Reaction toward false Kanji by native and non-native speakers of Japanese

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Abstract

This study examined how native and non-native speakers of Japanese react to Pseudo, Wrong, Vague, and real Kanji (Chinese character in Japanese). The non-native speakers in this study did not learn Chinese characters in their mother languages. They are begging to intermediate learners of Japanese. The participants were asked to decide if a character is true (exist) or not true (does not exist) by pushing a key. The correct rates of native speakers were significantly higher than those of non-native speakers in all stimulus groups. The correct rates of Vague and Pseudo were low in both groups. The correct rate of Wrong Kanji in native speakers was 100%, whereas the average correct rate of Wrong Kanji in non-native speakers was 57%. The position of a semantic radical is never change and crucial to get the meaning of a character. The correct rates of Wrong in non-native speakers increased in accordance with their proficiency. The importance of the semantic radical should be more emphasized in teaching Kanji.

Keywords

Chinese character, Recognition, Non-native speakers

1 Introduction

1.1 Background

The purposes of this study are exploring learning processes of graphic features of Kanji (Chinese characters in Japanese) and finding out difficult points when learners of Japanese from non-Chinese character area (LJNC), those who have not learned Chinese characters in their mother languages. Learning to read Japanese text is a big burden for LJNC (Toyoda, 2009). Japanese uses three different scripts, Hiragana, Katakana, and Kanji simultaneously in one text. Hiragana and Katakana are syllabograms. There is one to one correspondence between a character and reading. On the other hand Kanji is logograph which conveys meanings and readings in one character. Further, most of Kanji characters have multiple readings. This complex Japanese writing system discourages for LJNC to learn Japanese scripts. For example, there are some introductory Japanese language text books which are not written in Japanese scripts, but in all Romanized characters, such as "Japanese for Busy People I – Romanized Version " (Nihongo Fukyu Kyokai, 1995). Therefore, making learning Japanese scripts easier is one of important educational issues in teaching or learning Japanese as a second language (JSL). Among three scripts, Kanji is one of the biggest obstacles in learning to read Japanese for LJNC (Takebe, 1985).

Although there are controversies about pathways of reading process, cognitive reading process models basically assume that reading starts from perception of visual information, and then converting visual information to phonological information, and finally accessing meanings (Traxler, 2011). Recent neuroimaging studies of visual word processing using Magnetoencephalography (MEG) (e.g., Pylkkanen and Marantz , 2003) and event-rerated potential (ERP) (e.g., Hauk, Coutout, Holden, and Chen, 2011; Hauk, Davis, Ford, Pulvermuller, and Marslen-Wilson, 2006 ; Holcomb and Grainger, 2006) demonstrated that visual information is processed around 70-170 milliseconds (ms) after presenting a visual word, visual to phonological information is processed around 200-300 ms, and phonological-semantic information is processes around 350-400 ms. Thus, extracting visual information from print is the very first step of reading.

Chinese characters are processed slightly differently from alphabetic characters in the brain and require more graphic computation compared with alphabetic characters (Wu, Ho, and Chen, 2012). For example, Lv and Wang (2012) reported that font differences of Chinese characters led different activation pattern in the brain when native speakers of Chinese passively looked at Chinese characters. According to them,

graphically complex Chinese characters induced more activation in the brain. In Japanese, differences in Kanji and Kana (Hiragana and Katakana) processing in the brain also have been studied (e.g., Hatta, 1981; Thuy, Matsuo, Nakamura, Toma, Oga, Nakai, Shibusaki, and Fukayama, 2004). Thuy, Matsuo, and Nakamura et al. (2004) reported that Kanji and Kana used different routes, even if the routes in the brain were overlapped by and large. They also found that Kanji processing required more graphic computation than Kana did. Kanji seems to need more computational demand in graphic processing than syllabogram, Kana. Other neurological studies show importance of knowing graphic structures of Kanji. In Kanji recognition process, a Kanji character is decomposed into small parts and intergraded into the original character again. Flores d'Arcais and Saito (1993) found that pre-presenting a part of a Kanji character, such as 口, facilitating recognition of another Kanji character, such as 石. 口 has meaning "mouth" and is pronounced /kuchi/ or /kou/. 石 has meaning of "stone" and is pronounced /ishi/ or /seki/. 口 and 石 are not related each other semantically as well as phonologically in Japanese. Kashiwagi and Kashiwagi (1989) reported an aphasic patient who could write 日 and 立, but could not write 音. These results suggest that knowing structures of Kanji and being able to decompose a Kanji character accurately are crucial skills in Kanji learning and recognition

