Writing errors in Japanese kanji: A study with Japanese students and foreign learners of Japanese

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Abstract. The present study examined kanji errors in handwriting made by Japanese students and Australian learners of Japanese. First, a cognitive psychological model to explain the production of writing errors was proposed based upon the analysis of 374 writing errors of two-morpheme (kanji) compound words generated by Japanese students in spontaneous sentence writing situations. Despite the common assumption that kanji writing errors may not be related to the sounds of kanji characters (i.e., morphological phonology), the present study found that phonologically-related kanji writing errors were most numerous (60.0%), followed by orthographically-related errors (43.6%) and semantically-related errors (29.7%), including some overlap of these three types. Second, 408 kanji writing errors made by students learning Japanese in an Australian university were analyzed. Unlike the Japanese students, these subjects wrote more non-existing kanji and made orthographically-related mistakes rather than semantically- and phonologically-related errors. This result must be related to the level of kanji writing skills held by learners of Japanese. In light of these results, several suggestions were proposed for the methods of teaching kanji writing.

Key words: Spontaneous kanji writing errors, Phonological, morphological and semantic factors, Psychological model, Teaching implications

Introduction

Children usually begin to learn the writing system of their mother tongue as soon as they start school and are expected to master the rules which govern handwriting. In Japan, children officially begin to learn the Japanese writing system of both kana (phonetic symbols) and kanji (morphographic characters) at age 6. Because more than 95 percent of 15-year-old students go on to senior high school (Grades 10–12), most Japanese students learn Japanese writing for 12 years. Furthermore, about 40 percent of senior high school graduates enter either a two-year college or a four-year university program where they are expected to use various kanji when they write essays. Therefore, it is strongly expected that Japanese university students will achieve complete mastery of the kanji writing system. In actual fact, the true situation differs somewhat from the assumed norm: university students do occasionally experience difficulty in kanji reading and writing.

Why should people make kanji writing errors after such a long and intensive learning experience? Apparently, they tend to select an incorrect kanji when they cannot remember the correct one. A typical example of this occurs in a kanji writing test in a Japanese language class where children are presented with phonological kana symbols and asked to write down the corresponding kanji characters in brackets beside the kana. When their kanji memory is vague, they simply select an improper kanji to fill in the empty bracket. As Japanese native speakers have to remember so many kanji, they sometimes consult a kanji dictionary to aid their memory. Alternatively, if they feel some uncertainty regarding a word which is normally written in kanji, they can express it by using the phonetic symbols of kana instead. As kana can express all the Japanese sounds in an exact one-to-one correspondence at the mora level, Japanese people do not have much difficulty in presenting kanji-written words in kana, although writing Japanese sentences with few kanji tends to give the impression that the writer is not well-educated.

Interestingly, people make kanji errors even when they voluntarily choose to use kanji, though this occurs less frequently than in situations where they are forced to use it. Such errors suggest that their long-term memory of kanji is faulty and that incorrect kanji must be retrieved from the lexicon. If this is the case, the analysis of kanji writing errors must be a promising way to study the cognitive processing of kanji by exploring the long-term kanji memory store or the kanji lexicon. Thus, the purpose of the present study was to examine some cognitive mechanisms in the kanji writing system by investigating kanji errors generated in situations where subjects voluntarily chose to write in kanji, and to seek some suggestions for improving the teaching of kanji in Japanese language programs in foreign countries.

Previous studies of writing errors derived most of their findings by examining dyslexic or agraphic subjects. Studies of dyslexia suggest that poor writing is the inevitable concomitant of poor reading (e.g., Cook 1981; Gerber 1984). This idea seems to reflect the classical doctrine of neurology which states that writing disorders do not exist in isolation but that in fact they occur in conjunction with and as often as disorders of speech. However, several studies suggest that the occurrence of pure writing disorders is not necessarily accompanied by reading defects. These cases of dissociation – cases where writing disorders are dissociated from reading disorders – are sometimes called 'spelling-specific problems' (Frith 1980), 'spelling only retardation' (Jorm 1983), or 'developmental spelling disorders' (Nelson & Warrington 1974). The question as to whether this type of dissociation actually exists has become one of the most hotly-debated topics in recent neuropsychology. Beauvois and Derouesne (1979), Hatfield and Patterson (1983), and Temple

(1985) reported neuropsychological cases which support the existence of dissociation between reading and writing disorders. However, a recent study by Joshi and Aaron (1991) challenged this proposal of dissociation.

