler, but in this exercise each target word appears on the screen, and the participants in this group were instructed to read it aloud before the model reading played. They could then confirm whether their own reading was identical to the model or not by listening, but did not receive any online individual feedback. Figure 3.7 shows a screen of Katakana Reader (https://scratch.mit.edu/projects/29630836/). In the first and second weeks, the model reading was provided five seconds after each word was presented. In the third and fourth weeks the time was shortened, and the model was provided three seconds after each word because the same word set was used. Katakana Reader is more like an online version of a conventional classroom exercise.

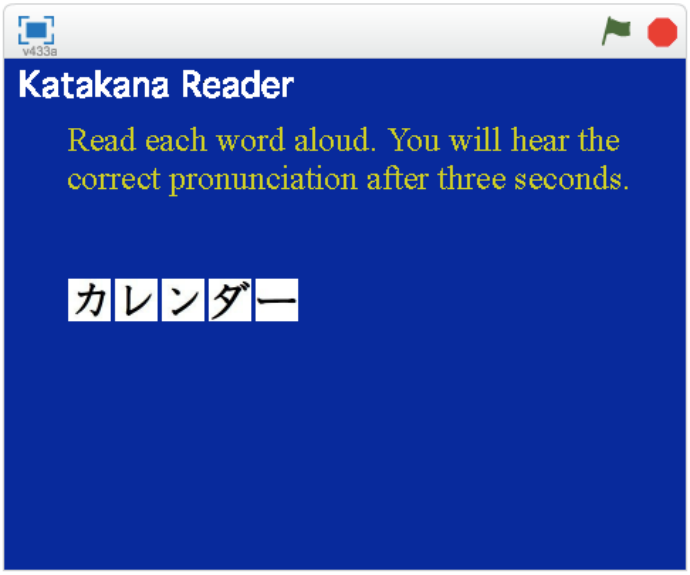

Figure 3.7 Screen of Katakana Reader

(Scratch is developed by the Lifelong Kindergarten Group at MIT Media Lab. See http//scratch.mit.edu)

3.5.4 The Control Group

The participants in the Control Group practiced Japanese original vocabulary with a *hiragana* version of the Katakana Scrambler. The system of the Hiragana Scrambler (https://scratch.mit.edu/projects/29631622/) was exactly the same as its *katakana* version, except using *hiragana* letters. The words for practice were chosen from the chapters the participants were studying in their course. The function of adding an extra letter to a string of letters of a word was employed as well, but it appeared during the second week and the fourth week. Thus, the participants practiced the *hiragana* words they studied in class at that moment. Figure 3.8 shows a screen of Hiragana Scrambler.

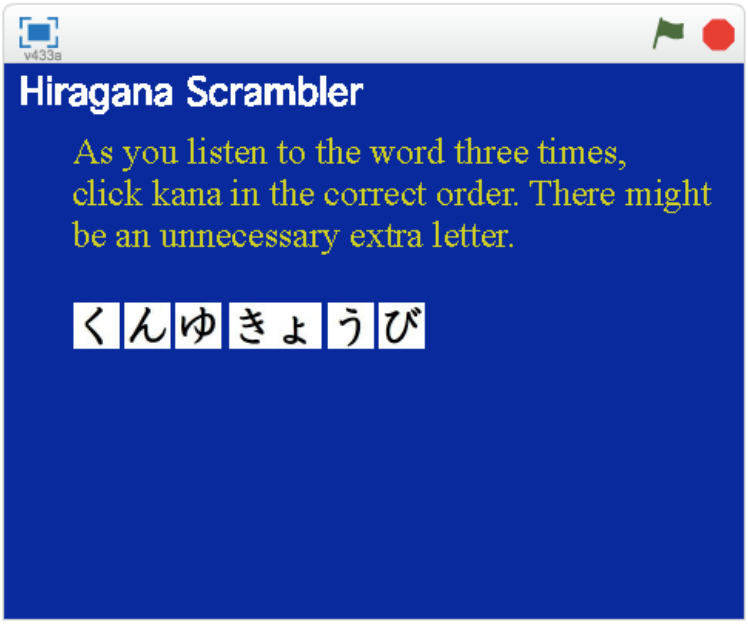

Figure 3.8 Screen of Hiragana Scrambler

(Scratch is developed by the Lifelong Kindergarten Group at MIT Media Lab. See http//scratch.mit.edu)

Hence, the Control Group did not practice with any *katakana* words in the treatment of this current study. Furthermore, the two experimental groups, the Scrambler Group and the Reading Group, practiced only the 30 practice *katakana* words, and none of the three groups practiced the 30 unpracticed words in the course of their treatments. The idea of the Katakana Scrambler came from one of the trial exercises created by Quackenbush and Fukada (1993) and they offered four different computer-assisted *katakana* exercises, but all of them have English translation as a stimulus. Then, learners are asked to choose from a given set of *katakana* letters or type them themselves. However, if English translations are given, learners tend to be influenced by English pronunciations or spellings when they read the Japanese counterparts. Therefore, the exercises of the current study is based on one of their exercises, but excluded English

translations of target *katakana* words and attempted to promote the participants' awareness of associations between typical *katakana* spelling patterns and original English sounds. Instead, aural information was provided as a cue by playing the sound files of practiced words.

The exercise assigned to the Reading Group is similar to one of the common means employed in a Japanese language classroom after introducing *katakana* letters, especially in time-constrained classrooms. In general, instructors show *katakana* words to their students in class and make them read each word aloud for practice and check whether they can recognize newly learned *katakana* letters as well as a string of letters as a word. The students, then, are usually given writing tasks in and outside class—for example, finishing several pages of the accompanying workbook, which usually includes converting *katakana* loanwords into English or vice versa. Thus, the Reading Group has extra opportunities to practice outside the classroom in a way similar to classroom instruction, and so it serves as a secondary experimental group that is expected to outperform the control group, but not the first experimental Scrambler Group. If the Reading Group improves as significantly as the Scramble Group in *katakana* recognition, we could conclude that the amount of exposure to *katakana* words is key for the *katakana* practice.

3.6 Survey Questions

In order to explore participants' attitudes toward the online exercises, the post-experiment questionnaire was completed online by the participants after the post-test in addition to the introductory questionnaire. The introductory questionnaire was conducted

to collect the participants' background information, such as sex, age, country of birth, first and additional languages, and history of learning Japanese. The post-experimental questionnaire was composed of two parts. The first part included 15 closed questions with 6-point Likert-scale evaluation questions (ranging from strongly agree to strongly disagree) to measure their impressions and thoughts toward the online exercises they were engaged in and general attitudes regarding online exercises. The second part contained three open questions asking about the advantages and disadvantages of the online exercises they practiced with and were answered in the participants' own words (see Appendix B for the post-experimental questionnaire). It also included two closed-answer questions asking the frequency of their practice and the devices they utilized for their practice.

3.7 Scoring Procedure

For the reading test, the researcher listened to all the sound files downloaded from the Speak Everywhere site using the Audacity software (http://www.audacityteam.org). The responses of each participant were transcribed and the time each participant took to enunciate a test item correctly within the time limit was measured. The Audacity software allowed the researcher to inspect the sound files by not only listening to but also looking at waveforms with a time scale to help determine the point when a participant initiated vocalizing each word. Since the recording function of the Speak Everywhere website was set up to start when a target word was presented, the time from a beginning of the file until the starting point of a participant's vocalization was measured up to the fourth decimal point. Only correct responses were measured. Because only the researcher

inspected the data, the manner of reading the data is described as follows. First, the researcher listened to the sound files participant by participant, and all the answers were transcribed into *katakana* letters. The answers the researcher found difficult to transcribe were considered as not precise reading. The answers, including sounds of whose correctness the researcher was unsure, were transcribed into *katakana* anyway and were kept as marked. After finishing the first transcription procedure, the researcher listened to the problematic files as mentioned above again word by word, comparing the words containing similar sounds hard to judge, and then decided on their acceptability.

Any sound files shorter than ten seconds were separately analyzed as censored items. In those files, a participant was saying something but the file ended in the middle of recording. Two different reasons were posited for the events; one could be because a participant had pressed the next button accidentally even though he or she was about to vocalize or was vocalizing; the other could be due to a technical problem. Furthermore, a few sound files failed to be uploaded to the Speak Everywhere site due to another technical problem, although those participants seemed to have completed all the questions. These items were also excluded and considered as censored items like the cases above. Then, the response time for each participant was estimated by survival analysis, instead of simply averaging only the observed response times.

The reading accuracy of each participant was indicated by counting the number of the test items he or she was able to read accurately. For the participants who had censored items the number of such observations was subtracted from the total number of test items, while those who completed the reading test perfectly had 30 answers for each word type

in total. Thus, each participant had four different values for the reading test—an estimated response time and accuracy rate for both practice words and unpracticed words.

Regarding the vocabulary test, the number of the test items for which the participants were able to provide correct English equivalents was calculated as their accuracy rate of the vocabulary test. The spelling mistakes due to typographical errors were ignored because the participants were typing the answers under time pressure. There were two items that had two possible answers in the test. The first one was "フォーク" with the English equivalents "folk" and "fork." The other was "スピード"; "speed" and "*Speedo"*, a brand name of swimsuits. There were two values for each participant: an accuracy rate for practice words and unpracticed words.

3.8 Analysis

In order to determine the effects of the experimental treatments, the current study examines the improvements between the pre-test and the post-test after the treatment among word recognition training groups (the Scrambler Group and the Reading Group) and the Control Group. A statistical program, SAS 9.4, was used to perform a linear mixed-effects analysis of the relationship between *katakana* word recognition efficiency of novice language learners of Japanese and exercises types. As fixed effects, treatments (three groups) and word types (practice vs. unpracticed) were entered into the model. Subject was considered as a random effect. The alpha significance level was set to 0.05.

In order to examine research questions 1, 2 3, and 4, a linear mixed-effects model was performed with the response time, the accuracy rate of the reading test, and the

accuracy rate of the vocabulary test respectively. Subsequently, Tueky-Kramer test was performed to compare improvements between the groups.

To determine an automatization of their word recognition performance, which is research question 5, the formula created by Segalowitz and Segalowitz (1993) was used. A correlational analysis between the mean of reaction times and coefficient of variability of the mean reaction times was conducted for the Scrambler Group as well as each word type by using Pearson product-moment correlation.

Additionally, to investigate the participants' attitude toward the online *katakana* exercises, responses to the post-questionnaire were analyzed based on the distribution of the Likert-scale scores of each question. In addition, the answers to the open questions were analyzed qualitatively to further explore the participants' perceptions of the treatments.

3.9 Summary of Chapter 3

This chapter discusses the overview of the experimental design, the description of the participants, the test materials, the treatments, the measurements, and their analyses. In the following chapter, the results of the above tests will be examined.

CHAPTER 4. RESULTS

4.1 Introduction

This chapter discusses the results of the data analysis to examine the six research questions in the current study. The first and second research questions tested the facilitative effects of the Katakana Scrambler and the Katakana Reading exercises on *katakana* word recognition for novice learners of Japanese. The efficiency was measured by the mean estimated response time and accuracy rate of the practiced words on the reading task. The third research question examined whether the Scrambler Group and the Reading Group showed similar improvement in the performance of processing words not included in their training. The transfer effect was measured by the mean estimated response time and accuracy rate of the unpracticed words on the reading task. The fourth research question investigated whether the *katakana* reading process of the Scrambler Group was qualitatively different, depending on the word types. In other words, it examined whether the participants processed practiced words via automaticity or via speed-up. The qualitative difference was measured by a correlational analysis between the mean estimated response time (RT) and the coefficient of variation (CV) of the response time (CV_{RT}). The fifth research question examined whether the aforementioned two word recognition exercises had facilitative effects on retrieving the meanings of practiced words after the training for the novice learners of Japanese. The effects were

measured by the differences of the accuracy rate of the vocabulary test between the pre-test and post-test and comparing the groups. The sixth research question tested whether the Scrambler Group and the Reading Group retrieved more accurately the meanings of unpracticed words after the training. The gain in accuracy rate on the vocabulary test was compared between the tests to see the transfer effects.

In order to answer these research questions, this section discusses the results of quantitative analyses of the reading and vocabulary test scores, comprised of both descriptive statistics and statistical analysis. The results of the pretests are presented (section 4.2), followed by the results of the post-tests with descriptive statistics (section 4.3), and the statistical analysis of the results and the hypotheses testing (section 4.4) follows.

4.2 Pre-test

The results of descriptive statistics of the pretest scores for the reading test and vocabulary test are summarized in Table 4.1. The numbers of subjects in each treatment group are indicated next to the treatment names in parentheses.

