

Kanji Knowledge as Read-only vs. Write-Only: The Effect of the Computer Age?

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INTRODUCTION

Orthographic reform has been in the air ever since the Meiji Restoration of 1868, and Japanese reading/writing habits have been changing ever since. Some of this has been through legislation, and some of this change has been the result of adapting to circumstance. There is, however, one crucial development in the evolving culture of orthographic practices that impacts all modern research into memory for kanji words. In some ways, it is tied to the kinetic aspects of kanji acquisition and maintenance. These kinetic values are the outgrowth of the enormous amount of time that goes into writing the kanji by hand over and over again, because everyone 'knows' that repeated copying is the tried and true way of learning how to produce kanji (see Kess and Miyamoto, 1999). But this has only been true in an orthographic culture where the children who wrote kanji became adults who practiced the same writing regimens. As we move from the 20th to the 21st Century, it is no longer as true for an electronic script culture which employs phonetically-based, keyboard-driven computer lookup to produce many kanji. Memory studies of the Japanese mental lexicon may have to accommodate the growing realization that there are in reality two 'character sets' in actual practice. A larger read-only set is available for reading comprehension, while a considerably smaller (read- and) write-only set would be the set literate Japanese can produce freehand in handwriting tasks, that is, without software or electronic dictionaries to produce them. This was probably always true, since vocabulary studies always suggest a larger active than passive inventory of lexical items in languages. In Japanese, the boundary between active vs. passive is very clearly drawn in written practice, because of the demands of everyday kanji calligraphy on memory. And, as electronic devices simplify the demands on memory in production, the production set grows smaller and smaller. Based on findings from pedagogical, psychological, and clinical studies, in the following paragraphs we discuss some issues/problems associated with this discrepancy between the two kanji sets we think of as 'read-only' and 'write-only'.

KANJI POLICIES AND KANJI FREQUENCIES

In Twentieth Century Japan, a unified writing system emerges and becomes increasingly familiar across a broader spectrum of the general population. The scene for this was already set by the Meiji Restoration. One of the Meiji goals was the acquisition and importation of knowledge, and the old orthographic system seemed to pose severe limitations on new ideas about mass education. The push and pull of reformist vs. conservative social philosophies has swayed language policies since at the beginning of the Meiji era. The Interim Committee on the National Language first recommended restricting the number of kanji to 2,108 characters in 1923, but official support for major orthographic revisions was only realized in the post-World War II sweep which effectively reduced the number of kanji in sanctioned formats as early as 1946 (Seeley, 1984). The kanji inventory within the Japanese writing system was whittled down to a set of *Tooyoo Kanji* characters, and later modified to a slightly expanded set of *Jooyoo Kanji* characters to be used in the educational system.

Statistical data point to a decline in the overall use of kanji over the term of last one hundred or so years. For example, novels written in 1900 employed text which was 39.3% kanji, while those written in 1950 employed only 27.5% (Nomura, 1984). The same decline can be illustrated by charting the frequency of kanji usage in major Japanese newspapers published during the Meiji (1868-1911), Taisho (1912-1925), and Showa (1926-1989) eras (see Kajiware, 1982). The use of kanji in the 'big newspapers' (*ooshinbun*) which were aimed at bureaucrats and intellectuals was at first extremely high, with kanji running as high as 65%. Government notices cited in such papers exhibited a kanji ratio which even went as high as 95%. High frequencies for kanji were observed even with the earlier versions of the 'small newspapers' (*koshinbun*) which were aimed at the common people; here the occurrence ratio was reported at around 55%. Some conservative skeptics have suggested that such downward trends, if allowed to continue, would inevitably lead to the demise of kanji, with all texts in the Twenty-first Century ultimately written in kana. However, the reality is that the advent of the computer age has reversed such general trends in kanji use, nullifying any such pessimistic views that kanji might eventually disappear from Japanese text.