In the case of normal neuropsychological subjects, Seymour (1973) and Ellis (1994) employed Morton's logogen model (1969) to account for the phases which occur when a subject writes in English. Basically, the logogen model distinguishes three operations or processes. First, the phonemic form of the word to be written is segmented into syllables or phonemes. Second, the letters which represent those sound segments are supplied. Third, the letters are assembled into a candidate spelling. It is apparent that the model emphasizes the crucial role of the phonological factor in the production of spelling errors in English. Although Ellis (1994) indicated the limitations of this so-called aphasic median theory (e.g., irregular word spelling, neuropsychological cases of phonological dysgraphia, etc.), his model also stressed the important role of the phonological factor in writing English words.

In short, these studies of brain-damaged and normal adult subjects seem to suggest that writing difficulties or writing errors in English are caused exclusively by problems in the phase of the phoneme-to-grapheme conversion process, and thus, a phonological factor plays the most crucial role in producing writing errors in English.

In Japanese kanji writing, the situation is believed to be very different from the alphabetic language of English. English words consist of multiple letter sequences (often of more than four). However, in Japanese, a mora, which is a phonological unit larger than a phoneme, corresponds with kana symbols in a one-to-one fashion (see Tamaoka 1991, for the linguistic and historical backgrounds of the kanji and kana writing system, and Tamaoka & Hatsuzuka 1997, for the processing of a single hiragana and katakana). In the case of kanji characters, though many kanji share the same sound (i.e., homophonic kanji), it is common that a single kanji character has more than two different pronunciations (i.e., On- and Kun-reading). These phonological differences seem to indicate strongly that, in the Japanese kanji writing system, the phonological factor may not play the crucial role it is thought to play in English.

The lesser degree of involvement of kanji phonology also seems to be supported by neurological studies of kana and kanji writing. In the Japanese writing system, the scripts of kanji and kana are generally used in a mixed fashion within a single sentence. Neuropsychological studies have reported a dissociation between kanji and kana writing. It is well known that, in cases of Broca type aphasia, writing a kanji character is affected more strongly than writing a kana symbol, whereas in cases of conduction aphasia, kana writing is more strongly affected than kanji writing (Yamadori 1985). The cognitive

processing model for kanji writing seems to be very different from the models for English. Thus, the present study examines whether distinctive differences actually do exist in writing errors between Japanese kanji characters and the English alphabet.

Few systematic examinations of Japanese kanji writing errors made by normal subjects have been conducted. In examining English writing errors, Cohen (1980) analyzed the spelling mistakes of adults and classified them into four types: A-type (the substitution of a real word homophone; e.g., 'blew' for 'blue'), B-type (the substitution of a real word; e.g., 'blow' for 'blue'), C-type (the substitution of a compatible pseudohomophone; e.g., 'bloo' for 'blue'), and D-type (the substitution of an incompatible pseudohomophone; e.g., 'bloe' for 'blue'). Using this type of classification approach, the first part of the present study analyzed kanji writing errors produced by Japanese college students to classify the writing errors and propose a working model to explain how these are produced. The second part of the study examined the writing errors in kanji generated by learners of Japanese in an Australian university and tried to clarify their characteristics.

Study 1: A model of writing errors in two-kanji compound words

In the Japanese writing system, kanji, kana, and digits, as well as 'logographic' symbols, are generally used in a mixed style, and the percentages of each type of script differ depending upon the nature of the documents in which they appear. For example, official documents consist of approximately 40–50 percent kanji, a higher percentage than that of popular literature. Because most Japanese words are two-kanji compounds, it is obvious that these compounds play important roles in modern Japanese writing. Thus, the present study analyzed writing errors in two-kanji compound words in order to develop a cognitive model which explains the production of kanji writing errors.