Table 4.1 Descriptive Statistics of Pre-test: Reading and Vocabulary Tests

Test	Reading Test				Vocabulary Test	
DV	Response Time (s)		Accuracy Rate (%)		Accuracy Rate (%)	
Word Type	P	U	P	U	P	U
Scrambler (n=9)						
M	4.60	4.95	46.43	38.98	54.81	43.33
SD	1.32	1.47	20.88	27.61	22.80	21.21
Reading (n=11)						
M	4.67	3.94	44.62	40.53	57.88	56.36
SD	2.14	1.39	20.43	26.34	23.49	22.18
Control (n=11)						
M	3.39	3.81	46.56	39.52	62.50	58.75
SD	1.32	1.47	19.55	24.16	20.68	26.30

P=practiced words; U=unpracticed words

In order to examine whether three groups were homogeneous before receiving the treatments, the response time and accuracy rates on the pre-tests (the reading test and the vocabulary test) were analyzed by a mixed effects model. The independent variable was the group (Scrambler, Reading, and Control) and the dependent variables were the estimated response time and accuracy rates of the reading and vocabulary tests. The results of the mixed effects model of analysis confirmed that there were no significant differences among the group means of the three dependent variables before the treatments were given ($F=2.03$, $p=0.1508$ for the response time of the reading test; $F=0.00$, $p=0.9987$ for the accuracy rate of the reading test; $F=0.63$, $p=0.5419$ for the accuracy rate of the vocabulary test). Thus, any comparative effect attributed to the training will not be ascribed to prior *katakana* processing skills of any of the groups.

4.3 Post-test

4.3.1 Descriptive Statistics of Reading Test

Table 4.2 presents a summary of the means and standard deviations for the estimated response time for the reading test of each group. Figures 4.1 and 4.2 graphically show the overall change of the estimated response time of reading test of each group's mean between the pre-test and post-test respectively, depending on the word type. The descriptive statistics demonstrate that the Scrambler Group and the Reading Group decreased their estimated response times of practiced words after the training, while that of the Control Group slightly increased after the training.

Regarding the processing efficiency of unpracticed words, the Scrambler Group gained speed in response after the training. On the other hand, the Reading Group slowed down in reading unpracticed words. As a result, the mean estimated reaction time of the Reading Group on the post-test was longer than that of the pre-test. The Control Group did not demonstrate any notable change between the pre-test and post-test, and the mean of their estimated reaction time on the post-test was slightly slower than that of the pre-test.

Table 4.2 Summary of the Means and Standard Deviations for Response Times of Reading Test

Word Type	Practiced				Unpracticed			
Test	Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD
Scrambler (n=9)	4.60	1.36	3.22	0.84	4.95	1.40	4.13	1.51
Reading (n=11)	4.67	2.14	3.40	0.91	3.94	1.39	4.62	1.01
Control (n=11)	3.39	1.32	3.65	1.28	3.81	1.47	3.94	1.2

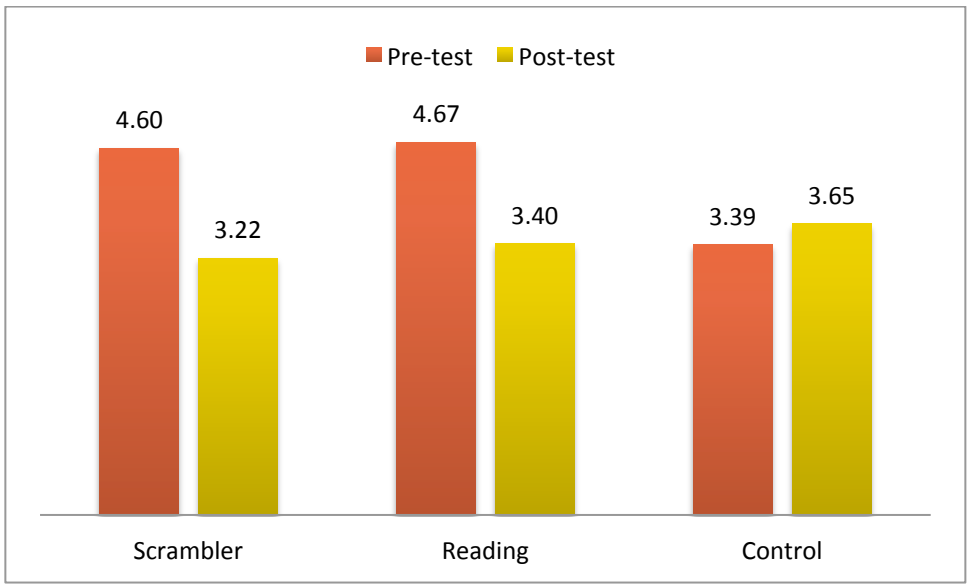

Figure 4.1 Mean Estimated Response Times of Practiced Words in Reading Test on Pre- and Post-tests

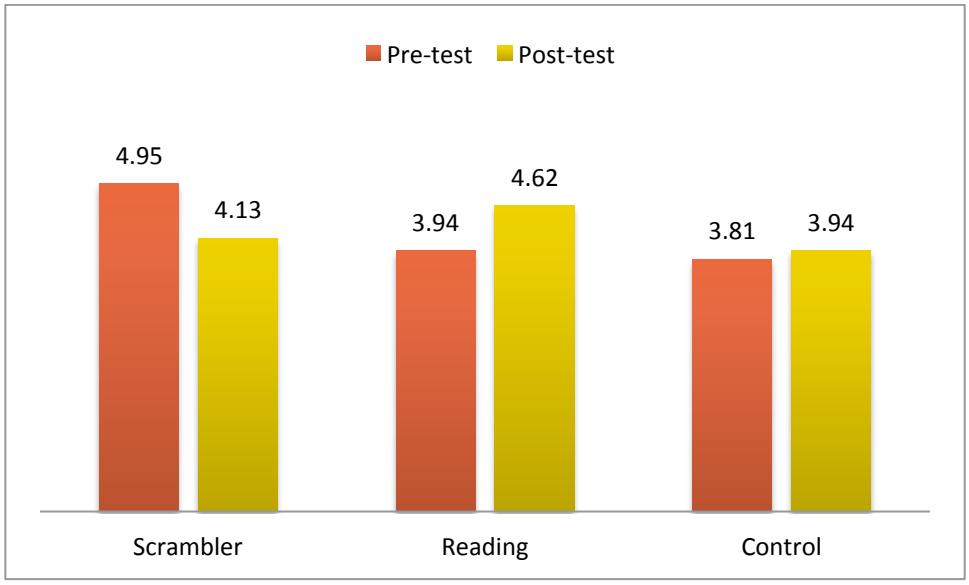

Figure 4.2 Mean Estimated Response Times of Unpracticed Words in Reading Test on Pre- and Post-tests

Table 4.3 displays a summary of the means and standard deviations for accuracy rate of reading test of each group and test. Figures 4.3 and 4.4 show the overall change of accuracy rate of each group's mean of word types respectively between the pre-test and post-test.

Although the three groups had relatively similar accuracy rates for practiced words on the pre-test, the Reading Group exhibited the most improvement in the accuracy rate of practiced words, followed by the Scrambler Group and the Control Group. Regarding the accuracy of reading unpracticed words, all three groups improved their accuracy rates after the training, but the gain of the Control Group was the largest among the three, followed by the Reading Group and the Scrambler Group.

Table 4.3 Summary of the Means and Standard Deviations for Accuracy Rates (%) of Reading Test

Word Type	Practiced				Unpracticed			
Test	Pre		Post		Pre		Post	
	M	SD	M	SD	M	SD	M	SD
Scrambler (n=9)	46.43	20.88	68.67	19.42	38.98	27.61	43.21	21.03
Reading (n=11)	44.62	20.43	74.00	22.00	40.53	26.34	53.26	24.09
Control (n=11)	46.56	19.55	56.88	20.54	39.52	24.16	54.52	24.16

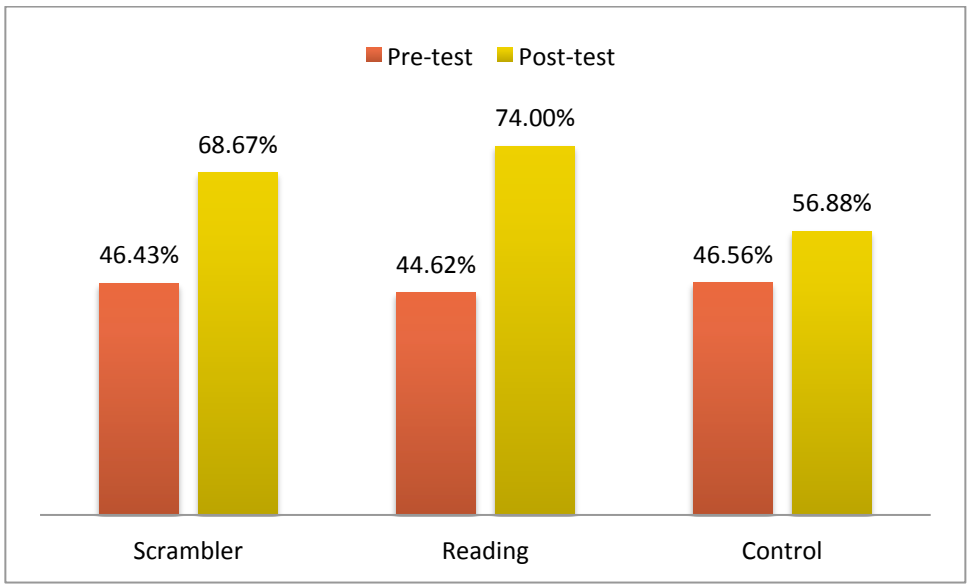

Figure 4.3 Mean Accuracy Rates of Practiced Words in Reading Test on Pre- and Post-tests

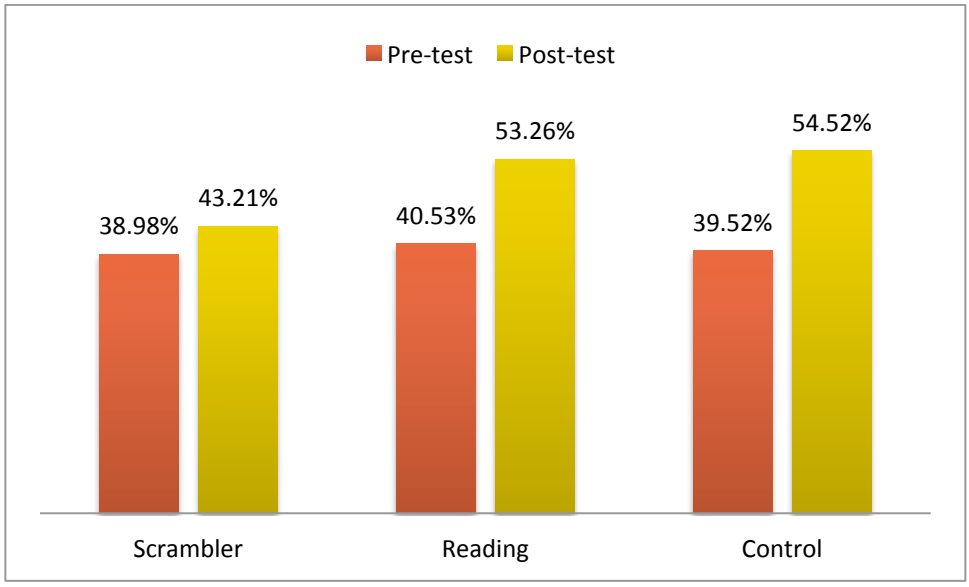

Figure 4.4 Mean Accuracy Rates of Unpracticed Words in Reading Test on Pre- and Post-tests

4.3.2 Descriptive Statistics of Vocabulary Test

Table 4.4 displays a summary of the means and standard deviations for the accuracy rate for vocabulary test of each group and test. Figures 4.5 and 4.6 demonstrate the overall change in each group's mean of accuracy rate by word type respectively between the pre-test and post-test.

The experimental groups engaged in online *katakana* training showed favorable improvement in their accuracy rates of practiced words regardless of the types of training. Their mean scores surpassed those of the Control Group, although the pre-test score of the Control Group was the best of the three. Furthermore, these experimental groups increased their accuracy rates of unpracticed words around 20% more than those of the pre-test. Even the Control Group, however, improved as much as the experimental groups did. Thus, it is unreasonable to conclude that the training effects are observable only in the treatment groups.