Studies on Japanese children and JSL learners showed the importance of graphic features of Kanji in Kanji learning. For example, Koyama, Hansen, and Stein (2008) reported that visual memory was a strong predictor of Japanese children's Kanji knowledge. Hatta, Kawakami, and Tamaoka (1998) reported that Australian learners of Japanese found learning graphic features of Kanji was most difficult. Some studies investigated how adult JSL learners from alphabetic language backgrounds learned Japanese scripts (Chikamatsu, 2006; Toyoda, 2009). Chikamatsu (2006) found that more advanced L2 readers relied on more graphic information than phonological information compared with less proficient L2 readers. Toyoda (2009) found that graphic awareness of Kanji components improved according to Japanese language proficiency. Cueva and Murota (2011) investigated decomposition of Kanji by non-native speakers of Japanese from various countries. They found that intermediate learners decomposed Kanji more efficiently than beginning learners. It appears that learning graphic feature of Kanji plays a key role in learning Kanji. However, most of previous studies have focused on phonology or semantics. Learning graphic features of Chinese character has not been studied well (Koyama, Hansen, and Stein, 2008). However, learning processes of graphic features of Kanji have not received much attention from researchers and teachers in Japanese primary education and JSL.

One of educational issues in teaching Kanji is introduction order of Kanji. Vorobyova (2008) argued that complex Kanji, such as 校 or 休 was introduced earlier than 木 in some 1st grade primary school textbooks. The Ministry of Education in Japan explained how they decided the introduction order of Kanji in each primary school grades in the 1955 primary school curriculum guidelines in *Kanji no Gakunen Haito* (1955). According to this explanation, the classification was based on 1) frequent use in social life, 2) familiarity, 3) small number of stroke order, and 4) easiness for remembering. The current primary school curriculum guidelines in 2011 (Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), 2011) still follow the 1955 guidelines. The same trend is found in teaching JSL. Instruction orders of Kanji in popular Japanese language textbooks, such as in Minnano Nihongo Shokyu I, Kanji English Edition (Nishiguchi, Shinya, Koga, Takada, and Mikogami, 2000) and Genki: An Integrated Course in Elementary Japanese I (Banno, Ikeda, Ohno, Shinagawa, and Tokashiki, 2011), are based on familiarity or frequent use. For example, in Genki: An Integrated Course in Elementary Japanese I (Banno, Ikeda, Ohno, Shinagawa, and Tokashiki, 2011), 時 (hour, time) is introduced earlier than 寺 (temple). Semantically "hour, time" is more important and familiar than "temple." However, graphically 時 is more complex than 寺. Effectiveness of introduction order of Kanji has not been well studied (Vorobyova, 2008). Investigating what kinds of graphic features of Kanji are difficult to learn could contribute to develop effective introduction order of Kanji.