KANJI IN THE COMPUTER AGE

The modern availability of word processors and personal computers has made kanji easily available through facile input strategies, such as typing in romaji or kana to access kanji images on the screen. Even homonyms are no longer a problem, for the entire list of homonyms is instantaneously retrieved, and choices are easily made. For the average person, however, the attractions of the electronic age have resulted in a basic push-pull conflict between the number of kanji actually used vs. the number of kanji possibly used. On the one hand, the drive to reduce and simplify kanji in this century has seen its effects in the proclamations regarding officially sanctioned kanji in the education system. But the reality is that ease of access has ironically increased the number of kanji made available to users, and greater computing power has been matched by more and more kanji being added to processing systems. Nomura (1991) observes that the commercial availability of computers and word processors has led to an expansion of the kanji in use, with each new stage meeting new challenges, at the same time that

it poses new challenges with the increased computing power it has just made available.

Even though scholars from the *Kokugogaku* 'National Language' school of thought sing the praises of the narrowly selected *Jooyoo Kanji* as a foundational set, claiming that the modern word processor requires only a limited range of 3,000 or so kanji to fulfill most writing requirements (Tanaka, 1991), this may not be true: the general drift allowed by increased computing power is toward expanded numbers. For example, in 1978 the JIS list standardized the kanji capacity in electronic devices at 2,965, with a secondary list of 3,388 available for more specialized uses. By 1990, a tertiary JIS list of 5,801 had brought the total to 12,154 (Gottlieb, 1995; Koizumi, 1991; Satake, 1991), although many in the secondary and tertiary lists are rare or seldom used characters that even kanji scholars might not know (Koizumi, 1991).

Furthermore, commercial publishers of magazines, books, and newspapers often maintain even larger inventories for the specialized demands made on them by proper names, place names, and specialized or technical vocabulary, and the JIS lists at least offer a uniform standard reference point. After all, there are occasions when one needs an old character for ancient texts, drama or song titles, or even company names, and specialized systems act as repositories for these needs. For such needs, there is, for instance, a non-profit organization, the Mojikyo Research Society (1999), which offers free services for their society members to create any character fonts which are not in their online inventory of 90,000 fonts.

Such developments obviously invite a wider range of kanji usage by the average user, and the advantages offered by word processing packages and electronic retrieval support this invitation. Many argue that these same benefits are not without their costs, since they weaken the active retrieval of kanji configurations from the human mental dictionary, and frustrate their conscious use in text production because the kinetic component involved in actual writing has been lost.

It may turn out that the question of how many kanji exist will cease to matter as a practical question, as increasing numbers of users simply plug into the easy accessibility afforded by mechanical devices. There may even come a time in Japan when there will be two character sets in actual practice; one will be for reading comprehension, a read-only set, while the other set will be a write-only set, the set that literate Japanese will have to be able to produce in handwriting tasks (see Takata, 1991). The former set could even include relatively rare characters, as well as an inventory of frequent, but complex characters with multi-stroke configurations; the latter set might be high in their frequency or simple in their configuration, or both. We contend that the reality is that the Japanese are already there, with some kanji readily accessible for production and the majority resident in a passive 'read-only' mental inventory. The rest of the paper now examines this asymmetry in other aspects of literacy in Japanese.

KANJI CURRICULUM

In every grade, at every level, the Japanese language is a mandated subject in the curriculum, and there are set rates for how many kanji should be mastered at each grade level. After 1971, the *Jooyoo Kanji* list increased the number of kanji to be learned to 1,945, so that the number to be learned in the Elementary School increased to a total of

996. These characters and a total of 2,005 possible readings associated with them are distributed according to grade, as shown below.

Table 1. Distribution of kanji characters and readings according to grade.

Grade	Number of Assigned Kanji Characters	Number of <i>On/Kun</i> Readings
First Grade	76	237
Second Grade	145	367
Third Grade	195	415
Fourth Grade	195	362
Fifth Grade	195	326
Six Grade	190	298
TOTAL	966	2005

With respect to these kanji learning assignments, there is always a discrepancy between learning the character as character, and then being able to correctly match it to its various *on/kun*-readings. For example, contrast the following figures for mastery of kanji as kanji, in contrast to their mastery as manifestations with multiple readings in *on/kun* representations.

Table 2. Reading and writing mastery ratios of kanji according to grade.