Table 4.4 Summary of the Means and Standard Deviations for Accuracy Rates (%) of Vocabulary Test

	Practiced				Unpracticed			
	Pre		Post		Pre		Post	
Group	M	SD	M	SD	M	SD	M	SD
Scrambler (n=9)	54.81	22.80	81.48	15.47	43.33	21.21	63.33	18.71
Reading (n=11)	57.88	23.49	83.33	13.08	56.36	22.18	76.97	18.94
Control (n=8)	62.50	20.68	77.92	23.43	58.75	26.30	76.25	27.16

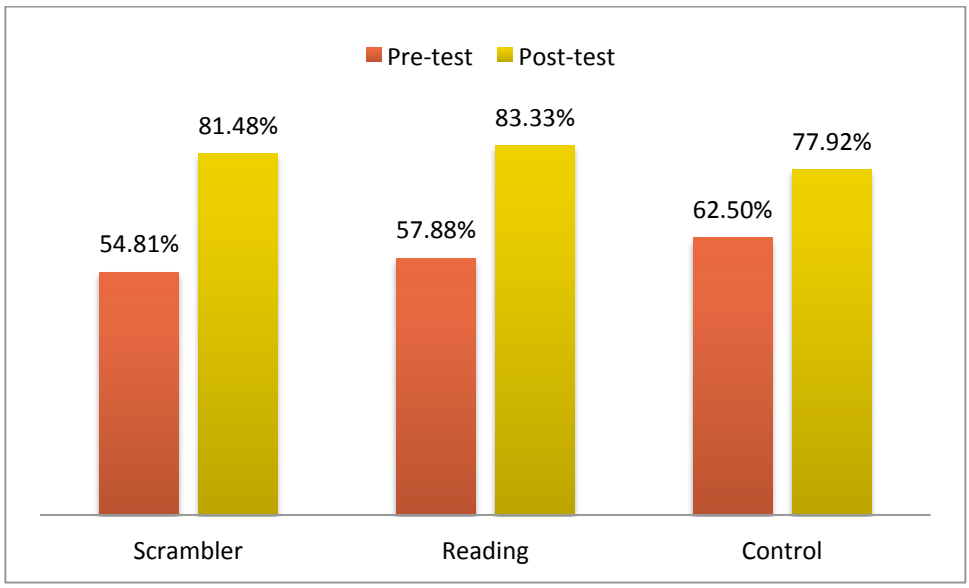

Figure 4.5 Mean Accuracy Rates of Practiced Words in Vocabulary Test on Pre- and Post-tests

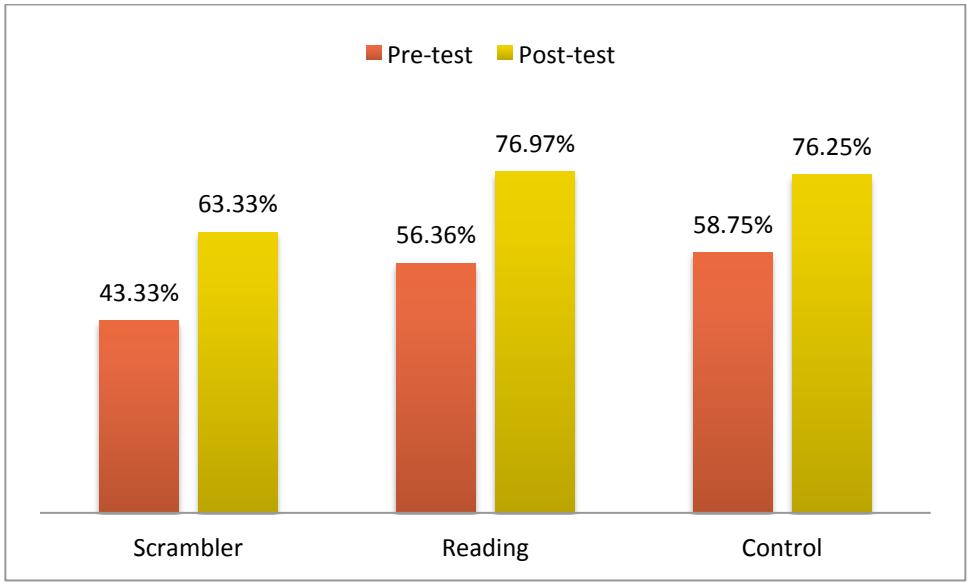

Figure 4.6 Mean Accuracy Rates of Unpracticed Words in Vocabulary Test on Pre- and Post-tests

4.4 Statistical Analyses and Hypotheses Testing

Research Question 1

In order to answer the first research question, "Can novice learners of Japanese significantly improve their *katakana* word recognition efficiency after the training?", Hypotheses 1 and 2 were examined.

Hypothesis 1: Both the Scrambler Group and the Reading Group should be able to read practiced words faster than the Control Group.

A mixed effects model of analysis was employed to examine *katakana* word recognition efficiency among the three groups. The independent variables were the groups (Scrambler, Reading, and Control), the tests (pretest and post-test) and the word types (practiced and unpracticed), and the dependent variable was the estimated response time for practiced words on the pre-test and post-test. The model was also set to produce ANOVA results with up to three-way interactions that took within-subject correlation into account.

The results of the pairwise within-subjects comparisons show that both the Scrambler Group and the Reading Group displayed a greater tendency to read practiced words faster after the training (t=-3.22, p=0.0742 for the Scrambler Group; t=-3.29, p=0.0607 for the Reading Group). However, the difference between the experimental groups and the Control Group was not significant (t=-0.71, p=0.9999 for between the Scrambler and Control Groups, t=-0.44, p=1.000 for between the Reading and Control Groups). Thus, Hypothesis 1 was rejected.

Hypothesis 2: Both the Scrambler Group and the Reading Group should be able to read practiced words more accurately than the Control Group.

In order to examine Hypothesis 2 the same model was utilized, with the accuracy rate of practiced words on the pretest and post-test being the dependent variable. A comparable tendency to the changes in response time on the reading test was observed regarding the changes in the mean accuracy rates of practiced words among the three groups. Both the Scrambler and the Reading Group significantly improved their accuracy in reading practiced words after the training ($t=4.66$, $p=0.0007$ for the Control Group; $t=6.80$, $p<.0001$ for the Reading Group). However, the differences between the groups were not statistically significant ($t=1.16$, $p=0.9908$ for between the Scrambler and the Control Groups; $t=1.77$, $p=0.8291$ for between the Reading and the Control Groups). Thus, Hypothesis 2 was not supported either.

Research Question 2

Since the first research question was not confirmed, the second research question, "If yes, will the Scrambler Group significantly outperform the Reading Group in terms of speed and reading accuracy?" was unable to confirm either. Still, the statistical analysis is reported in the following.

Hypothesis 3: The Scrambler Group should be able to read faster and more accurately practiced words than the Reading Group.

According to the results of the mixed effects model of analysis employed to answer the first research question, the differences between the Scrambler and the Reading

Group were not significant (t=0.29, p=1.000 for difference in the response time; t=0.52, p=1.000 for difference in the accuracy rate). Therefore, Hypothesis 3 was not supported either.

Research Question 3

In order to answer the third research question, "Can the Scrambler Group and the Reading Group show similar improvement in the performance of processing unpracticed words?", the same analytical procedure was undertaken as the one for processing practiced words, and thereafter Hypotheses 4, 5, and 6 were examined. Tables 4.5 and 4.6 display a summary of t-values and p-values of multiple comparisons of response time and accuracy rate of reading test respectively.

Table 4.5 Summary of t-values and p-values of Multiple Comparisons of Response Time of Reading Test

Group	Comparison between word type/test			t-value	p-value
Scrambler	Practiced Post	vs.	Practiced Pre	-3.22	0.0742
	Unpracticed Post	vs.	Unpracticed Pre	-1.92	0.7423
	Practiced Post	vs.	Unpracticed Post	-2.11	0.6150
Reading	Practiced Post	vs.	Practiced Pre	-3.29	0.0607
	Unpracticed Post	vs.	Unpracticed Pre	1.76	0.8348
	Practiced Post	vs.	Unpracticed Post	-3.15	0.0876
Control	Practiced Post	vs.	Practiced Pre	0.68	0.9999
	Unpracticed Post	vs.	Unpracticed Pre	0.35	1.0000
	Practiced Post	vs.	Unpracticed Post	-0.74	0.9998

** p<.01 and *p<.05

Table 4.6 Summary of t-values and *p*-values of Multiple Comparisons of Accuracy Rate of Reading Test

Group	Comparison between word type/test		t-value	*p*-value
Scrambler	Practiced Post	vs. Practiced Pre	4.66	0.0007**
	Unpracticed Post	vs. Unpracticed Pre	0.89	0.9991
	Practiced Post	vs. Unpracticed Post	5.33	<.0001**
Reading	Practiced Post	vs. Practiced Pre	6.80	<.0001**
	Unpracticed Post	vs. Unpracticed Pre	2.95	0.1433
	Practiced Post	vs. Unpracticed Post	4.80	0.0004**
Control	Practiced Post	vs. Practiced Pre	2.39	0.4244
	Unpracticed Post	vs. Unpracticed Pre	3.47	0.0366*
	Practiced Post	vs. Unpracticed Post	0.55	1.0000

** $p<.01$ and * $p<.05$

Hypothesis 4: The Scrambler Group became able to read unpracticed words faster.

As mentioned in section of the descriptive statistics of the reading test, the average estimated response time of unpracticed words on the post-test was reduced from that of the pre-test (from 4.95s to 4.13s); however, the difference between the pre-test and the post-test was not statistically significant (t=-1.92, p=0.7423). When the estimated response time of practiced words on the post-test and that of unpracticed words on the post-test were compared, the difference was not statistically significant either (t=-2.11, p=0.6150). This fact indicates that the Scrambler Group became able to read unpracticed words in a similar manner to reading practiced words on the post-test. Although it was not statistically significant (t=-3.22, p=0.0742), the Scrambler Group considerably reduced its mean response time of practiced words on the post-test. Consequently the processing speeds of practiced words and unpracticed words of the Scrambler Group on the post-test were not significantly different. Thus, Hypothesis 4 was partially supported.

Hypothesis 5: The Scrambler Group became able to read unpracticed words more accurately.

As the descriptive statistics of the reading test illustrated, the improvement of reading accuracy of unpracticed words of the Scrambler Group was not obvious. The difference in the means of accuracy rate of unpracticed words between the pre-test and post-test was not statistically significant ($t=0.89$, $p=0.9991$). Moreover, the difference in accuracy rate on the post-test between practiced and unpracticed words was significant ($t=5.33$, $p<0.0001$), which implies that the Scrambler Group did not significantly improve their accuracy of reading unpracticed words as a result of the training. Therefore, Hypothesis 5 was rejected.

Hypothesis 6: The Reading Group and Control Group did not show any improvement in the performance of processing unpracticed words.

According to the descriptive statistics of the reading test, both the Reading Group and Control Group slowed down in responding to unpracticed words. The difference in means of reading response time of the unpracticed words between the pre-test and post-test for each group was not significant ($t=1.76$, $p=0.8348$ for the Reading Group; $t=0.35$, $p=1.0000$ for the Control Group). Thus, they did not show any improvement in reading unpracticed words after the treatments in terms of processing speed. With regard to the accuracy of reading, the Reading Group showed significant improvement on practiced words ($t=6.80$, $p<0.0001$), but not on unpracticed words ($t=2.95$, $p=0.1433$). Because the comparison between the two types of words on the post-test was significant ($t=4.80$, $p=0.0004$), they did not demonstrate similar improvement on the accuracy of reading

unpracticed words. Although the Control Group significantly improved their accuracy of reading unpracticed words after the training (t=3.47, *p*=0.0366), they did not improve that of practiced words (t=2.39, *p*=0.4244). Moreover, the difference between the practiced and unpracticed words on the post-test was not significant (t=0.55, p=1.000), which means their accuracy rate of unpracticed words was similar to that of practiced words. Hence, Hypothesis 6 was supported.

Research Question 4

In order to explore the fourth research question, "If the Scrambler Group read faster both practiced and unpracticed words after the treatment, is the *katakana* reading process of the Scrambler Group qualitatively different depending on the word types, practiced or unpracticed words? In other words, do they process practiced words via automaticity?", Hypothesis 7 was examined by employing a Pearson product-moment correlation between the mean estimated response time (RT) and the mean coefficient of variation (CV) of the estimated response time (CV_{RT}), even though the reduction of the estimated response time was not statistically significant (t=-3.22, *p*=0.0742).

Hypothesis 7: The Scrambler Group processes practiced words via automaticity as a result of training, but unpracticed words via speed-up. The strong correlation should be observable only between the mean RT and mean CV_{RT} of the practiced words.

A correlation analysis was performed between the mean estimated RT and CV_{RT} of the estimated RT for the Scrambler Group. Table 4.7 displays a summary of Pearson's correlation analysis of the Scrambler Group. With regard to the pre-test, the mean

estimated RT and CV_{RT} were negatively correlated for unpracticed words (r=-0.89728, *p*=0.0010), but not significantly correlated for practiced words (r=-0.6001, *p*=0.8781). However, the mean estimated RT was significantly correlated with CV_{RT} in the processing of practiced words on the post-test (r=0.73658, *p*=0.0236) as expected. As for unpracticed words, the positive correlation was observable, but not significant (r=0.60599, *p*=0.0837). Although the CV_{RT} value was supposed to decrease due to the automatic process (Segalowitz et al., 1998), the reduction of CV_{RT} values did not occur for the practiced words, but for unpracticed words. Hypothesis 7 was thus partially supported.