1.2 Radicals and structure of Kanji

Even though some Chinese characters have pictographic origins, the graphic features of Chinese characters today are abstracted (Shu and Anderson, 1995). Many Chinese characters are largely decomposed into two parts horizontally, such as 古 or vertically, such as 利 (Fang and Wu ,1989). One of the two parts in vertical or horizontal structure is a radical. Chinese character dictionaries are arranged by radicals. A radical has a dominant position (i.e. frequently occurring position) in a Chinese character. For example, 氵, a radical which means water, is always placed at the most left side of a character. Psychological studies using native speakers of Chinese (e.g., Taft and Zhu, 1997: Taft, Zhu, and Peng, 1999) reported that changing

dominant radical position slowed graphic, phonetic, and semantic processes in Chinese recognition. Su, Mak, Cheung, and Law (2012) reported that characters with a less dominant position radical, such as 覽, invoked slower reaction than characters with a dominant position radical, such as 蜆 did. In Chinese 見, as a radical, dominantly appears on the right side of a character. Lin, Chen, Zhao, Li, He, and Weng (2011) compared neural activities of N170 which is an ERP component after 170ms onset of stimulus presentation and is supposed to reflect visual processing in the brain using real Chinese characters, pseudo characters, false characters, and stroke combination. In pseudo characters the combination of two radicals does not exist. In false characters the position of a semantic radical was changed. Stroke combination is made with non-existing radicals. Lin et al. (2011) found that real and pseudo characters evoked larger left-lateralized (dominant language hemisphere) N170 reaction compared with false characters and stroke combination. They also reported that real and pseudo characters produced the same amplitude of left-lateralized N170. Real character is pronounceable, whereas false characters, pseudo characters, and stroke combination are not pronounceable. These finding suggest that orthography rather than phonology plays an important rule in Chinese character recognition.

Besides the position of a radical, there is another important graphic feature in Kanji to access the right meaning. Very slight graphical differences become distinctive features of Kanji. For example, in 末(end) and 未(feature) or 士(warrior) and 土 (soil), length of the two horizontal lines is crucial to know the meanings of a Kanji character. For those LJNC, it must be very difficult to be aware of the importance of length of the two lines without any guidance.

In 1945 commonly used Chinese characters in Japanese, 1167 Chinese characters are *Keisei*, a compound character group, which consists of a semantic radical and a sound radical. Knowledge of combinations of a semantic radical and a sound radical must be useful for learning Kanji. One might be able to guess the meaning of a Keisei character, if one knows the meanings of a semantic radical and a sound radical. For example, 晴 is made of 日 and 青. 日 is a semantic radical with meaning of "sun". 青 is a sound radical with meaning of "blue". Then the meaning of 晴 is "fine sky". A *Kun* reading, that is Chinese origin reading, of 青 is /sei/ in Japanese. Therefore, it might be easy to guess that a reading of 晴 is /sei/. Even if learners fail to guess the meaning or reading of 晴, knowledge of radicals would help them with learning the meaning and pronunciation of a *Keisei* character. However, knowing the right combinations is difficult even for native speakers of Japanese. The biggest Chinese character dictionary in Japanese, *Dai kanwa jiten* (Morohashi, 2000), listed around 51,000 Kanji characters, whereas only around 2,100 characters have been selected by the Japanese government as commonly used Kanji. That is there should be lots of Kanji which even Japanese have not learned.

In this study, we focused on three Kanji graphic features, 1) slight distinctive differences, 2) the right combinations of a semantic and a sound radicals, and 3) the right position of a radical. We tested awareness of the above three points in LJNC and Japanese adopting an experimental paradigm of Lin et al. (2011). We employed three different types of illegal Kanji, namely Vague, Pseudo, and Wrong. Vague has very minor wrong graphic features, such as equal length of the two horizontal lines, like 未 or士. Or a part was 180 degree rotated, like災. Vague characters were based on JLNC's writing mistakes and were supposed to be mistakable forms by JLNC. Vague was used to examine awareness of slight graphic differences of Kanji. Pseudo consisted of parts with the correct radical position. However the combination of two components does not exist. Pseudo was used to examine awareness of the right combination of a radical and a component part. Wrong does not follow the dominant radical positioning rules. The position of a semantic radical is inverted horizontally or vertically. Wrong was used to examine awareness of the right radical position in a character. We also employ Korean characters as a stimulus group. Graphic combining structures of Chinese characters and Korean characters are the same. Korean characters also can be divided into largely two parts vertically, such as 마 or horizontally, such as 루. Component parts are different in Chinese and Korean characters. Korean characters are shown in many signs in the city, such as in department stores or stations. Therefore, one who lives in Tokyo can easily see Korean characters in daily life at least passively. Korean characters are good indicators to examine if JLNC participants can discriminate graphic differences of components between Kanji (Chinese) or Korean characters. Korean characters also serve as fillers among stimuli.