Assigned Kanji	Reading Mastery Ratio (%)		Writing Mastery Ratio (%)	
	Character	<i>On/Kun</i>	Character	<i>On/Kun</i>
First Grade Kanji	93.5	58.2	88.3	54.9
Second Grade Kanji	94.9	69.3	75.7	51.2
Third Grade Kanji	93.2	75.2	67.1	52.4
Fourth Grade Kanji	93.3	82.0	64.1	55.7
Fifth Grade Kanji	90.6	80.8	57.6	50.1
Six Grade Kanji	92.0	87.0	60.4	57.4

As can be seen, the comprehension rates level out with progression through the elementary grades, for the simple reason that the percentage of multiple readings decreases steadily, and the discrepancies are minimized. Secondly and more importantly, the other factor to be considered in assessing 'mastery' is the clear asymmetry between children's reading and writing abilities in kanji (see Shimamura, 1990). Writing kanji is quite different from kanji reading comprehension and poses a different task to the child learner. In testing fourth-, fifth-, and sixth-graders for their ability to read (that is, to name) and write isolated kanji, Yamada (1992) found asymmetries in their abilities. Especially, in writing errors, Yamada found that his subjects sometimes invented kanji,

gave a homophonous but incorrect kanji, gave a graphically similar character, or provided the wrong character for a two-kanji compound. In fact, the invented kanji errors and homophone errors accounted for between a third and a half of the writing errors, depending on which of the three grades is considered. Yamada's conclusion was that learning to read and learning to write kanji take place more or less independently of each other. In simplest terms, many children could read kanji they could not write

Shimamura (1990) also generalizes that the elementary and junior high school students she tested for the 996 *Jooyoo Kanji* showed *on*- and *kun*-readings to be relatively well-established, with an average acquisition rate in respect to reading comprehension of the items resting comfortably at 92.7%. Their kanji writing abilities, however, were considerably weaker than their reading abilities, with an average acquisition rate of the items at 66.2%.

Some suggest that while learning difficulties in the acquisition of writing skills may arise from the figural complexity of the kanji, this could be compensated for by changing a teaching tradition wherein kanji pedagogy is often arbitrary and lacking in scientific methodology (see Yamada, 1984). The time-honored method for inculcating kanji stops at tracing and copying, with enormous emphasis on the latter. There is some evidence that, at the early stages of pre-school and early grades at least, copying is the most effective method for learning kanji for production in handwriting (see Onose, 1988), and for later learning this same labor-intensive exercise remains the most common method of acquisition and maintenance.

KINETIC INFORMATION IN KANJI WORDS

The result of this time-honored learning protocol is that there is a kinetic aspect to kanji acquisition by Japanese children. The result is a kinetic memory which can be unlocked by the priming of the initial steps of a motor program (see Nihei, 1991), meaning that the motor representation of the kanji can be retrieved directly, without retrieving the accompanying phonetic or semantic representations (though these informational features may be activated automatically (see Watanabe 1991)). This is confirmed by research on 'slips of the pen', the graphemic equivalent of verbal 'slips of the tongue'. It is possible to induce 'slips of the pen' by activating the motor memory of a similar character, revealing that repeated use of a motor activity can cause other motor memories to become active. For example, slips of the pen during rapidly repeated writing can be induced by writing a similar character prior to the target character, also under speeded or repeated conditions (Nihei, 1986a, 1986b, 1988). Usually there is some common identity between the intended characters and the mistakes: some begin with similar strokes, or proceed through common turning points in cursive writing, or end in similar ways. The motor programs for writing the intended and mistaken characters obviously share common segments in sequences of movement, and such results suggest that Japanese kanji storage incorporates not only the expected phonetic, semantic, and configurational features, but also their motoric sequences in terms of kinetic movement.

Unlike non-logographic languages, it seems that the graphic representations in kanji storage that are used for motor output incorporate kinetic information and form part of the mental representation for a given kanji. For instance, Naka and Naoi (1995) report that this kinetic factor is stronger in logographic languages, such as Japanese, simply reflecting the enormous amount of time spent learning by physically practicing kanji

production by hand, and the continuing belief that repeated copying is the tried and true way of learning how to write (but see Onose, 1987, 1988). At least this continues to be true in an age where children are still taught kanji by continuous writing regimens.