Method

Materials. Three hundred and seventy-four writing errors in two-kanji compound words were collected, mainly from essays and letters to teachers in examination answer sheets. The subjects who made the errors were Japanese students from five colleges: two nursing training colleges, one college of kindergarten teachers, one for geriatrics, and one teacher training college. The research sample totalled 2200 students. All were high school graduates, and therefore had at least 12 years of education.

Owing to the presence of time constraints, writing an examination is stressful for any student. Despite this fact, we assumed that the writing situation in which we collected the data of kanji writing errors was free of such pressure because essays and letters to the teacher were written only when the students had ample time left during their 90–100 minute examination. Under this condition, the study collected writing errors to total 374 two-kanji compound words. However, the point might be raised that the students made their errors because they were dealing with specialized or unusual kanji with which they were unfamiliar and which would not naturally be stored in their memory. However, as mentioned above, a native Japanese speaker who knows that he or she cannot correctly recall any given kanji can automatically use its kana equivalent instead. These students, who were under no obligation to use kanji in their essays and letters to their teacher, could certainly have done the same. Obviously, no student would knowingly include errors in an essay, and because they voluntarily chose to write the kanji form we must conclude that they thought their versions were correct. Therefore, the students must have misread the kanji when they saw them for the first time, and given this, their kanji errors must result from distorted memory, not from uncertainty.

Results and discussion

As the baseline information of two-kanji compound words which comprised the research materials was not clear in the subjects' kanji knowledge, it was useless to try to determine which errors appeared most frequently. However, we did discover ten distinct error categories. These ten categories were as follows.

(1) substitution by a same reading or phonological kanji (P Type),
(2) substitution by a configurational and orthographically similar kanji (O Type),
(3) substitution by semantically similar kanji (S Type),
(4) mixture of P and O types (P+O Type),
(5) mixture of P and S types (P+S Type),
(6) mixture of O and S types (O+S Type),
(7) mixture of P, O and S types (P+O+S Type),
(8) substitution by non-kanji (NK Type),
(9) placement-order error (R Type), and
(10) others (Other).

Samples of two-kanji writing errors in each classification are shown in Figure 1. As is apparent from these classifications, writing errors consisted mainly of phonological, semantic and orthographic factors. The percentages of each error type are shown in Table 1.

Error Type	Samples	Error Type	Samples
P Type	/sha kai/ /sha kai/ 社回 for 社会 (society)	O+S Type	/tai zoku/ /ji zoku/ 待続 for 持続 (to maintain)
O Type	/i setsu/ /ki setsu/ 委節 for 季節 (season)	P+O+S Type	/shin to/ /shin to/ 侵透 for 浸透 (penetration)
S Type	/sen zon/ /sen puku/ 潜存 for 潜伏 (concealment)	NK Type	/ho ----/ /ho ken/ 保建 for 保健 (sanitation)
P+O Type	/i shiki/ /i shiki/ 意織 for 意識 (consciousness)	R Type	/dan han/ /han dan/ 断判 for 判断 (judgment)
P+S Type	/sei shin/ /sei shin/ 精心 for 精神 (mind)	Other Type	/maki geki/ /shi geki/ 牧激 for 刺激 (stimulus)

Figure 1. Error classification types and samples of kanji writing errors generated by Japanese students.

Table 1. Number of writing errors in two-kanji compound words made by Japanese subjects as a function of types (percentages are shown in parentheses)

Error type	Number	Error type	Number
P Type	34 (9.1)	O+S Type	2 (0.5)
O Type	67 (17.9)	P+O+S Type	6 (1.6)
S Type	6 (1.6)	NK Type	56 (15.0)
P+O Type	88 (23.5)	R Type	8 (2.1)
P+S Type	97 (25.9)	Other Type	10 (2.7)
Total			374 (100.0)

Abbreviations of type are shown in the text.

As a single-factored mistake, the orthographically-related errors (O Type) were the most common type of writing error at 17.9%, followed by phonologically-related errors (P Type) at 9.1%. The least frequent errors were the semantically-related errors (S Type), at 6.0%. Thus, when we consider only the single factor, kanji orthography seems to be difficult for native Japanese speakers. Since mastering the great variety of kanji forms is a more complex task than mastering the 26 letters of the alphabet, this result is to be expected.