This study solely focused on graphic features of a Kanji character following a word decision paradigm in experimental cognitive studies. Processing phonological and semantic information of Kanji or Kanji compounds is cognitively very complex and difficult to control many aspects of linguistic features and individual differences, such as frequency and familiarity for words, and linguistic and social backgrounds of

the participants. Avoiding confusion and stress of JLNC during the experiment is another reason why Hiragana and Kanji compounds were not used in this study.

3 Method

3.1 Participants

The participants were eight JLNC (4 male and 4 female, *M*=25.6, *SD*=2.45) from various countries and eight Japanese (3 male and 5 female, *M*=27.3, *SD*=4.01). The experiment in this study was approved by Ethical Review Boards at Tokyo Medical Dental University. All participants satisfied the following three requirements by Ethical Review Boards, 1) participants should belong to the same department or faculties with the author or partner researchers, 2) participants agree to participate in the experiment voluntary, and 3) the participants had advisers' permission to participate in the experiment. All participants signed the informed consent. All participants were healthy and had normal or corrected visions. JLNC participants were graduate students at a university in Tokyo. They did not receive formal Japanese language education at their home countries. Eight Japanese participants were undergraduate students at a university in Tokyo. Table 1 showed background information of the eight JLNC. Five JLNC participants (number 1, 3, 4, 5, 7, and 8) studied Japanese at a formal classroom setting for 330 hours in 6 months intensively at a university. The used testbooks were Genki I (Banno, Ikeda, Ohno, Shinagawa, and Tokashiki, 2011), and Genki II (Banno, Ikeda, Ohno,Shinagawa, and Tokashiki, 2011). Around 200 Kanji were introduced in the class. The number 7 participant studied Japanese before coming to Japan by herself. Her level was intermediate, even if her stay in Japan was less than one year. The number 2 participant studied Japanese at a language class for 67.5 hours in 3 months at a university. The used textbook was Hakase, Basic Japanese for students (1) (Yamazaki and Doi, 2006). Kanji were used in the main text in this textbook. However, Kanji was not taught in class. The number 6 participant studied Japanese language for one year at a language school. However, the participant cannot remember the exact hours of instruction at the school. Intermediate participants' level was judged using Level 3 test from Japanese-Language Proficiency Test Official Practice Workbook (2009). Japanese-Language Proficiency Test before 2010 had four levels, form Level 1 (advanced) to Level 4 (beginning). Level 3 was placed as intermediate. The number 2 and 4 students did not take Japanese classes for last one year at the time of experiment.

Table 1: Background information of JLNC participants

Number	Nationality	Japanese learning hours and period at a formal language class	Period of living in Japan	Level
1	Bangladesh	330 hours, 6 months	2 years	Beginning
2	Bangladesh	67.5 hours, 3 months	2 years	Beginning
3	Bangladesh	330 hours, 6 months	3 years	Beginning
4	Ghana	330 hours, 6 months	2 years	Beginning
5	Thai	330 hours, 6 months	2 years	Beginning
6	Nepal	Unknown* , 1 year	2 years	Beginning
7	Indonesia	330 hours , 6 months	11 months	Intermediate
8	Pakistan	330 hours , 6 months	3 years	Intermediate

Note: * The participant did not remember the exact hours of classes.