Another area where the kinetic values attached to kanji comes into play is perhaps best observed in the traditional practice known as *kuusho*, the finger-writing strategy for recalling the form of a kanji. When Japanese writers are unsure of a kanji, they may begin tracing the outline of the kanji on the palm of their hand to initiate the motor sequence which unlocks the remainder of the kanji configuration. Or when the identity of a homophonic kanji is unclear in conversation, one of the co-locutors may trace the kanji in the air or on a flat surface to indicate which specific kanji was meant. This activity recalls the motoric strategy inculcated by teachers and students alike when internalizing characters as a series of strokes which must be exactly memorized in respect to number and order. *Kuusho* finger-writing obviously serves as a probe which accesses motoric- or action-based representation, as well as serving as an external mnemonic to facilitate a conscious mental process (see Endo, 1988, and Sasaki, 1987).

Interestingly, there is no report of finger-writing in non-kanji cultures, though it appears as early as 10 for Japanese children. In an examination (Sasaki, 1984) of 500 school children between the ages of 7 and 12, the following developmental sequence emerges for *kuusho* use. When children were required to provide correct kanji after exposure to integral parts of the kanji, the number of children using this strategy correlates with age: 11.8% of the 7-year-olds, 5.6% of the 8-year-olds, 22.2% of the 9-year-olds, 56.7% of the 10-year-olds, 57.3% of the 11-year-olds, and 66.7% of the 12 year-olds employed a finger-writing strategy to aid recall. When 105 female college students were required to perform kanji integration tasks, Sasaki and Watanabe (1983) found that all but two subjects exhibited finger-writing in space (44%) or on surfaces like a hand, desk, or thigh (66%).

Sasaki and Watanabe (1984) extended this paradigm to other orthographic cultures, comparing Japanese subjects with Chinese subjects and subjects from non-kanji cultures. Both the Japanese and Chinese subjects used finger-writing in solving a kanji integration task, but such behaviour was absent among the subjects from non-kanji cultures. When finger-writing was prohibited, the percentage of correct answers for the Chinese students was much worse than for their Japanese counterparts. Chinese writers typically know three times the kanji that Japanese know, and the results suggest that Chinese rely even more upon finger-writing as a puzzle-solving and memory strategy.

There is also evidence that certain aphasics are able to comprehend kanji which were previously unreadable, once they are allowed to trace the kanji, a clear indication of the facilitating aspects of this kinetic memory when it is initiated. For instance, with respect to this well-documented phenomenon (see Kess and Miyamoto, 1994), Fukuzawa *et al.* (1986) examines whether two different processing stages are involved in writing, with internal representations of letters existing in long-term memory. A first processing stage would thus retrieve visual images of letters from memory before the initiation of writing, while a second processing stage would convert this letter image into the appropriate motor pattern in writing. If both stages are necessary in writing, agraphia can occur from impairment at either level, and their study gave evidence of impairment at the first level of internal representations. Two Japanese patients with agraphia showed no difficulty in copying kanji when characters were visually available; stroke orders were always correct and hand movements in writing were smooth. But their agraphia was evident when they

were required to write the characters based only on auditory stimuli, as they failed to generate the appropriate internal graphic representations of given kanji.

POSSIBLE PROBLEMS

Before closing this paper, we might re-iterate the problems which arise from the asymmetry between reading and writing abilities for kanji. First, an increased number of kanji characters in potential use leads to the following considerations:

- (i) comprehensibility: the increased use of unfamiliar kanji, which are in the domain of JIS secondary (3388 characters) and tertiary (5801 characters), will lead to the incomprehensibility of these characters by readers, who are mostly likely to be familiar with mere 2,965 JIS primary kanji characters;
- (ii) recoverability: most of JIS tertiary kanji characters are extremely rare in occurrence and highly idiosyncratic in radical configurations in that their phonetic and semantic values cannot easily be decoded based merely on their phonetic/semantic radicals; and
- (iii) economy: even if *furigana* is added for such kanji characters, such placement decreases the print, as well as cognitive, economy associated with kanji representation, and also does not solve the problem associated with semantic decoding.