However, once we take multiple factors into consideration, the actual figures of error occurrence change dramatically. The total of phonologically-related errors is 60.2% which was calculated by adding the phonologically-related errors (P Type), the phonologically- and semantically-related errors

(P+S Type), the phonologically- and orthographically-related errors (P+O Type) and the phonologically-, orthographically- and semantically-related errors (P+O+S Type). Orthographically-related errors stood at 43.6%, a total which was reached by adding all the orthographically-related errors (O Type), the phonologically- and orthographically-related errors (P+O Type), the orthographically-, and semantically- related errors (O+S Type), and the phonologically- orthographically-, and semantically-related errors (P+O+S Type). Semantically-related errors accounted for 29.7% of mistakes, a sum which was calculated by adding all the semantically-related errors (S Type), the phonologically- and semantically-related errors (P+S Type), and the phonologically-, orthographically- and semantically-related errors (P+O+S Type). As indicated in these percentages of kanji writing errors, phonologically-related errors actually exceeded the orthographically-related and semantically-related errors once we took these three multiple factors into consideration. Therefore, despite the common notion that orthographically-related or semantically-related errors are more frequently seen in kanji writing than are phonologically-related errors, the present study indicated that morphological phonology must be one of the major factors which causes mistakes in kanji writing.

The present study also hypothesized firstly that in the kanji mental lexicon, single and compound kanji words are stored in different domains. There are two reasons for maintaining this point.

One is that, because college students have accumulated a great deal of learning experience in studying kanji reading and writing, it is not efficient for them to access one kanji morpheme and then search for another kanji combination in the case of two-kanji compound words. In fact, a previous study by Tamaoka and Hatsuzuka (1995) revealed that kanji printed-frequency showed its effect in the processing of two-kanji compound words independently from word printed-frequency. Thus, a single kanji morpheme, as well as a whole word consisting of two kanji, should be represented in the orthographic lexicon.

The second reason is based upon two recent case studies with brain-damaged patients. Matsuda, Showtenmoku, Nakamura, Nakatani and Suzuki (1996) reported a case of a male patient with left parietal lesions who could read single kanji separately 手 (/te/, hand) and 紙 (/kami/, paper), but who failed to read those same two-kanji morphemes when they were presented as a compound word 手紙 (/tegami/, letter). Conversely, Higuchi, Saitoh, Tominaga, Shimada, Yamaguchi, Motomura, Kashiwagi and Yamadori (1996) reported on a female patient with multiple sclerosis who could not correctly read single-kanji words, but who could read the same kanji characters when they appeared as a part of a two-kanji compound. For instance, when she
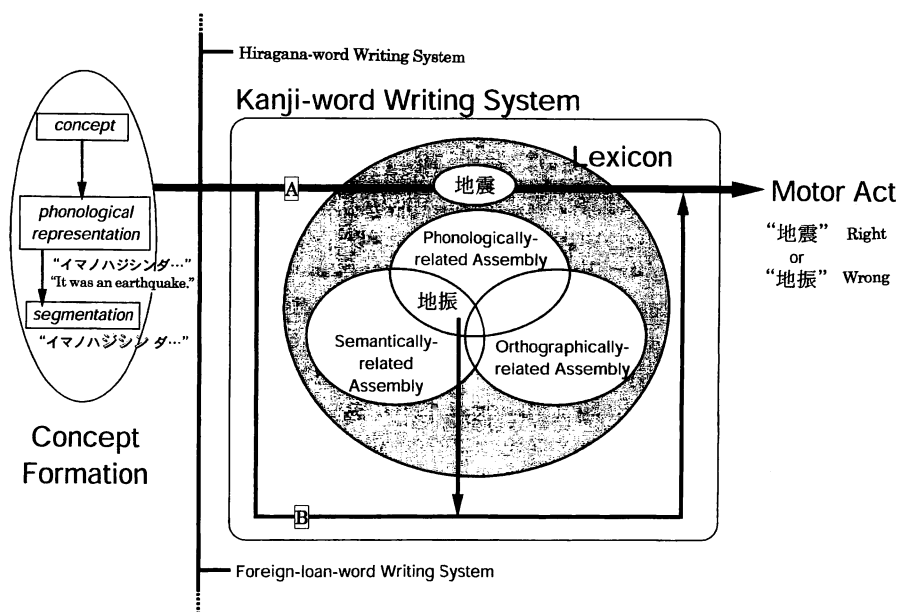
Figure 2. A cognitive model which explains why a wrong kanji candidate (semantic and phonologically-related) is recruited.