3.2 Character stimuli

There were five groups of character stimulus groups, four Kanji groups and one Korean group. Four Kanji stimulus groups were Vague, Pseudo, Wrong and Real. Vague and Wrong consisted of 15 characters. Pseudo consisted of 20 characters. Korean consisted of 10 characters. Real consisted of 25 characters. Original Kanji characters of Wrong and Real were chosen from Kanji characters which were introduced in beginning level Japanese language textbooks, Minnano Nihongo Shokyu I (Three A Network, 1998a), Minnano Nihongo Shokyu II (Three A Network, 1998b), Genki I (Banno, Ikeda, Ohno, Shinagawa, and Tokashiki, 2011), and Genki II (Banno, Ikeda, Ohno, Shinagawa, and Tokashiki, 2011). The list of Character stimuli is presented in Appendix A.

3.3 Procedure

Each character was presented one by one in the computer monitor and remained until a participant reacted. The participants were asked to hit "1" when they thought a presented character was true Kanji and to hit "0"

when they thought a presented character was not true Kanji. In the experiment, the stimuli were presented randomly for each participant. A short practical session was conducted before the experiment. After the experiment, short oral interview was conducted for JLNC asking, 1) if a participant tried to read Kanji on the street or not, and 3) if a participant continued to learn Kanji by oneself. Super Lab 4.0 (Cedrus Cooperation) was used to present stimuli and correct data. The participants' response and reaction time were recorded. Reaction times were not analyzed in this study, because individual differences were large in reaction times regardless of nationality and did not relate to correct rates. SAS 9.0 (Windows, SAS Institute Inc.) was used to perform statical analyses. Mann-Whitney U test was used to compare the mean correct rates between the participant groups. Friedman test was used to examine the differences of mean correct rates within participant groups.

4 Results and Discussion

4.1 Oral interview

The participant number 2 and 4 told that they did not try to read Kanji on the street. The participant number 4, 6, and 7 told that they gave up learning Kanji.

4.2 Mean correct rates

Table 2 shows the mean correct rates of Vague, Pseudo, Wrong and Real in JLNC and Japanese. Both JLNC and Japanese detected Korean characters prefect. All participants could distinguish Kanji (Chinese) characters from Korean characters well. The correct rates of Wrong and Real were perfect in native speakers of Japanese. Vague was lowest correct rates in both LJNC and Japanese.

Table 2: Mean correct rates of character groups

	Vague	Pseudo	Wrong	Korean	Real
LJNC	0.37 (0.13)	0.51 (0.16)	0.58 (0.22)	1.00 (0.0)	0.83 (0.14)
Japanese	0.59 (0.14)	0.88 (0.12)	1.00 (0)	1.00 (0)	1.00 (0)

Note: Figures in parentheses is *SD*.

The Mann-Whitney U test was conducted to compare correct rates between LJNC and Japanese in the four character groups. In the all four character groups, the correct rates of Japanese were higher than those of LJNC, U=56.0, Z=2.54, p=.011, r=.63 in Vague, U=62.5, Z=3.22, p=.001, r=.80 in Pseudo, U=64.0, Z=3.59, p<.000, r=.89 in Wrong, and U=62.0, Z=3.34, p=.001, r=.83 in Real. It is reasonable that performance of Japanese native speakers was significantly better than that of LJNC.

4.3 Correct rates of Wrong Kanji

The position of a radical is fixed and important in Kanji recognition process. It was a surprise that the correct rates of Wrong was law in JLNC. Figure 1 shows correct rates of Wrong Kanji in LJNC. It seems that correct rates of Wrong Kanji increased along with Japanese language proficiency.