Second, the regular use of the keyboard input method and abandoning the kinetic practice of kanji production imply the following considerations:

- (i) portability: one must consistently depend on electronic devices to write kanji characters for which there is no firm kinetic memory association;
- (ii) independence: in other words, one cannot be apart from such devices to write one's own orthography; and
- (iii) prestige: inability to write kanji precisely invokes others' devaluation of one's own education and intelligence.

Related to the above, there is also an issue of efficiency of the input mechanism (see Unger, 1984, 1987, for details).

CONCLUSION

The arrival of the computer age has definitely enlarged the pre-existing discrepancy in size between writing-only kanji and reading-only kanji sets. This discrepancy will widen, as computer users become younger and younger. The introduction of computers would be not able to solve the very problem which prompted the Interim Committee to simplify the Japanese writing system. It is interesting to see if the age-old method of kanji acquisition based on kinetic practice is retained in this computer age or if it will be totally abandoned.

REFERENCES

- Endo, Y. 1988. "The Role of a Motoric Aspect of Representation: Spontaneous Writing-Like Behavior in Japanese". *Practical Aspects of Memory: Current Research and Issues*, Vol. 2, *Clinical and Educational Implications* ed. by M. M. Gruneberg, P. E. Morris & R. N. Sykes, 459-463. New York: John Wiley.
- Fukuzawa, K., M. Itoh, S. Sasanuma, Y. Fukusako and T. Masui. 1986. "Impairment in the Ability to Operate the Internal Representation of Kanji and Kana Characters in Japanese Patients With Pure Agraphia". *Clinical Aphasiology* 16.197-206.
- Gottlieb, N. 1995. *Kanji Politics: Language Policy and Japanese Script*. London and New York: Kegan Paul International.
- Kajiwara, K. 1982. "Shinbun no Kanji Ganyuritsu no Hensen: Meiji, Taisho, Showa o Tsujite [Shifts in Occurrence Rate for Newspaper Kanji: Through the Meiji, Taisho, and Showa Eras]". *Kokuritsu Kokugo Kenkyusho Hokoku* 71.209-236.
- Kess, J. F. and T. Miyamoto. 1994. *Japanese Psycholinguistics: A Classified and Annotated Research Bibliography*. Amsterdam: John Benjamins Publishers.
- Kess, J. F. and T. Miyamoto. 1999. *The Japanese Mental Lexicon: Psycholinguistic Studies of Kana and Kanji Processing*. Amsterdam: John Benjamins Publishers.
- Koizumi, T. 1991. "Nihon ni okeru Moji Seisaku no Rekishi [The History of Character Policy in Japan]". *Gengo* 20.38-43.
- Mojikyo Research Society. 1999. *Pasokon Yuyu Kanji Jutsu [An Guide to Easy Use of Kanji Fonts]*. Tokyo: Kinokuniya.
- Naka, M. and H. Naoi. 1995. "The Effect of Repeated Writing on Memory". *Memory and Cognition* 23.201-212.
- Nihei, Y. 1986a. "Dissociation of Motor Memory From Phonetic Memory: Its Effects on Slips of the Pen". *Graphonomics: Contemporary Research in Handwriting* ed. by H. S. R. Kao, G. P. Van Galen & R. Hoosain, 243-252. Amsterdam: North-Holland.
- Nihei, Y. 1986b. "Experimentally Induced Slips of the Pen". *Linguistics, Psychology, and the Chinese Language* ed. by H. S. R. Kao & R. Hoosain, 309-315. Hong Kong: Centre of Asian Studies, University of Hong Kong.
- Nihei, Y. 1988. "Effects of Pre-activation of Motor Memory for Kanji and Kana on Slips of the Pen: An Experimental Verification of the Recency Hypothesis for Slips". *Tohoku Psychologica Folia* 47.1-7.
- Nihei, Y. 1991. "Bonyo Undo Puroguramu o Meguru Undo Kioku Kenkyu no Tenkai: Shoji no Mondai o Chushin ni [A Generalized Movement Program for Kinetic Memory: Focussing on the Problem of Handwriting]". *Shinrigaku Hyoron* 34.358-382.
- Nomura, M. 1984. "Kanji no Tokusei o Hakaru: Kanji no Keiryō Kokugogaku [Measuring the Characteristics of Kanji: Mathematical Linguistics and Kanji]". *Kanji o Kagaku Suru [Making Kanji Scientific]* ed. by H. Kaiho, 1-34. Tokyo: Yuhikaku.
- Nomura, M. 1991. "Johoka Jidai no Kanji to Seishoho [Orthography and Kanji in the Information Age]". *Gengo* 20.30-35.
- Onose, M. 1987. "Yoji Jido ni okeru Nazori oyobi Shisha no Renshu ga Shoji Gino no Shutoku ni Oyobosu Koka [The Effect of Tracing and Copying Practice on Handwriting Skills for Pre-School and First Grade Children]". *Kyoiku Shinrigaku Kenkyu* 35.9-16.