Table 4.7 Summary of Pearson's Correlational Analysis of the Scrambler Group

		Practiced	Unpracticed
Pre-test	CV_{RT}	0.47186	0.7489
	r	-0.06001	-0.89728
	p-value	0.8781	0.0010**
Post-test	CV_{RT}	0.47564	0.35604
	r	0.73658	0.60599
	p-value	0.0236*	0.0837

CV, coefficient of variation; r, Pearson's correlation coefficient; ** $p<.01$ and * $p<.05$

Research Question 5

In order to investigate the fifth research question, "Can novice learners of Japanese retrieve more accurately the meanings of practiced words after the training?", Hypothesis 8 was examined.

Hypothesis 8: The Scrambler Group and the Reading Group retrieved more accurately the meanings of practiced words than the Control Group.

The mixed effects model of analysis utilized to analyze the efficiency of processing *katakana* words in the reading test was employed, with the accuracy rate of the vocabulary test being the dependent variable. The results showed that both the Scrambler Group and Reading Group significantly improved the mean accuracy rates of practiced words on the vocabulary test after the training (t=5.40, $p<0.0001$ for the Scrambler Group; t=5.70, $p<0.0001$ for the Reading Group), but not the Control Group (t=2.95, $p=0.1464$). However, the pair-wise comparisons between groups were not significant (t=0.35, $p=1.000$ for between the Scrambler and the Control; t=0.55, $p=1.000$ for between the Reading and the Control). Therefore, Hypothesis 8 was not supported.

Research Question 6

The last research question explores whether the Scrambler Group and the Reading Group retrieved more correctly the meanings of unpracticed words after the training. Although the fifth research question was not confirmed, the analysis of the accuracy rate of unpracticed words was conducted as well.

Hypothesis 9: Only the Scrambler Group showed similar improvement in the performance of processing unpracticed words.

Table 4.8 illustrates the summary of t-values and *p*-values of multiple comparisons of the accuracy rate of the vocabulary test. The experimental groups retrieved the meaning of unpracticed *katakana* words significantly better after the training (t=4.05, $p=0.0064$ for the Scrambler Group; t=4.62, $p=0.0009$ for the Reading Group). Thus, the online training for each group seemed effective for retrieving the

meanings of *katakana* words even if they had not practiced with them. However, regarding the comparisons of the mean accuracy rate between the practiced words and practiced words on the post-test, the Scrambler Group showed a significant difference (t=3.68, *p*=0.0209), while the Reading Group did not (t=1.43, *p*=0.9546). These numbers can be interpreted that the Scrambler Group improved the accuracy of retrieving meanings of both types of words better than the pre-test, but their accuracy rate of unpracticed words was not as good as that of practiced words. On contrary, the Reading Group retrieved the meanings of practiced and unpracticed words at a similar accuracy on the post-test.

Moreover, even the Control group, which did not undertake the *katakana* training, improved their skills of retrieving the meanings of unpracticed *katakana* words considerably (t=3.34, *p*=0.0542). However, the comparisons of the mean accuracy rate between the practiced words and unpracticed words in the post-test for the Control Group was not significant (t=0.32, *p*=1.0000). Thus, we could conclude that they did not display any significant improvement for both types of words. To sum up, the Scrambler Group showed significant improvement on retrieving unpracticed words, but it was not as good as the Reading Group performance and there still seemed to be a room for improvement for the Scrambler Group. Thus, Hypothesis 9 was rejected, and further investigation is necessary.

Table 4.8 Summary of t-values and *p*-values of Multiple Comparisons on Accuracy Rate of Vocabulary Test

Group	Comparison between word type/test			t-value	*p*-value
Scrambler	Practiced Post	vs.	Practiced Pre	5.40	<.0001**
	Unpracticed Post	vs.	Unpracticed Pre	4.05	0.0064**
	Practiced Post	vs.	Unpracticed Post	3.68	0.0209*
Reading	Practiced Post	vs.	Practiced Pre	5.70	<.0001**
	Unpracticed Post	vs.	Unpracticed Pre	4.62	0.0009**
	Practiced Post	vs.	Unpracticed Post	1.43	0.9546
Control	Practiced Post	vs.	Practiced Pre	2.95	0.1464
	Unpracticed Post	vs.	Unpracticed Pre	3.34	0.0542
	Practiced Post	vs.	Unpracticed Post	0.32	1.0000

** $p<.01$ and * $p<.05$

4.5 Summary of Chapter 4

This chapter describes the quantitative results of the two *katakana* tests; reading and vocabulary test, examining the nine hypothesis formulated in Chapter One. Although any statistically significant difference was not observed between the groups, the three groups respectively demonstrated distinctive behaviors in each test.

Regarding the reading test, the Scrambler Group demonstrated a modest increase in the speed of processing both practiced and unpracticed words as a result of the four-week training. The Reading Group was able to read practiced words faster in the post-test, but not unpracticed words. Such a tendency was not observed in the Control Group. In contrast, both the Scrambler and Reading Groups exhibited significantly better performance in accuracy of reading practiced words on the post-test. With regard to reading unpracticed words, the Reading Group showed better accuracy than Scrambler Group. Surprisingly, the Control Group significantly improved accuracy of reading only

unpracticed words, but not practiced words on the post-test without any *katakana* word recognition training.

Because the relative increase of recognition speed of the Scrambler Group was observed, the automaticity of word recognition process was examined to see whether the process of *katakana* words were qualitatively different depending on word types. Even though its increase was not statistically significant, two out of three conditions indicating that the Scrambler Group processed practiced words via automaticity were detected.

The vocabulary test revealed that the two experimental groups significantly developed their skill of inferring meaning of both practiced and unpracticed words after the training. Because the Control Group displayed positive improvement on the post-test as well, any significant difference between groups was not identified either.

The following chapter will discuss interpretations of the results described in this chapter, limitations of the present study, pedagogical implications and the future direction of *katakana* word recognition studies.

CHAPTER 5. DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter discusses interpretation of the results (section 5.2), limitations of the current study (section 5.3), pedagogical implications (section 5.4), the future direction of *katakana* word recognition studies (section 5.5), and the conclusion (section 5.6). The results are analyzed with the quantitative data presented in Chapter 4 as well as the responses to the post-experimental questionnaire (See Appendix E).

5.2 Interpretation of the Results

5.2.1 Reading *Katakana* Words

The results from the mixed effect models of analysis of the current study demonstrated that there were no significant differences between the three groups in terms of the increase of *katakana* word recognition efficiency resulting from the training. Therefore, it is impossible to generalize the results to the other population of entry-level Japanese language learners. However, some interesting tendencies possibly stemming from the training effects were observed among the participants of the study.

First of all, the Scrambler Group exhibited a great tendency to improve the word recognition speed for both practiced and unpracticed words. The *p*-value of comparing

the estimated reaction times of practiced words between pre-test and post-test was 0.0742; thus, it was close to the significance level, which was set at 0.05 for the current study. In addition, their estimated reaction times of practiced and unpracticed words on the post-test were not statistically different from each other. In other words, the Scrambler Group became able to read both practiced and unpracticed words in a similar manner after the training. This result might suggest that the participants in the Scrambler Group established a stronger association between *katakana* letters and sounds as a result of the training compared to the other two groups. They were asked to put a string of scrambled *katakana* letters of a word into the right order while listening to the target word being vocalized. One of the participants answered in the post-experimental questionnaire, "The words used during each week were the same, so it became fairly easy to unscramble the words on sight, rather than having to listen for the voice." This participant's experience clearly indicated that his process of *katakana* word recognition was becoming automatic as a result of repetitive practice. Other participants in the Scrambler Group commented that the training helped memorizing *katakana* words and spellings. As the researcher anticipated, unscrambling units of *katakana* letters, each of which was comprised of a mora, seemed to assist them to perceive typical *katakana* spelling patterns and phonological changes between *katakana* words and English equivalents while the training. The participants also claimed the training should have more variety because a set of limited words made the exercises predictable. From those comments on the post-experimental questionnaire, the participants in the Scrambler Group became able to identify practiced words faster as a result of the training. As the skill acquisition theory (DeKyser, 2007) posits, the participants' cognitive mechanisms restructured through a

series of the same task promoting recognition of *katakana* letters, and then their performance became rapid without paying much attention to deciphering. Consequently, their recognition speed of even unpracticed words became faster on the post-test because they become able to recognize individual *katakana* letters precisely. As Besner & Hildebrandt (1987) describe *kana* processing, these participants probably came to treat the practiced words as chunks, a sequence of letters, resulting from multiple exposures and the training promoted them to recognize the whole-word orthographic shape.

Nevertheless, the Scrambler Group's accuracy rate of unpracticed words on the reading test after the training was the lowest among the three groups. One of the reasons could be that the Scrambler Group was not required to read *katakana* words aloud in their training. They listened to each word vocalized, but never vocalized it themselves. For this reason they were not ready to pronounce *katakana* words accurately even after the four-week training. In fact, one of the participants pointed out the lack of speaking practice on the questionnaire, saying, "you don't really get practice saying them." Another possible reason could be because the participants became adept at quickly recognizing only certain *katakana* letters and letter combinations that appeared in the training. This point was supported by a comment provided by one of the participants above saying, "This (being able to unscramble without listening to the audio) may mean the characters were easier to recognize with time, but it felt like I was simply learning sequences of characters for specific words instead of learning to read any word in general." The previous training studies (Akamatsu, 2008; Fukkink et al. 2005) had intermediate level of ESL learners as their subjects, while the participants in the current study were novice learners of Japanese. Those ESL learners had already been capable of processing English high-frequency

words fast enough even before the training. That is why an achievement of automaticity was observed only for the low-frequency words on both studies. Therefore, the four-week training might have not been enough for the current study's participants to transfer their *katakana* recognition skills to the words they had never been exposed to. As this participant did not realize that he could have been able to manage other unknown words that he had never practiced, the Scrambler Group was not able to enhance the accuracy of reading unpracticed words. To summarize, it could be speculated that the Katakana Scrambler offered the participants an opportunity to improve their visual processing speed of *katakana* words, but not their reading accuracy. Furthermore, one thing necessary to be mentioned here is that the survival analysis also could have considerably contributed to the reduction of their estimated response time because it was calculated by the response time of only the test items that the participants had read accurately.

Secondly, the Reading Group significantly improved the accuracy of reading only for practiced words, although their mean accuracy rate of reading unpracticed words on the post-test was better than that of the pre-test. Similarly, their speed of reading became faster only for practiced words ($t=-3.29$, $p=0.0607$), not for unpracticed words. They were asked during the training to do exactly the same task as the reading test; thus, it is natural that they became able to read practiced words faster and more accurately after the training. The group thus marked the highest mean accuracy rate among the three groups for the practiced words. Regarding their insignificant increase of the accuracy rate of unpracticed words, it could be speculated that the participants in the Reading Group heavily relied on the addressed phonology route not only on the pre-test but also during the training. Seven out of 11 participants in the group recognized the audio component as

an advantage of the exercises. For example, “The audio component is very helpful, especially because the English meaning of the words can be understood through the *katakana* reading,” “Being able to hear the words being pronounced,” and “can listen to the correct pronunciation.” Thus, they probably listened to the model reading with careful attention and then mastered correct pronunciations of more letters and letter combinations through the training than the other two groups did. However, they did not seem to attain a similar level of visual processing skill as the Scrambler Group processed practiced words. Feldman and Turvey (1980) have hypothesized that naming words written in *kana* can be achieved by two routes, visual and phonological processes, while *kanji* has one route, which is a visual route because *kanji* is not phonologically transparent. Generally speaking, a sight word strategy does not work for unfamiliar words. However, because the correspondences between letters and sounds are highly consistent in *kana*, word unfamiliarity does not inhibit proficient readers from naming (Aro, 2006, Komendzinska, 1995). Especially the native speakers of Komendzinska’s study showed consistent *kana* processing efficiency regardless of *kana* familiarity. It could be because they were not attentive to its meaning while engaging in naming task. Since native speakers of Japanese make use of both addressed phonology and assembled phonology routes while reading *kana* (Yamada et al., 1990), language learners should restructure their word recognition skills appropriate for reading Japanese. Furthermore, Chikamatsu (1996, 2006) reveals that readers of Japanese need to be equipped with visual processing strategy even for words written in *kana*, although they are sound-based scripts. Thus, it can be postulated that reading practice did not help develop the visual processing strategy and the Reading Group could have relied more on phonological processing than visual processing.