was presented with the single-kanji word 然 (/zen/, as), she incorrectly read it as 犬 (/inu/, dog) which is actually a part of the kanji character. In contrast, when this single kanji appeared as part of a compound word 自然 (nature), she read it correctly as /shi zen/. These two studies show evidence of dissociation between single kanji and kanji compound words. Thus, we maintain that two-kanji compound words and single kanji characters could be processed differently.

As can be seen in Figure 2, we hypothesized that the act of writing kanji involves three main steps – Concept Formation, Kanji Lexicon and Motor Act. Firstly, when we wish to write something, we decide what to write and make a phonological representation. After that, the phonological representation is segmented in Concept Formation where the writer decides which part should be written in kanji and which in kana. If the writer feels some uncertainty about transforming segments into kanji, s/he writes all the segmented parts with kana. However, if the writer feels no uncertainty (whether justified or not), s/he writes some segments with kanji. For example, 'It was an earthquake' is segmented in Japanese into 'ima no wa jishin da'. Open text in Figure 2 represents the parts of the sentence (the word 'jishin') which should be in kanji. Then, the segmented phonetic representation of 'jishin' is sent to the recruiting mechanism from the two-morpheme Kanji Lexicon.
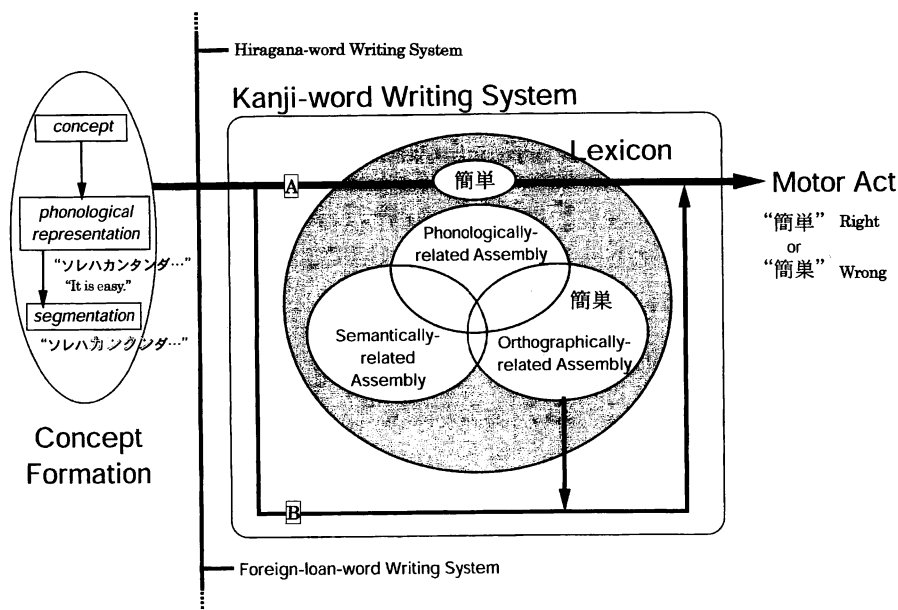
[310]

Figure 3. A cognitive model which explains why a wrong kanji candidate (orthographically-related) is recruited.