- Onose, M. 1988. "Nazori oyobi Shisha Renshu no Kumiawase ga Yoji Jido no Shoji Gino ni Oyobosu Koka [The Effect of the Combination of Tracing and Copying Practice on Handwriting Skills for Pre-School and First Grade Children]". *Kyoiku Shinrigaku Kenkyu* 365.129-134.
- Sasaki, M. 1984. "Kusho Kodo no Hattatsu [The Development of Kanji Finger-Spelling]". *Kyoiku Shinrigaku Kenkyu* 32.34-43.
- Sasaki, M. 1987. "Why Do Japanese Write Characters in Space?". *International Journal of Behavioral Development* 10.135-149.
- Sasaki, M. and A. Watanabe. 1983. "Kusho Kodo no Shutsugen to Kino: Hyosho no Undo Kankakuteki na Seibun ni Tsuite [The Appearance and Functions of Kanji Finger-Spelling Behavior]". *Kyoiku Shinrigaku Kenkyu* 31.273-282.
- Sasaki, M. and A. Watanabe. 1984. "Kusho Kodo no Bunkateki Kigen [The Cultural Origins of Kanji Finger-Spelling]". *Kyoiku Shinrigaku Kenkyu* 32.182-190.
- Satake, H. 1991. "Wapuro to Hojo Kanji [Word Processing and Supplementary Kanji]". *Gengo* 20.50-51.
- Seeley, C. 1984. "The Japanese Script since 1900". *Aspects of the Japanese Writing System*, Special Issue of *Visible Language*, ed. by C. Seeley. *Visible Language* 18.267-302.
- Shimamura, N. 1990. "Kanji no Shutokuritsu: Haito Kanji ni Yoru Chigai [Acquisition Rates of Kanji by School Children: Differences in Kanji by Grade Level]". *Keiryō Kokugogaku* 17.273-279.
- Takata T. 1991. "Kanji no Unmei [The Fate of Kanji]". *Gengo* 20.52-58.
- Tanaka, A. 1991. "Gendai Hyoki ni Hitsuyo na Kanjisu [The Necessary Number of Kanji in Contemporary Orthography]". *Gengo* 20.59-61.
- Unger, J. M. 1984. "Japanese Orthography in the Computer Age". *Visible Language* 18.238-253.
- Unger, J. M. 1987. *The Fifth Generation Fallacy: Why Japan is Betting Its Future on*
- Yamada, J. 1984. "Kodomo ni Totte Kanji to wa: Kanji no Kyoikugaku [Kanji for Children: Kanji Education]". *Kanji o Kagaku Suru [Making Kanji Scientific]* ed. by H. Kaiho, 121-154. Tokyo: Yuhikaku.
- Yamada, J. 1992. "Asymmetries of Reading and Writing Kanji by Japanese Children". *Journal of Psycholinguistic Research* 21.563-580.
- Watanabe, Y. 1991. "Latency in the Transcription, Transliteration, and Pronunciation of Japanese Ideographs and Syllabic Letters". *Tohoku Psychologica Folia* 50.25-34.