The participant number 7 and 8 were intermediate learners. Participant number 2 studied Japanese only for 3 months and did not show much interests in reading Kanji in the street. Knowledge of Kanji might be limited, even if the participant lived in Japan for two years at the time of the experiment. Participant number 1, 3, 4, 5, 7, and 8 took the 6 month intensive Japanese language class and studied 200 Kanji characters. They lived in Japan more than 2 years. Post experiment oral interview revealed that the three participants (number 4, 6, and 7) did not study Kanji after the intensive course. Oral communication skill of the 6 participant (number from 1 to 6) was roughly equivalent to Novice High in ACTFL Proficiency Guidelines 2012 Speaking (2012). Differences between those 5 participants and 2 intermediate participants were interests in Japanese text and the length of Japanese learning. Even if the participant 7 gave up learning kanji, she enjoyed reading Japanese comic books for a long time in her country. The participant 8 continued studying Japanese by himself after the 6 month intensive Japanese language class. The participant 1 and 3 showed interests in learning Kanji by themselves. Therefore, follow up studies might reveal if learners' knowledge of a radical position in a character increase with continues motivation to learn Kanji. Many beginning LJNC quit learning Kanji due to complex nature of Kanji in Japanese text. A Kanji character has multiple readings. Readings and meanings of a Kanji character heavily rely on the context. Further, many Japanese content words are Kanji compounds. Learners have to study not only single Kanji character but also Kanji compounds. It must be very tedious and difficult for LJNC to study Kanji. Knowledge of Kanji is

important to advance Japanese language proficiency, because most of abstract words are Chinese compounds in Japanese. Therefore, it is necessary to develop teaching materials or methods for LJNC to continue to learn Kanji.

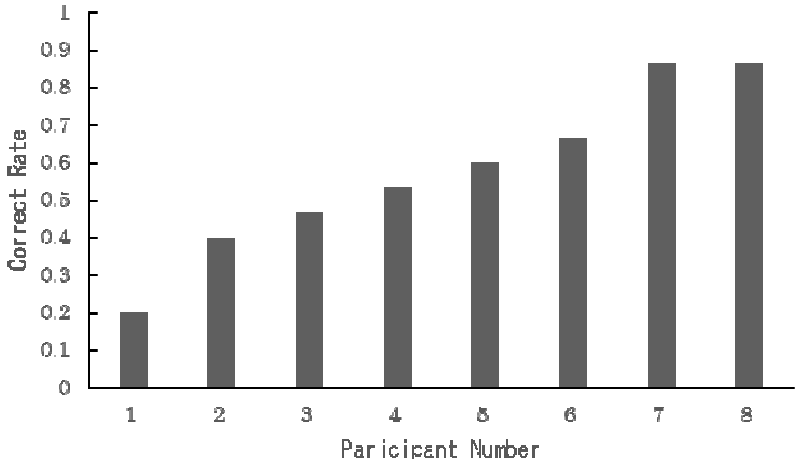

Figure 1: Correct rates of Wrong Kanji in JLNC

Table 3 shows the lowest and highest correct rates of Wrong Kanji in LJNC. Two intermediate participants answered the lowest correct rate characters correctly. The two components in the lowest correct rate characters are complex and have similar oblong shapes. As far as comparing the highest and lowest correct rate characters, it seems that more complex characters are difficult to judge for beginning LJNC. However, 言 and 糸 are popular radicals which appear at the left side of a Kanji character. For example, 話(story), 語(language), 結(unite or result), and 終(end) were frequently used in daily life and were introduced in the 6 month intensive class. One problem is that component parts are introduced later than a whole character in 話 or 語 or 結. For example, 話 consists of 言(say) and 舌(tongue). 舌 is not introduced in the beginning textbooks, because "tongue" is not a familiar word in daily life. It might be difficult for LJNC to judge which component is the radical.

Table 3: Lowest and highest correct rates of Wrong Kanji in JLNC

	Highest	Second Highest	Lowest
Character	トタ	寺亻	詰絡語
Correct Rate	0.92	0.85	0.31

The correct rate of Wrong in Japanese native speakers was perfect. This result suggests that the knowledge of the right position of radicals is indispensable in mastering Kanji. A close look at LJNC errors revealed that the correct rates of Wrong Kanji seemed to increase according to Japanese proficiency of the LJNC. This result suggests that knowing the right position of the radical in a character might be a good indicator of Kanji or Chinese character learning. Developing educational materials or devices is needed to improve LJNC's awareness of the right position of a radical in a character. Information about Kanji structures and meanings of semantic radicals are introduced in beginning Japanese language textbooks. It seems that further emphasizing the importance of a correct radical position is necessary. In this study the number of participants is small. And the number of characters is limited. Therefore, further studies should examine what kinds of radicals are difficult for LJNC to learn.