The thick line (Line A) in Figure 2 refers to the correct recruiting route which seems to occur in ordinary situations. The thin line (Line B) refers to the recruiting route which is taken in cases where writing errors are produced. In the process of incorrect recruiting from the Kanji Lexicon, several candidates consisting of each or a combination of any of phonological, semantic or orthographic association assemblies which are stored in the Lexicon suggest themselves. The strongest is caught up and sent to Motor Act. Figure 2 shows that when the most strongly suggested candidate is from the common phonologically- and semantically-related assemblies, a special incorrect kanji word is produced. When the kanji recruiting route takes the outer thin line and no upper threshold candidates are involved, Non-Kanji Types or writing order types of writing errors are produced.

Figure 3 shows a different case in which the outer thin recruiting route B is selected, an incorrect candidate from the orthographically-related assembly is put forward and a kanji writing error is produced.

Therefore, it is suggested that semantic, orthographic and phonological factors all contribute to the production of incorrect kanji candidates in memory storage. The present study also indicated that, despite the widely held belief that kanji writing errors must be strongly related to semantics and

orthography, phonologically-related errors were observed most frequently in kanji writing.

Study 2: Analysis of writing errors in Australian learners of Japanese

As shown in Figures 2 and 3, writing involves several processes such as the generation of phonological representation, segmentation, the generation of orthographic representation from the Kanji Lexicon, and the generation of motor representation. The effects of orthographic representation based on an auditory presentation are decreased or sometimes neglected due to the experience of learning and usage (Iwata 1979). Therefore, the characteristics of kanji writing errors are expected to differ between subjects with little experience and those with profound experience.

In the present study, types of kanji writing errors made by Australian learners of Japanese as a foreign language were classified to compare with those of Japanese college students. The materials collected were from the tests of the Japanese class in an Australian university. Thirty-nine students took a weekly kanji quiz for ten weeks. The course in which the subjects were enrolled was at the introductory level and the students themselves were just beginning to learn kanji. Their kanji quiz was taken from their study workbook for the Japanese language (Sections #13 to #22). The appendix shows the kanji which the students learned to write.

Results and discussion

Table 2 shows the patterns of error types made by the Australian subjects. When we compare the results in Table 2 with those in Table 1 (for Japanese college students), we find that the most frequent error made by the Australian students was the substitution by non-kanji (NK Type). Seventy-six percent of their errors were of this type, whereas the Japanese subjects showed only 15.0 percent in this category. In contrast, phonologically-related errors showed only 5.0 percent among Australian subjects, but accounted for 9.1 percent of the errors made by Japanese subjects. Likewise, semantically-related errors (4.2%) occurred less frequently than non-kanji substitution. Consequently, semantic and phonological factors do not play an important role in kanji writing errors made by Australian students.

To examine the detailed error types, as indicated in Table 3, the substitution errors of non-kanji made by both Japanese and Australian subjects were further classified into the following five subtypes: (1) one- or two-stroke additions or omissions which relate to the construction of a segment, (2) the misuse of a segment, (3) the dislocation of a segment, (4) the addition

Table 2. Number of writing errors in two-kanji compound words made by Australian subjects as a function of types (percentages are shown in parentheses)

Error type	Number	Error type	Number
P Type	5 (1.2)	O+S Type	9 (2.2)
O Type	41 (10.0)	P+O+S Type	0 (0.0)
S Type	17 (4.2)	NK Type	310 (76.0)
P+O Type	7 (1.7)	R Type	2 (0.5)
P+S Type	4 (1.0)	Other Type	13 (3.2)
Total			408 (100.0)

Abbreviations of type are shown in the text.

Table 3. Number of NK errors made by Japanese and Australian students as a function of subtypes (percentages are shown in parentheses)

Type	Japanese	Australian
Addition or omission of one or two strokes	4 (7.1)	100 (32.2)
Mismatching of segments	38 (67.9)	124 (40.0)
Dislocation of segments	2 (3.6)	14 (4.5)
Addition or omission of segments	4 (7.1)	16 (5.2)
Combination of more than two types	8 (14.3)	56 (18.1)
Total	56 (100.0)	310 (100.0)

or omission misuse of a segment, (3) the dislocation of a segment, (4) the addition or omission of a segment, and (5) the combination of more than two types. In this classification, 'segment' refers to the basic configurational section of kanji which is constructed by a few strokes. Segments construct kanji morphemes.