Four participants in the Reading Group commented in the post-experimental questionnaire, the exercises did not provide any interactional or personal feedback; hence, the exercises did not ensure that all the participants practiced each word in the exercises accurately. Some of them might not have been able to identify an accurate model pronunciation solely by listening and could have kept practicing a wrong one. However, the participants seemed to pay as much thorough attention as possible to the audio information that they obtained from the exercises and did their best to master the correct pronunciations of typical *katakana* sounds. Therefore, it might be possible to conclude from the results of the reading test that the Reading Group was also establishing an association between written forms and sound representations during the training; however, their change did not involve speed of processing. Developing a skill to visually process written scripts is necessary in order to accelerate the processing speed in Japanese. Because the participants in the Reading Group still decoded each letter of a word phonologically, their reading process of unpracticed words (especially those unfamiliar to them) took longer than that of the pre-test.

Thirdly, the Control Group recorded the shortest mean estimated response time of the three in the pre-test, but their speed did not change very much after the training. The training period, which lasted for four weeks in the current study, might not have been long enough for the novice learners of Japanese to improve their *katakana* recognition speed naturally with only regular classroom learning. The Control Group rather slowed down their recognition speed of both practiced and unpracticed words in the post-test; however, their mean estimated reaction time for both types of words on the pre-test was not significantly different from those of the experimental groups' estimated reaction time

on the post-test (estimated reaction times of practiced words between the Scrambler's pre-test and the Control's post-test, t=0.7789, *p*=1.000; between the Reading's pre-test and the Control's post-test, t=0.0822, *p*=0.8346). Although there were no significant differences regarding prior *katakana* processing skills among the three groups based on the results of the pre-test, it can be assumed that the *katakana* reading performance of the Control's group was not so poor even before the treatment was given. Due to a lack of practice opportunities, their progress was not observable; however, their performance was still comparable with those of the experimental groups that showed a greater tendency to read practiced words faster after the training. Thus, it is necessary to collect data from a larger group of novice Japanese learners in future studies to investigate the effect of the training on recognition speed.

On the other hand, the Control Group's significant improvement of the reading accuracy of unpracticed words went against the researcher's expectation (between pre-test ad post-test, t=3.47, *p*=0.0366) because they did not show any noticeable improvement of practiced words (t=2.39, *p*=0.4244). Additionally, they marked the best accuracy rate of reading unpracticed words among the three groups without any special *katakana* training. It is difficult to determine what could have contributed to the progress of reading accuracy from the data collected in the current study; however, their tendency of processing *katakana* words is more similar to that of the Reading Group than that of the Scrambler Group. The participants could have been very attentive to accuracy of reading on the test and instead sacrificed the promptness of reading. Like the performance of the Reading Group, the Control Group seemed to rely on the phonological coding.

Considering the current study's research design, the collected data demonstrated that the more careful in reading accuracy the participants became, the longer time it took to read. Unlike a lexical judgment task, which measures the time a participant takes to determine whether a given word is real or non-real, a naming task takes longer response time (Jiang, 2012). The current study's participants were novice learners of Japanese and had just learned *katakana* letters when the data were collected, unless they had previously studied Japanese before being registered for the first Japanese course at the college. Because their overall accuracy rate was lower than the researcher expected, only a processing time of the test items that the participants correctly enunciated within the time limit was measured; the estimated reaction time was then calculated based on the observed response times for each participant. In other words, the initial faulty attempt was disregarded as long as the later attempt was successful. Thus, if a participant persists in the correctness of his reading, the estimated reaction time would be likely to be longer than other participants who paid more attention to promptness.

5.2.2 Inferring Meanings of *Katakana* Words

Like the results of the reading test, the vocabulary test did not display statistically significant differences between the groups in terms of retrieving meanings of *katakana* words. The experimental groups demonstrated significant development in inferring the meanings of both practiced and unpracticed words after the training, while the Control Group did not. Because the Scrambler Group did not outperform the Reading Group, the type of training did not seem to matter to the improvement of inferring *katakana* word meanings. When examined in detail, the answers to the test showed that the slower

participants in the Scrambler Group were not able to get through all the pre-test items due to the time constraints (20 minutes). However, they were able to look at up to the last item in the post-test. Because their processing speed became faster than when they took the pre-test as a result of the training, they might have had enough time to answer all the post-test items, and then their mean accuracy rate on the vocabulary test also improved from the pre-test.

With regard to the Reading Group, some of them claimed in the post-experimental questionnaire that they did not like to practice reading *katakana* words without knowing the meanings. However, their performance on inferring the meanings of both practiced and unpracticed words was significantly better after the training, and the accuracy rates of both practiced and unpracticed words were the best among the three groups. They could have been connecting sound information with written representations while working on the exercises without realizing it. Accordingly, they became able to read unfamiliar *katakana* words with accurate pronunciation and more successfully inferred the original English meanings than on the pre-test. Shibatani (1990) and other researchers (e.g., Daulton, 2008; Nishi & Xu, 2013; Quackenbush, 1977) who have been investigating processing difficulties of *katakana* loanwords unanimously claim incomprehensibility of Japanese loanwords coming from English to native English speakers due to the alternation of the original pronunciation. Thus, the performance of the Reading Group demonstrated that successful decoding plus understanding of phonological alternations foster better comprehension of *katakana* loanwords. Kess and Miyamoto (1999) clearly assert, “As far as foreign learners of Japanese are concerned, *katakana* words are strictly Japanese” (p.89). Because Chinese characters do not

represent phonological information obviously, novice leaners of Chinese with L1 English background store meaning of a word and its spoken form together. Thus, when learners know the meaning, they are most likely to know its pronunciation as well (Everson, 1998). In contrast, *katakana* is sound-based; therefore, learners can decode Japanese pronunciation from the string of letters as long as they can recognize each letter. Taking into account the fact that *katakana* loanwords are Japanese, learners should be instructed to make associations between a loanword with the Japanized pronunciation and its meaning without relying too much on their English lexicon.

Although multiple encounters with *katakana* words in the online training seemed to provide the participants with better word processing skills, the Control Group also showed moderate improvement from the pre-test to the post-test. That is why the group differences in the vocabulary test were not observed. Even though the current study aimed to demonstrate the efficacy of online *katakana* word recognition training, the Control Group, which did not receive any training in *katakana* recognition, also demonstrated great improvement in inferring the English meanings of unpracticed words ($t=0.32$, $p=0.0542$). It is challenging to determine the reason for this solely from the data provided by the current study; however, it could be speculated from the responses of the post-experimental questionnaire the participants responded to. The participants of the Control Group answered a question asking how they practice *katakana* in the following ways: some of them learned only from class, while others described their way of learning *katakana* as trying to memorize a list of *katakana* words in the *katakana* chapter of their textbook, using online flashcards, and trying to read *katakana* words on the Internet or on the packages of food products. Based on their responses these learners seemed to find

their own way of learning and practicing *katakana* words, and their strategies seemed effective to some extent. Another possible reason is a facilitation effect of the pre-test. Because both the reading test and the vocabulary test were composed of the same *katakana* words, the participants in the Control Group were exposed to the same word set at least two times in the pre-test. Although the post-test was conducted four weeks later and the test items were presented in a different order, they were instructed to take the reading portion of the post-test before taking the vocabulary test. Consequently they had already encountered the same word set three times before taking the vocabulary portion of the post-test. These multiple exposures to the same word set in a short period of time might have somewhat facilitated their learning *katakana* vocabulary.

Lastly, if explicit instructions of the training were given to the experimental groups, such as asking the participants in the experimental groups to pay attention to spelling patterns or sound changes from English to Japanese while being engaged in exercises, the results would have been rather different from those of the current study due to raising their awareness of the target concepts of the study.

5.2.3 Automaticity of *Katakana* Processing of the Scrambler Group

Among the three groups in the current study, only the Scrambler Group improved *katakana* word recognition speed for both practiced and unpracticed words after the online exercises. Segalowitz and his colleagues have reported in the series of their studies (e.g., Segalowitz & Segalowitz, 1993; Segalowitz et al., 1998) that the correlation between CV_{RT} and RT suggests automatization of word recognition process and distinguishes automatic processing from speed-up processing as a result of practiced

effects. They have also claimed that the reduction of CV_{RT} should be observed when the process becomes automatic.

According to the results analyzed with a Pearson product-moment correlation, a highly strong correlation (r=0.73568, *p*=0.0236) between CV_{RT} and estimated RT of practiced words on the post-test was observed in the current study, but not on the pre-test (r=-0.06001, *p*=0.8781). This fact could be interpreted to mean that the Scrambler Group achieved automatic process of recognizing practiced words. However, the CV_{RT} of the Scrambler Group was not reduced after the training, contrary to the researcher's expectations.

In fact, this reduction of the CV_{RT} was a puzzling result because the reduction of the estimated response time of the Scrambler Group after the training was not statistically significant. This discrepancy could be attributed to the characteristics of the method of handling the data in the current study. The individual accuracy rates of the reading test varied considerably among the participants and some of them had very low accuracy rates. However, the number of the participants was limited in the current study so that none of them were eliminated due to low accuracy rates. Instead of simply eliminating the response times of the words that the participants were not able to read accurately, the current study employed survival analysis to calculate an estimated reaction time for each participant by word types based on the observed response times of test items read correctly.

Hulstijn et al. (2009) questioned the use of coefficient of variability as an indication of automaticity and attempted to verify the index by analyzing the same date sets with different methods of data cleaning and demonstrating the change in CV_{RT} and

the correlation values between the CV_{RT} and RT. According to them, the CV_{RT} calculations have a tendency to be confounded with different accuracy rates of the responses. Therefore, their series of analysis did not produce consistent results, and one of them analyzed with estimated reaction times, instead of observed reaction times, did not produce significant CV_{RT} reductions. Likewise, the current study generated a reduction of estimated RT as well as a positive correlation between the estimated RT and CV_{RT}, but not the reduction of CV_{RT}, which agreed with that of the results done by Hulstijn et al. As Hulstijn et al. claimed, it is too early to conclude that the reduction of CV_{RT} should be an indication of automatization. Because the current research contains both missing data and low accuracy rates, it is better to avoid determining whether the Scrambler Group's performance achieved automaticity as a result of the training by using the CV_{RT}.

Chikamatsu's study (2006) has demonstrated that the intermediate level learners of Japanese have restructured their word recognition strategies suitable for reading Japanese, while the beginning level learners still rely on the phonological coding, which is useful for processing alphabets. The participants in the Scrambler Group seemed to be getting accustomed to visual processing as a result of training because their word recognition performance was different from those of other groups in terms of speed. Although it is indisputable whether the Scrambler Group achieved automaticity in processing practiced words due to the low accuracy rate, they seemed to start recognizing *katakana* stimulus visually as L1 Japanese readers do. This behavior manifests a part of restructuring their word recognition operation, which leads them to speedy processing. As Hulstijn et al. (2009) demonstrated, the reduction of CV_{RT} could be observed when

the outliers of the distribution are cut off because it affects the variability of the original data. Thus, it might be possible to observe the reduction of CV_{RT} under the current research design if the data can be collected from more subjects than the current study. Automaticity can be interpreted in various ways, such as effortless processing or spontaneous, unstoppable behavior, as Segalowitz and Hulstijn (2005) and Hulstijn et al. state. The claim regarding the use of a coefficient of variability made by Segalowitz and his colleagues is mainly concerned with the speed of automaticity (Hulstijn et al., 2009). Nara (2003) pointed out by citing Chen's (1985) explanation that whether a complex cognitive skill is mastered or not depends on the accomplishment of coordinating and integrating various sub-skills. Because automaticity is gradually gained through accumulation of knowledge and practices, it is difficult to extract only a skill related to automaticity, for example, a speed component in a word recognition task (Hulstijn et al., 2009). Thus, it is necessary to consider other subcomponents of word recognition to determine the automaticity besides speedy processing.

5.3 Limitations of the Current Study

First of all, the present study had 31 participants in total and one of the three groups was composed of only nine; for this reason, the findings of the present study cannot be generalized to other populations of Japanese learners. It would be ideal to conduct a similar study with a larger pool of participants in order to confirm the efficiency of the training and observe whether there will be significant differences between the groups. In addition, the participants' first languages varied and some of them were learning Japanese as their third language. *Katakana* was an orthographically new set

of scripts to any language groups, but it would be better to control their language backgrounds in the future study.

Secondly, *katakana* words for the exercises and tests should be selected more carefully. Although the randomness of the selection of *katakana* words in the current study was addressed by survival analysis, the number of target sounds was not necessarily matched between practiced and unpracticed words. All unpracticed words included one of the special sounds created for transcribing foreign words; therefore, the level of difficulty might have been relatively high for novice leaners of Japanese. That could be one of the reasons the substantial improvement was not observable among the participants of the two experimental groups in terms of reading speed and accuracy. Future research should determine more carefully which and how many target sounds should be included in selecting *katakana* words.