4.4 Vague and Pseudo Kanji

Friedman test yielded significant differences in both participant groups, $\chi 2(3, N=8)=14.5$, $p=0.002$, Kendall's W is .61 in LJNC, and $\chi 2(3, N=8)=16.7$, $p<0.000$, Kendall's W is .80 in native speakers of Japanese. Multiple comparisons showed that the mean correct rate of Vague was significantly lower than that of Real in LJNC. However, any significant differences were not fond in other paired comparisons in LJNC. The mean

correct rates of Wrong and Pseudo were lower than that of Real. However, statistical significances were not found.

The mean correct rate of Vague was significantly lower than those of Wrong and Real in Japanese. Vague led highest mistakes in both LJNC and Japanese. It seems that slight distorted graphic features of Chinese characters led native speakers' confusion.

Table 4 shows four Vague characters in which both all LJNC and Japanese native speakers made higher errors. Surprisingly, most of Japanese native speakers thought 末 is right, even though it does not have distinctive features. It is not 末 nor 未. It appears that when 末 was presented alone without context, most of Japanese accepted it as a real character. Probably, Japanese can easily differentiate 末 from 未 within a context. Japanese native speakers were more easily able to detect correctly 土 than 末. It might be graphic nature of 土 is simpler than that of 末 . We should not assume that JLNC do not need to pay attention to slight differences of distinctive graphic features of Kanji, just because native speakers of Japanese also did not detect the differences of distinctive graphic features of Kanji well. For beginning LJNC, it might be difficult to make use of a context as well as Japanese native speakers do. Therefore, LJNC need to recognize a character accurately paying attention to minor graphic differences.

Table 4: Correct rates for some Vague Kanji characters

Vague	学	向	魚	未	土
Right	学	向	魚	未未	土士
JLNC	0	0.50	0.12	0.12	0.15
Japanese	0.50	0	0	0.12	0.46

Table 5 shows Pseudo characters which obtained higher and lower correct rates in LJNC and Japanese native speakers. In Japanese native speakers, the lowest correct rate character was 神. As shown in the Table 5, the difference of 神 and the real Kanji was very minor. The native speakers of Japanese might not detect the difference. In Japanese native speakers, the highest correct rates characters were 点 and 邪. There are not so many Kanji characters which have 心 at the bottom in a character and 阝 at the right of a character. Therefore, it might be easier for native speakers of Japanese to make a decision on the correctness of a character. This might suggest that importance of teaching frequent occurring combination patterns in Kanji learning. Further investigation is needed to know what kinds of combinations of a radical and a component part are difficult to learn for LNJC.

Table 5: Correct rates for some Vague Kanji characters

	Highest	Second Highest	Lowest	Second Lowest	
JLNC	定衫	仙	祥	佁痂洼	
Correct rate	0.85	0.69	0.23	0.15	
Japanese	点邪	拄痂	衫	神 (Pseudo)	神 (Real)
Correct rate	0.92	0.85	0.62	0.54	

During the experiment, the author encountered an interesting case. Slight graphic differences of a character caused by computer type fonts confused judgment of native speakers of Japanese. Five out of seven Japanese native speakers judged the Gothic 外 is wrong. Table 6 shows the differences of Kanji and Hiragna in Gothic, *Mincho* and *Kyokasho* fonts. *Kyokasho* means textbook in Japanese. *Kyokasho* font is used in Japanese primary and secondary school education. Japanese children have to write by hand as characters printed in Kyokasho font. Continued lines are more economic than cut lines in creating printing