A segment is sometimes similar to a radical but is not necessarily identical. Figure 4 shows the samples of each subclassification of the non-kanji substitution errors (NK Type). These types of kanji writing errors are also seen in agraphia patients. Iwata (1979) indicated that kanji writing errors in agraphia are characterized by configurational errors such as the omission of strokes, the addition of strokes, and the misuse of radicals.

As shown in Table 3, mismatching segments of kanji was most frequently observed in both Japanese (67.9%) and Australian (40.0%) subjects. Australian subjects often added or omitted one or two strokes in kanji (32.2%) although this type of error was relatively less frequent among Japanese sub-

Error Type Category	Samples
One or two stroke addition or omission	/ken ----/ /ken kyu/ 研完 for 研究 (study)
Misuse of segment	/ki ----/ /ki mei/ 記絡 for 記銘 (to memorize)
Dislocation or omission of segment	/---- dai/ /ka dai/ 顆題 for 課題 (task)
Addition or omission of segment	/---- syu/ /sen syu/ 迷手 for 選手 (player)
Combination of more than two types	/---- tei/ /soku tei/ 倶定 for 測定 (measurement)

Figure 4. Sample of subclassification of NK type writing errors. Figures in parentheses are the samples of errors.

jects (7.1%). This difference may reflect different levels of kanji writing skill. Unexpectedly, the dislocation of segments occurred to a lesser degree in kanji writing errors at 5.2 percent for Australian subjects though the Japanese subjects showed a slightly higher percentage of 7.1. The sense of spatial kanji arrangement is acquired by learners at the beginning level and therefore our Australian subjects would recently have studied this aspect of kanji. It was rather surprising to find that despite their considerable kanji learning experience of over 12 years, Japanese subjects still mismatch kanji segments. In Australian learners of Japanese as well as in native Japanese speakers, the orthographic representations of kanji segments used to constitute kanji morphemes seem to be feeble.

Conclusion

From the analysis of the kanji writing errors in the present study, some educational implementations are proposed regarding the teaching of Japanese kanji writing. First, despite the common belief that kanji errors are closely related to the semantic and orthographic morphemic elements of kanji, we found that phonologically-related errors are dominant, so that the phonological aspect of kanji morphemes should also be taken into consideration for the teaching of kanji writing. For example, homophonic kanji morphemes, mostly On-reading, are commonly seen even in the 1945 basic kanji characters taught in Grade 9 at Japanese schools. When students learn new kanji, other kanji which they have already mastered and which share the same sound

as the new material should be presented to avoid potential confusion. Second, because kanji writing errors of segment mis-arrangement were common for both our Japanese and Australian subjects, the spacial arrangement of kanji segments should be taught by showing some kanji which all share the same arrangement of segments. Third, once the kanji segments and single kanji have been mastered, it is necessary to clarify the roots that allow two kanji to combine to create a noun. Single kanji are taught intensively at school, but thereafter less emphasis is placed upon methods of kanji word construction. Thus, kanji teaching should also focus on the proper way of combining two kanji to create the various compound words in Japanese.

Appendix: Kanji lists taught in work 13 to 22

Work 13	宿題	台所	下宿	学期	文化	科学	数学	南米	羽根	何点
Work 14	子供	強力	身体	高低	短足	化学	多忙	色々	家族	指
Work 15	夕方	遊戯	竹	友達	音楽	欠点	頭	酒	練習	占い
Work 16	医者	薬品	大変	注意	料理	果物	王様	主人	顔	雑音
Work 17	公園	風	雲	晴天	星座	桜花	船舶	遠方	猛暑	伝達
Work 18	週末	映画	昼食	暗所	恋愛	死亡	開始	終了	両親	切手
Work 19	工場	仕事	運動	自転車	客人	次回	薄弱	起床	首	押す
Work 20	辞書	政府	質問	回答	地図	去年	選挙	経済	世界	治療
Work 21	説明	今度	計画	郵便	収集	教室	受信	家内	部屋	部局
Work 22	水泳	不便	連絡	海岸	取得	感覚	呼吸	形成	成功	電池

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