Thirdly, the method of data collecting might also have affected the present study's result. Because the experiment was conducted entirely online, the participants each had different testing and training environments. Because the Speak Everywhere website caused some random problems with storing the recorded voices, some of the sound files were not saved properly. Thus, survival analysis was carried out to compensate for this missing data. It would be ideal to assemble all participants in a computer lab at a certain time and make them take the test together. However, such an environment could also distract them and hamper their performance, especially in a study involving a recording task. It is necessary to maintain as identical an environment as possible in collecting data in the future study.

Fourth, the current study was not able to track the completion of daily training with precision, and relied basically on their self-reportage. The researcher checked their login history on the course management website, but this did not guarantee that the participants practiced on the assigned websites each day. The researcher also noticed that some participants tended to overreport their training frequency compared to their login history. Thus, the training effects of the present study could have been more modest than in the actual research design.

Fifth, because the researcher was the only rater to evaluate the participant's recorded data in this study, other raters did not verify the rating reliability. It would be ideal to have multiple raters or create a computer program that can help to uniformly measure response time in order to ensure rating reliability for future research. The current study utilized the Audacity software; however, it would be better to utilize better quality software that can provide both waveforms and spectrograms, such as the Praat (http://www.praat.org), which is software designed for analyzing speech in phonetics, in order to more precisely measure reaction time for each word.

Lastly, the test items were composed of three different lengths of words (10 four-letter words, 10 five-letter words, and 10 six-letter words, although a very few exceptional words were included); however, differences in response time resulting from word length was disregarded as result of the survival analysis. The longer a word becomes, the longer the response time is expected to be. As already mentioned in the methodology section, only the observed reaction times with accurate readings were utilized to estimate the response times of each participant. Therefore, careful attention is needed in interpreting findings regarding word recognition speed in the present study.

5.4 Pedagogical Implications

As mentioned above, the present study demonstrated that the two different online *katakana* word recognition exercises facilitated the Japanese novice learners' processing speed and reading accuracy, respectively. In addition, the participants overall displayed positive attitudes toward online exercises in the post-experimental questionnaire. The integration of these online exercises into a course curriculum is highly feasible, because learners undergo the exercises outside of classroom. This section thus discusses the possible implementation of the online word recognition exercises, taking into consideration the participants' responses to the post-experimental questionnaire.

The current study compared two different online exercises to assess their efficiency in terms of *katakana* word recognition skills, so that each group was assigned one type of exercise with the same set of *katakana* words. Since each exercise contributed differently to the improvement of *katakana* word processing, both of them could be assigned to compensate for each weakness. Although repetitive practice is necessary to establish letter-sound correspondences, it is imperative to motivate language learners to continue to practice with online exercises outside a classroom. Although the participants were asked to practice the assigned training every day, some of them seemed to be reluctant to do so due to the monotony of the practices. If it is implemented as a part of the foreign language course curriculum, a variety of exercises in addition to the two exercises employed in the current study should be given for the learners to find them meaningful and practical, as suggested by Crawford (2005). As the post-experimental questionnaire showed, some of the participants had already developed strategies for learning *katakana* words, but not all the students taking Japanese language courses are

good at learning foreign languages. Considering the complexity of learning non-alphabetic letters of Japanese, providing useful online learning tools whose contents match the classroom materials is attractive to both language learners and instructors.

Moreover, it is necessary to reexamine our method of teaching *katakana* in Japanese courses. From her past teaching experience, the researcher had the first-year students write *katakana* words by giving the English equivalents only after *katakana* letters had been taught. Although they had a list of *katakana* words in advance to prepare quizzes, they did not have enough time to digest complex transcribing rules or receive explanations of typical *katakana* spelling patterns. The students were expected to inductively learn how to convert English words into Japanese *katakana* words. If Japanese instructors want to confirm their students' mastery of *katakana* writing, filling in the blanks on a *katakana* chart or converting *hiragana* into *katakana* allows them to check each learner's mastery of *katakana* letters. As this study demonstrated, the novice learners of Japanese were not well equipped even for reading *katakana* words smoothly. The instructors should be mindful of how difficult it is for Japanese learners to convert English words into Japanese *katakana* words and whether the converting skill is more important than accurately reading *katakana* words as an aspect of learning Japanese, especially for novice learners.

Regarding the participants' attitudes toward the online word recognition exercises, the positive aspects they identified in the questionnaire were receiving immediate feedback, listening to pronunciations recorded by a native speaker, saving time for making paper flashcards, and no need to use a pencil and paper while practicing. Some of them referred to their own experiences with the online flashcards and provided comments

by comparing the online exercises of the current study with them. Some of the commercial flashcard applications and websites have a function of vocalizing words by using a machine voice. Those machine voices do not usually carry accurate pitch-accent patterns, which may create meaning differences with homophones in Japanese. Thus, including accurate pronunciations that the learners can model is one of the paramount functions that online exercises should offer. Another advantage of the online training program the participants appreciated was its privacy. They liked to study in a comfortable environment without feeling the pressure from other students or instructors which they would experience in the classroom. Thus, making use of technology and providing online drill-type exercises could bring our students more learning opportunities outside of their classroom in a safe atmosphere.

Although the online exercises used in the current studies had several positive features, they did not possess functions useful for individual learning, such as setting aside the words already mastered and focusing on the words that required more time to work on. The participants were digital natives (Prensky, 2001) and they wished to make their learning individualized. Simply providing repetitive practices in a technological format did not satisfy them. Online quiz applications presently available on the smartphone and tablet devices are pervasive now. These popular applications usually contain a variety of convenient functions that help learners to control their learning. Thus, it is important to offer exercises that learners can use voluntarily and feel a sense of accomplishment in order to encourage their learning.

Another weakness of the exercises in this study is the requirement of online access. Since Scratch utilizes Adobe Flash, the exercises were not available on their

smartphones, but instead on computers and Windows tablets. Considering the ease of access, the commercial flashcard applications allow their users to practice anywhere and anytime even without Internet access, once they download the application content on their individual devices. It is necessary to research existing flashcards and quiz applications in detail and make use of them for language instruction as well as creating original online exercises by using Scratch, depending on the objectives of the exercises. Most of the mobile applications are free of charge; however, not all the useful functions are. Thus, some of the participants of the current study liked the training applications that were free of charge, which the researcher was not aware of these applications while preparing the study.

In summary, individualized online exercises with immediate feedback would be ideal, especially because they would be assigned outside of the classroom. The exercises utilized in the current study were not perfect in that sense, but they could definitely be a part of online learning. It is essential to create a series of exercises that promote *katakana* word recognition efficiency in response to learners' vocabulary size. These online *katakana* exercises could be assigned as preparation before giving an in-class *katakana* quiz or starting a new reading material. Consequently, a lack of *katakana* reading ability would not hinder their learning structures or understanding of the contents. Moreover, constant short recurring exercises would help learners expand their *katakana* vocabulary.

5.5 Directions for Future Research

The findings of the current study generated several implications for further research. First, as pointed out in the section on the limitation of the study, a replicated

study with a modified research design should be conducted with a larger number of subjects so that the generalizability of the findings would be established. If it is possible to collect data from learners at multiple proficiency levels, we could monitor development of *katakana* word recognition skills. Because learners' exposure to *katakana* vocabulary is limited in a foreign language setting (Nakayama et al., 2008), it would be fascinating to see how word recognition training could impact their recognition of *katakana* vocabulary over time.

Second, the online exercises in the present study were designed to inductively learn typical *katakana* spelling patterns and sounds through repetitive encounters with a certain set of words. Although the analysis focused on individual participants' improvements, it did not disclose whether the participants became familiar with the unique conversion patterns from English vocabulary to equivalent *katakana* words. The post-experimental questionnaire revealed positive reactions toward learning typical *katakana* spelling patterns and sound changes among the participants in the experimental groups, but the answers were based solely on their perceptions. Thus, a comparison study with the learners who receive a series of training sessions on explicit *katakana* transliteration rules is needed because several scholars and language instructors perceive *katakana* writing skills required (Lovely, 2011; Preston & Yamagata, 2004).

Third, a detailed analysis on subjects' reading ability at the word level would also be one of the interesting future research directions for *katakana* learning. Language learners must learn letter-sound correspondences of their target language in order to become fluent readers. If we examine the accuracy rate of each word, we could sort out letters and sounds by the level of difficulty. Identifying certain letter combinations that

are difficult for language learners to associate with original English sounds would help not only the learners to read *katakana* words accurately, but also would help the instructors to create useful and meaningful exercises for their students. Many of the practiced words were names of materials such as foods, sports, countries, etc., while a set of unpracticed words contained more words indicating concepts and ideas. The words indicating intangible things appear to be more difficult for learners to guess their meanings, but this is not necessarily true because even the Control Group demonstrated considerably better performance with inferring meanings of unpracticed words on the post-test. Thus, it is necessary to investigate characteristics of individual *katakana* words thoroughly in order to identify what elements could hinder recognizing *katakana* words.

Fourth, the current study investigated recognition of *katakana* words in isolation. The participants in this study were given 60 isolated words in experimental environment. However, in reality, context is a great help in figuring out of meanings of unfamiliar words, regardless of whether the learner is reading in the first or second language. Thus, it would be interesting to see how much context could help language learners recognize unfamiliar *katakana* words while reading in a future study.

Fifth, the use of CV_{RT} was not a perfect indicator for differentiating an automatic processing from a speed-up processing for this study. As Hulstijn et al. (2009) stated, the method of data cleaning obviously affected the variability of the participants' processing. If a similar study is conducted to examine the validity of the index in the future, it is necessary to design a test that can produce a very high accuracy rate with appropriately targeted participants and to examine the data carefully.

Lastly, the current study measured the accuracy of reading and inferring the meanings of *katakana* words in two separate tasks and the data were analyzed independently as well. It would be very interesting to investigate whether language learners know the meaning whenever they identify a *katakana* word with the correct Japanese pronunciation. Based on the results of the vocabulary test, the accuracy rate of inferring meanings was higher than that of reading regardless of the word types or the treatments. In other words, they could guess the meaning of a word even if they failed to read it with the correct pronunciation. The findings would help the language instructors understand how learners acquire *katakana* reading skills and provide more effective instruction to their students.

5.6 Conclusion

The present study investigated the efficiency of online *katakana* word recognition exercises for improving three different skills: recognition speed, reading accuracy, and inferring originated English meanings of *katakana* words among novice learners of Japanese by helping them establish an association between sound representations and written forms. It also explored the qualitative differences of *katakana* word recognition processing of the group that improved reading speed before and after the training.

First of all, although the group differences were not observed regarding the improvement of the three skills mentioned above, the Katakana Scrambler, which had the participants unscramble a string of scrambled letters while listening to the word being vocalized, demonstrated a strong tendency to bring an effect of promoting the processing speed of *katakana* words. While they were engaged in exercises with immediate feedback,

the participants could have established letter-sound correspondences of *katakana* scripts and developed a strategy of visually processing *katakana* words, at least for the ones they practiced repeatedly.

Second, actual enunciation practice seemed to be necessary to improve the accuracy of reading *katakana* words, according to the improvement in the group practicing reading *katakana* words with model pronunciations. Once *katakana* letters are taught, the instructors tend to believe that their students can read them without difficulty because *katakana* is a set of sound-based scripts. Or, they often expect their students to master how to read *katakana* letters naturally as they acquire *hiragana* recognition. However, learners seem to need repetitive practice in which they can get used to pronouncing the special sounds invented to transcribe foreign words.

Third, regarding the accuracy of inferring English meanings of *katakana* words, both the experimental groups significantly improved for both practiced and unpracticed words. As the researcher expected a reciprocal influence between being able to read a word and identifying the meaning was observed, because sound information becomes help to some degree for figuring out the meaning in *katakana* loanwords. However, even the participants in the Control Group exhibited not significant, but positive improvement on identifying the unpracticed words. The training of the current study demonstrated certain effects on inferring meanings of *katakana* loanwords, but further investigation regarding the relationship between naming and identifying *katakana* loanwords is necessary.

Fourth, the study was unable to determine whether the Scrambler Group's processing of *katakana* words was speed-up or automatic. The insignificant increase in

speed between the pre- and post- test could be the main reason; however, the use of the CV_{RT} as an index of automatization was not appropriate, considering the characteristics of the data collected in the experiment. Future studies should create test items for which the subjects can attain a nearly perfect score or target more advanced students equipped with better *katakana* recognition in order to manifest the indication of automatic process by using the CV_{RT}.