type fonts. Gothic or Mincho fonts are used more commonly as printing type fonts. Most of Japanese often see さ or き on the street. Therefore, Japanese native speakers accept Gothic font さ or き, even if theses Hiragana characters are graphically clearly different from さ or き in *Kyokasho* font. However, the difference between 外 and 外 is very minor, and when the font size is small, most people cannot notice the difference. When a font size is large, the graphic difference becomes very clear, and it becomes easy to notice the graphic difference. Not, *Kyokasho* font, but Gothic or *Mincho* font is used in most of Japanese language text books for non-native speakers of Japanese. As a result many JSL learners hand write Hiragana characters as Gothic or *Mincho* fonts. The MEXT Notice on Joyo Kanji (1981) says that graphic differences due to font differences are small. Therefore, font differences do not affect comprehending Kanji. However, majority of native Japanese speakers judged Gothic type font of 外 is wrong. Minor graphic differences due to font types do affect acceptance of a Kanji shape. Further research is needed to find out what kinds of graphic features of Kanji are acceptable and what kinds are not.

Table 6: Differences in Gothic and Kyokasho fonts

Font	Kanji	Hiragana	Hiragana
Gothic	外	さ	き
Mincho	外	さ	き
Kyokasho	外	さ	き

In sum, native Japanese speakers may not pay much attention to minor graphic features of Kanji, because they easily detect the meaning of Kanji from the context. However, minor graphic features of Kanji should not be considered less important in the JSL context, because LJNC may not be able to make use of context as same as Japanese do. We need further studies to know what kinds of graphic features and what kinds of combinations of a radical and a component are important in learning Kanji in the JSL context.

5 Conclusion

Slight distortion in Vague, such as rotation of components of a character or length of lines, seemed to lead highest errors in both native speakers of Japanese and LJNC. Ignoring minor graphic features may not influence Japanese native speakers' comprehension, because Japanese can utilize contexts to reach the meaning of a character. However, it must be important for LJNC to learn minor graphic features of Kanji, because LJNC cannot make use of context as well as native Japanese speakers do. Pseudo was also difficult for LJNC to judge. The result of Japanese native speakers suggests that knowing popular combination patterns of a radical and a component part might be useful to judge the right Kanji characters. However, it is necessary to evaluate how knowing frequent occurring combinations of Kanji component parts are important in successful Kanji learning. Learning the correct radical position of a Kanji character might be a good indicator of mastery of Kanji in LJNC. Further research and development of teaching materials are necessary to improve awareness of the right position of a radical in a character.

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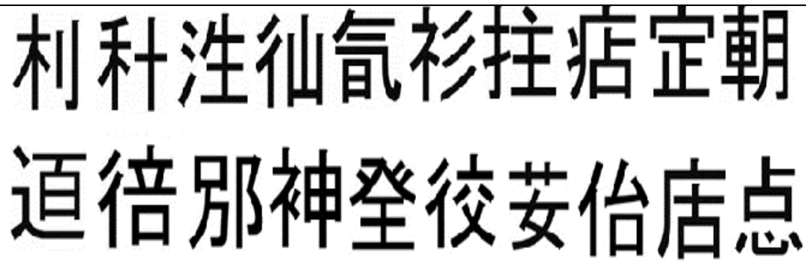
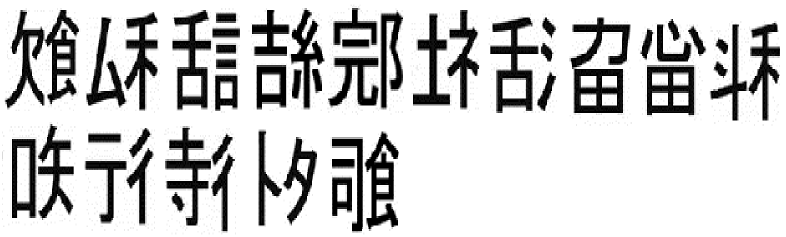
Appendix A. List of stimuli

	Number of Characters	Character
Vague	15	
Pseudo	20	
Wrong	15	
Korean	10	메닝벚도앞랴먼모래앨
True	25	間外朝古音会安行多同 言気交強週先飼図名西 計向悪社来