Generally speaking, only a few class hours are devoted to teach and practice *katakana* in Japanese language courses compared to *kanji* instruction and learning. For this reason there are quite a few students even in advanced-level courses that feel uncomfortable reading *katakana* loanwords. In fact, both language learners and instructors have noticed a lack of *katakana* instruction and practice. The number of *katakana* loanwords has been increasing due to the influences of globalization, and this trend will likely continue into the future. In order to help those language learners, the language instructors should reconsider what aspects of *katakana* are important for the learners so that they will not encounter difficulty in understanding written communication. A first step may be to provide ample practice opportunities for *katakana,* in-class or out-of-class activities that could contribute to the cultivation of visually processing printed letters and decoding accurate phonological information, which are necessary for readers of Japanese, by making use of technologically advanced tools such as online software and applications.

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APPENDICES

Appendix A Language Background Questionnaire

Sex: Male Female

Age: 18-20 21-25 26-30 31-

Country of Birth: U.S. Other _____

Your first language: English Other _____

Do you know any other languages than English / your first language?

Chinese French German Spanish Other _____

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1. Do you feel comfortable in reading hiragana? Please circle the number that describes your opinion.

1 (least) 2 3 4 5 6 (most)

2. Do you feel comfortable in reading katakana? Please circle the number that describes your opinion.

1 (least) 2 3 4 5 6 (most)

3. What do you read in Japanese besides assignments outside of class?

Books Game Internet Manga Others _____ None

4. Have you ever studied in Japan? Yes No

If yes, how long? _____

5. Have you ever lived abroad? Yes No

If yes, where and how long? _____

What language is spoken there? _____

6. Have you ever studied Japanese before taking this course?

Yes No ➔ Thank you!

🡻

For those who answered yes above, please continue to answer the following questions.

6-1. How long have you been studying Japanese?

Less than 1 year 1-2 years 3-5 years Other _____

6-2. Where did you study?

Secondary school Private tutoring Self-study Other _____

6-3. Have you already mastered hiragana and katakana before taking this course?

Both Hiragana only Katakana only No

Appendix B Post-experiment Questionnaire

This post-experiment questionnaire has two parts. Please answer both parts.

Part I. The following questions are regarding reactions to the online *katakana* training. Please use the scale below to circle the response that most closely resembles your perspectives.

1: strongly disagree
2: disagree
3: somewhat disagree
4: somewhat agree
5: agree
6: strongly agree

1. The Rapid Recognition Trainer (the program assigned before the pre-test) has improved my *katakana* reading ability.

2. The Rapid Recognition Trainer was more effective than practicing with paper flash cards.

3. The Katakana Scrambler / Katakana Reader/ Hiragana Scrambler (the main training between pre-test and post-test) has improved my *katakana/hiragana* reading ability.

4. The Katakana Scrambler / Reader has helped me recognize typical *katakana* spelling patterns. / The Hiragana Scrambler has helped memorize Japanese vocabulary.

5. The Katakana Scrambler / Katakana Reader has helped me recognize typical sound change patters from English to Japanese. (Not applicable for the Control Group)

6. It has become easier for me to guess original English meaning of given *katakana* words after the training. (Not applicable for the Control Group)

7. Reading *hiragana* is easier than *katakana*.

8. Guessing original English meaning of *katakana* words is difficult.

9. I would like to keep using the online *katakana* trainings to practice *katakana*.

10. I would like to use similar online exercises to practice *katakana*.

11. I would like to try more variety of online *katakana* exercises for my practice. (Not applicable for the Control Group)

12. I would like to use online exercises to practice Japanese letters including *kanji*.

13. I would like to use similar online exercises to practice vocabulary.

14. I need *katakana* writing practice, in addition to this reading exercise.

15. I will recommend the Rapid Recognition Trainer to other students.

16. I will recommend the Katakana Scrambler / Katakana Reader / Hiragana Scrambler to other students.

Part II. Please answer the following questions regarding how you used the online exercises.

1. How often did you practice with the Katakana Scrambler / Katakana Reader / Hiragana Scrambler over four weeks? How many times a week in average? Choose one that most closely resembles your frequency.
   Every day 5-6 times 3-4 times 1-2 times Never

2. Which device did you mostly use to do the online katakana training? You may choose multiple answers.
   PC/Mac Tablet PC Other _____

3. What are the three advantages of the online *katakana* training?

4. What are the three disadvantages of the online *katakana* training?

5. What else did you do to practice *katakana* in addition to the assigned online *katakana* training?

Appendix C The List of the Test Items

	Practiced Words	Unpracticed Words
4-letter words	＊チェロ	ウォッチ
	スケート	チェンジ
	スピード	フェンス
	ウォッカ	シアター
	フォーク	セオリー
5-letter words	サーフィン	ウィンドー
	バイオリン	チャレンジ
	クラシック	カルチャー
	トースター	ポジティブ
	カレンダー	アイディア
	ハイウェイ	ファミリー
	シェーバー	タイミング
	ディズニー	フィールド
	デュエット	リフォーム
	バスルーム	フォーカス
6-letter words	ハンバーガー	ソフトウェア
	ホットドッグ	プロジェクト
	サンドイッチ	インタビュー
	チョコレート	アーティスト
	フットボール	コントロール
	バレーボール	クオリティー
	オーケストラ	ディスプレー
	トランペット	ディレクター
	ジェスチャー	エディション
	アイスティー	プロデュース
	ファッション	ファンタジー
	フィンランド	ファイナンス
	フェンシング	オフィシャル
	サードベース	パーフェクト
	＊ウィスコンシン	フォーマット

＊ indicates exceptions. The practiced words were chosen from the chapter introducing katakana of the *Nakama I* textbook (Hatasa et al., 2014), but they were the only words including the targeted sounds.

Appendix D Rules and Conventions of Transcribing *Katakana* from *Nakama I*

Rules of transcribing katakana	**Examples**
1. The English sounds –er, -or, and –ar are heard as [aa] in Japanese. A dash represents the long vowels.	Carter カーター heart ハート
2. The English [v] is heard in Japanese as [b]. Accordingly, [va], [vi], [vu], [ve], and [vo] becomes [ba], [bi], [bu], [be], and [bo] in Japanese.	cover カバー violin バイオリン
3. The English [l] and [r] are both heard as an [r] in Japanese.	right or light ライト reader or leader リーダー lobby or Robby ロビー
4. The English [th] as in think and third is heard as [s] and the [th] as in that or mother is heard as [z].	Thanksgiving サンクスギビング Mother Goose マザーグース third base サードベース bathroom バスルーム
5. If an English word ends in [k], [g], [m], [f], [v], [l], [s], [z], [th], [p], or [b], the vowel [u] is added in Japanese. The vowel [u] is also added when these sounds are followed immediately by consonants in English.	milk ミルク ring リング hotel ホテル Miss ミス Jazz ジャズ
6. If an English word contains [t] or [d], the vowel [o] is added in Japanese.	cost コスト speed スピード last ラスト bed ベッド
7. The English vowel sounds in bus and cut or bat or gas are both heard as [a] in Japanese.	bus or bath バス cut カット bat バット gas ガス
8. To approximate as much as possible the pronunciation of people's names and other borrowed sounds, the following combinations are commonly used. These combinations are never used in hiragana. ウィ[wi]、ウェ[we]、ウォ[wo] シェ[she]、ジェ[je]、チェ[che] ティ[ti]、ディ[di]、デュ[du] ファ[fa]、フィ[fi]、フェ[fe]、フォ[fo]	Wisconsin ウィスコンシン highway ハイウェイ vodka ウォッカ shaver シェーバー gesture ジェスチャー cello チェロ Iced tea アイスティー Disneyland ディズニーランド duet デュエット

Rules of transcribing katakana	Examples
	fashion ファッション Finland フィンランド fencing フェンシング fork フォーク

Appendix E Responses to the Post-experimental Questionnaire

1. The Rapid Recognition Trainer (the program assigned before the pre-test) has improved my *katakana* reading ability.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	1	3	2	2	9	4.33	4
Reading	0	1	1	1	7	1	11	4.55	5
Control	0	0	0	8	1	0	9	4.11	4

2. The Rapid Recognition Trainer was more effective than practicing with paper flash cards.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	3	2	1	2	9	4	4
Reading	0	2	1	3	4	1	11	4.09	4
Control	0	0	2	3	2	2	9	4.44	4

3. The Katakana Scrambler/ Katakana Reader/ Hiragana Scrambler (the main training between pre-test and post-test) has improved my *katakana*/*hiragana* reading ability.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	0	0	3	5	1	9	4.78	5
Reading	0	0	1	1	5	4	11	5.09	5
Control	0	0	0	4	5	0	9	4.56	5

4. The Katakana Scrambler/ Katakana Reader has helped me recognize typical *katakana* spelling patterns. / The Hiragana Scrambler has helped me memorize Japanese vocabulary.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	0	1	4	3	1	9	4.44	4
Reading	0	0	1	5	3	2	11	4.55	4
Control	0	1	1	1	4	2	9	4.56	5

5. The Katakana Scrambler/ Katakana Reader has helped me recognize typical sound change patterns from English to Japanese. (Not applicable for the Control Group)

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	1	2	3	2	9	4.44	5
Reading	0	1	2	2	6	0	11	4.18	5
Control									

6. It has become easier for me to guess the original English meaning of given *katakana* words after the training. (Not applicable for the Control Group)

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	0	4	3	1	9	4.33	4
Reading	0	1	3	1	5	1	11	4.18	5
Control									

7. Reading *hiragana* is easier than *katakana*.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	0	0	2	6	9	5.33	6
Reading	0	0	2	2	2	5	11	4.90	5
Control	0	0	0	1	1	7	9	5.67	6

8. Guessing the original English meaning of *katakana* words is difficult.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	2	1	4	0	2	9	3.89	4
Reading	0	3	1	3	4	0	11	3.72	4
Control	0	1	1	5	0	2	9	4.11	4

9. I would like to keep using the online *katakana* trainings to practice *katakana*. / I would like to use similar online exercises to practice *katakana*.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	2	4	2	0	9	3.78	4
Reading	0	0	2	6	3	0	11	4.09	4
Control	0	0	1	4	3	1	9	4.44	4

10. I would like to try more variety of online *katakana* exercises for my practice. (Not applicable for the Control Group)

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	0	1	2	5	1	9	4.67	5
Reading	0	0	0	1	9	1	11	5	5
Control									

11. I would like to use online exercises to practice Japanese letters including *kanji*.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	0	0	3	4	2	9	4.89	5
Reading	0	1	1	0	3	6	11	5.09	6
Control	0	0	0	2	7	0	9	4.78	5

12. I would like to use similar online exercises to practice vocabulary.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	0	3	3	2	9	4.56	5
Reading	0	0	0	2	5	4	11	5.18	5
Control	0	0	0	3	5	1	9	4.78	5

13. I need *katakana* writing practice, in addition to this reading exercise.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	1	1	3	2	2	9	4.33	4
Reading	1	1	3	1	3	2	11	3.91	4
Control	1	3	3	0	2	0	9	2.89	3

14. I will recommend the Rapid Recognition trainer to other students.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	2	1	3	2	1	9	3.89	4
Reading	0	0	3	2	6	0	11	4.27	5
Control	0	0	2	3	4	0	9	4.22	4

15. I will recommend the Katakana Scrambler/Katakana Reader/Hiragana Scrambler to other students.

	1	2	3	4	5	6	Total	M	Mdn
Scrambler	0	2	1	3	2	1	9	4.11	4
Reading	0	0	2	2	7	0	11	4.45	5
Control	0	0	1	5	3	0	9	4.22	4

M: Mean, Mdn: Median

16. How often did you practice with the Katakana Scrambler/Katakana Reader/Hiragana Scrambler over four weeks? How many times a week on average did you practice? Choose one that most closely resembles your frequency.

	1-2 times	3-4 times	5-6 times	Every day	Total
Scrambler	0	5	3	1	9
Reading	1	4	5	1	11
Control	1	2	4	1	9

17. Which device did you primarily use to do the online katakana training? You may choose multiple answers.

	PC/Mac	Tablet PC	Other	Total
Scrambler	9	0	0	9
Reading	11	0	0	11
Control	9	0	0	9

18. What are the three advantages of the online katakana training

Scrambler:

- Audio feedback is very helpful.
- Activities are more interactive than just using flashcards.
- It gives automatic feedback if you get an answer wrong.
- Can access it from nearly anywhere.
- It can give you live feed back.
- It be mixed up.
- Getting to hear the pronunciation of the words.
- It really helped me to memorize the words and spellings used in the training
- It added new words or challenges (such as an extra letter) as each week went by.
- It's accessible, quick, and provides instant feedback.
- I can listen how to read the words.
- I got to know more katakana words.
- I got to know the form of katakana words.
- It's easy to access and use
- It's quick
- It's somewhat effective
- Easy access being in a comfortable environment while practicing
- Can more easily understand pronunciation of words through native speakers saying the words
- Having words read to me helps me sound better when I say those words
- It tells you when you've made a mistake.
- The computer can give you a good idea how the word is supposed to sound.
- I can practice as many times as I want

Reading:

- The words appear much faster than if you used real flashcards.
- The audio component is very helpful, especially because the English meaning of the words can be understood through the katakana reading.
- It's also very convenient to have many words available without having to carry around a lot of flashcards.
- Availability
- Ease of access
- Privacy of home
- Convenience and flexible for us to learn katakana
- Can easily correct my pronunciation
- Free training
- Being able to hear the words being pronounced.
- Being given time to read katakana before the word is spoken.
- Having each katakana have a blue line inbetween.
- Have correct pronunciation.
- Convenient.

- It's easy to access, can be accessed at any time, and doesn't cost anything.
- Can listen to the correct pronunciation
- Easy to access, makes you feel inclined to do better, keeps you interested
- Become familiar with some words and can easily identify them
- Could listen to correct punuctiation [pronunciation] after I try
- Was daily practice
- You can practice over and over on the same thing
- There's a voice in the practice
- I don't have to make my own flashcards so, it saves time.
- Easy to use, convenient, easy to understand

Control:
- Fast, easy to review, multiple attempts
- Flexible schedule
- Save people (less teacher is needed)
- Everyday practice helps review
- Memorize how to write the hiragana much faster
- It helps me to memorize the word
- It helps me with my study
- Provide a good way to know the pronunciation
- Easy to remember
- Impressive
- It was always there when I felt I needed to practice
- It spoke the words so that I could hear what they would sound like.
- It allowed me to figure out the dictation of each word better.
- Quick.
- Able to read as much as desired.
- Not many resources required.
- Hear the words
- Time how long it talks to respond
- Can do on own time
- Its online so its interactive.
- It saves time.
- Convenience, I dont have to go get pen and paper etc
- They helped me with spelling, particularly with glides and such.
- The vocabulary used by the hiragana training was similar to vocabulary that was relevant to my class, which was helpful.
- Using online study tools is much more convenient than studying online.

19. What are the three disadvantages of the online katakana training?
    Scrambler:
    - I don't get writing practice
    - I can't personalize online training to focus on what I need to learn.

- Online training didn't work on my phone, so I couldn't study unless I was at home. When I make flash cards, I can bring them anywhere.
- Online isn't always the most stable.
- There usually more information in books written by actual experts in the language.
- Sometimes it doesn't work.
- The activity felt very repetitive which caused it to feel dull after a few days.
- The words used during each week were the same, so it became fairly easy to unscramble the words on sight, rather than having to listen for the voice. This may mean the characters were easier to recognize with time, but it felt like I was simply learning sequences of characters for specific words instead of learning to read any word in general.
- Sometimes if I finished unscrambling a word quickly, the program would still give the pronunciation for the word I just finished at the same time it gives the pronunciation for the new word on the screen. This always resulted in a temporary buzzing noise. However, I do not know if that was a problem with program or if it was caused by my computer lagging, so this may not be a problem with the training itself.
- It's predictable, doesn't change frequently enough, and doesn't offer ways to correct mistakes
- Not easy to persist in
- The words go too fast.
- Can not ask questions.
- Needs more variety
- Gets repetitive
- Easy to forget to practice
- No way to work through each letter individually without outside help
- very easy to forget about
- no speaking feedback
- You don't get practice writing the words, and you don't really get practice saying them.
- You could also just click until you stumble on the right answer.

<u>Reading</u>:

- There is no way to practice writing.
- There should be a way to select different word banks so each training week does not feel so repetitive.
- You cannot put aside and review separately the words you have difficult with.
- No personal treatment
- No corrections
- Online access needed
- Still can't understand its English meaning
- Too few words provided
- No feedback on my weekly study

- Some meanings are still unknown to me.
- Slightly repetitive after a while.
- Only small variety of words given.
- No translation for each word.
- Can't practice writing.
- It's not very interactive, relies on a repetition to teach the student, and doesn't provide a very strong way to keep the student's attention.
- Cannot save time for the words that are already know
- Cannot practice writing
- The speed testing (pre-test practice without verbal feedback) is a little too fast at the very beginning
- Limited amount, same words for a week
- If the English translation was not really apparent, I didn't learn it.
- Couldn't ajust time you got
- There's not an instructor so, I can't really ask any specific questions as they come up.
- You have to rely on technology.
- I can't really think of anything else.
- No explanation of patterns in katakana, needs more vocabulary, could use more interactivity

Control:

- The training content repeats
- Not always have a computer with me
- Easy to forget training
- Because it is repeated too many time, and I need to practice it everyday with the same word, it getting boring.
- The level of difficulty is easy
- A little bit short.
- You don't know what the word you're putting together means.
- If you take the same thing over and over again, it starts being committed to memory and not because you're listening.
- In the scrambler, there were mostly hiragana words.
- Easy to forget.
- Not always able to access internet.
- Not able to go back.
- Have to remember to do outside of class
- Can't ask questions impersonal
- The words were the same every week
- The words repeated VERY loudly three times and wouldn't cut off when you moved to another word
- Too easy sometimes
- You have to have an internet connection.

- You have to be in a quite place, so you can hear.
- You don't get to write out the hiragana.
- Lack of interaction
- No translation
- Can't go over specific words

20. What else did you do to practice katakana in addition to the assigned online katakana training?

Scrambler:

- Attend regular Japanese classes and do homework
- I like to make flash cards and practice writing words. Sometimes I like to write English words in katakana for fun, though I have no way of checking to make sure I am right.
- I studied Katakana as part of the class and did exercises from the textbook and workbook. I also tried reading any hiragana/katakana I came across online (such as in screenshots from videogames that don't yet have English translations).
- I attended class and practiced there
- Read Japanese twitter
- Homework and other Japanese course work
- Went to class and studied it by writing the characters down in a note book
- Not much. I mostly just did what we had in class.
- Watching Japanese movies

Reading:

- Writing and sounding out letters
- Nothing else but some kanji
- Attempted to read katakana in the manga I was reading.
- Watch Japanese drama
- Reading comics in Japanese, talking to other Japanese students, talking to fluent Japanese speakers, and watching videos in Japanese.
- I studied a bit to try to remember the differences between "shi," "tsu," "so," and "n." Other than that, nothing.
- Quizlet.com over various Nakama 1 vocabularies.
- Add translate English to katakana part
- Just the practice from JPNS 101 classes

Control:

(How do you practice *katakana*? Please describe your way of studying *katakana*.)

- Learn from class
- Reading a lot of vocabulary is the most common way for me. I rarely write katakana.
- I memorized all words on P81 (a list of katakana words) in textbook

- I learn katakana by using textbook only and try to read any katakana word that I found in food packaging and on internet
- reading
- I didn't study katakana.
- I try to practice katakana by doing my best to commit it to memory. There isn't really any other way of getting the hang of katakana
- Reading from Jap class.
- During the experiment I was not studying katakana, but when I was learning it I used online flashcards. During the experiment I just used your training modules to brush up and improve.

VITA

VITA

Yumiko Tashiro

EDUCATION

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Japanese Language Courses:
JPNS 101, 102, & 201 (Team teaching with the course coordinator)
JPNS 102, 301, & 402
Content Course:
JPNS 361 Elementary survey of Japanese Linguistics

Japanese Faculty Summer 2011 - Summer 2014
Middlebury Japanese Language School Oakland, CA & Middlebury, VT
Level 3 Intermediate Japanese I (2013 & 2014)
Level 4 Intermediate Japanese II (2011 & 2012)

Visiting Instructor August 2009 - May 2010
Earlham College Richmond, IN
JPNS 101 & 102 Basic Japanese I & II
JPNS 351 & 352 Teaching Japanese as a second language

Japanese Language Fellow August 2007 - June 2009
Earlham College Richmond, IN
JPNS 101 & 102 Basic Japanese I & II (Assisted and taught)
JPNS 201 & 202 Intermediate Japanese I & II (Assisted and taught)

Graduate Teaching Assistant August 2004 - May 2007
West Virginia University Morgantown, WV
First-year and Second-year Japanese courses (Assisted and graded assignments)
Third-year Japanese courses (Taught)

Secondary Level

Teacher August 2007 - June 2009
Richmond Japanese Language School Richmond, IN
Taught Japanese and social studies for grades 9 through 11

Full-time English Teacher April 2001 - March 2004
Haruhigaoka High School Aichi, Japan

CONFERENCE PROCEEDING

Tashiro, Y., & Imamura, H. (2011). Developing Word Recognition Strategies of L1 English Learners of Japanese. *Proceedings of the 23rd Japan-U.S. Teacher Education Conference*, 23. Lowell, MA.

PRESENTATIONS

Tashiro, Y. (2015, September). Revisiting How to Improve Your Students' Katakana Recognition Skills. FLAVA Conference, Williamsburg, VA.

Shimoura, S., Tashiro, Y., & Hatasa, K. (2015, August). Out-of-class Japanese Learning with Place-based Mobile Games. CAJLE Annual Conference, Vancouver, Canada.

Hatasa, K., Shimoura, S., & Tashiro, Y. (2015, May). The Effect of Physically Dynamic Foreign Language Exercises – Character and vocabulary learning for non-alphabetic languages. CALICO, Boulder, CO.

Tashiro, Y. (2015, March). Effects of Online Katakana Word Recognition Practice for Japanese Beginning Learners, AATJ Annual Conference, Chicago, IL.

Tashiro, Y., Shimoura, S., & Hatasa, K. (2014, November). Physically Dynamic Exercises with a Motion Sensor for Learning Japanese. ACTFL, San Antonio, TX.

Shimoura, S., Tashiro, Y., & Hatasa, K. (2014, November). Practical Use of Physically Dynamic Exercises for Non-alphabetic Language Learning. IFLTA, Indianapolis, IN.

Hatasa, K., Shimoura, S., & Tashiro, Y. (2014, May). Making Foreign Language Exercises Physically Dynamic. – Letter recognition and vocabulary learning for non-alphabetic languages-. (Courseware Showcase) CALICO, Athens, OH.

Hatasa, K,. Shimoura, S., & Tashiro, Y. (2013, November). Using a Motion Sensor to Make Language Exercises Physically Dynamic. ACTFL, Orlando, FL.

Miura, K, Ono, Y, & Tashiro, Y. (2013, November). Merging Language and Content: Moving toward Advanced Proficiency. ACTFL, Orlando, FL.

Tashiro, Y. (2010, December). Processability Theory and Developmental Stages of English Morphology: A case of L1 Chinese learner of English. FLLinguistics Workshop, Purdue University.

PROFESSIONAL DEVELOPMENT

Preparing Future Faculty January 2014 - May 2014
The Graduate School, Purdue University West Lafayette, IN
Explored faculty roles, responsibilities, and development opportunities at different types of higher education

The Graduate Teacher Certificate April 2014
Center for Instructional Excellence, Purdue University West Lafayette, IN
Documentation of a graduate teaching assistant's classroom teaching and teacher development activities, workshops, micro-teaching with consultative feedback, classroom observations, together with student and colleague feedback and self-analyses

The ACTFL Workshop, OPI assessment (Japanese) June 2009
University of Illinois at Urbana-Champaign Champaign, IL
Participated in a four-day workshop to become a rater of Oral Proficiency Interview

GRANTS & AWARDS

Purdue Research Foundation Summer Research Grant Summer 2014
School of Languages and Cultures Excellence in Teaching Award 2012 - 2013
Departmental Conference Travel Grant Fall 2011, Fall 2013, Fall 2014

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

The Computer Assisted Language Instruction Consortium (CALICO)
American Council on the Teaching of Foreign Languages (ACTFL)
Association of Indiana Teachers of Japanese (AITJ)
American Association of Teachers of Japanese (AATJ)

INSTITUTIONAL SERVICE

SLC Recruitment Committee, Member 2014-2015
School of Languages and Cultures, Purdue University
Graduate Student Committee, Vice President (elected) 2012-2013
School of Languages and Cultures, Purdue University
Graduate Student Symposium Committee, Member 2010-2012
School of Languages and Cultures, Purdue University

CAMPUS AND COMMUNITY INVOLVEMENT

Volunteering to set up the 2015 Japanese Olympiad of Indiana
Purdue University August 2014-February 2015
Introduced exchange programs to undergraduate students at the Study Abroad Fair
West Virginia University September 2004, September 2005, September 2006
Taught Origami to pre-school and elementary school children for Stepping Stone
Morgantown, WV May 2005, May 2006
Demonstrated and spoke on Japanese Culture at local elementary schools
Oakland, MD, Cheat Lake, WV May 2005, March 2006