

WORDS WRITTEN IN KANA ARE NAMED FASTER THAN
THE SAME WORDS WRITTEN IN KANJI*

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Two adult Japanese named colors written in Kanji, a logographic orthography, and in Kana, a syllabary. Although colors are more frequently written in the Kanji form and although Kanji are more compact graphic representations of words in general, latency to vocalization was consistently less for the Kana. This superiority is attributed to the closer relation of Kana to phonology and, therefore, to speech. The demonstrated greater facility for naming Kana accords with observations in the literature that very familiar visual configurations are consistently named faster when they conform to a phonographic principle than when they do not.

The evolution of writing systems is characterized by a trend away from representing many concrete morphological units towards representing a more restricted set of abstract phonological units. The characters of the oldest systems depicted objects and situations. These pictographs and semasiographs did not represent words. Their iconic quality made them visually distinctive, but they could refer to only a few concrete objects and common rituals. As these drawings became more conventionalized and their resemblance to specific objects diminished, the linguistic value of the character as the symbol for a spoken word was enhanced. Since a symbol could represent any word, logographs provided for expanded expression. For explicit written communication, however, a large number of characters had to be developed, usually according to a morphological principle. In Chinese, for example, semantically related words were often visually similar as they contained a common radical. Their particular pronunciation, however, was not specified in the written form. The subsequent introduction of phonology into orthography — phonetization (Gelb, 1953) — occurred at many levels. In rebus writing, words that sounded alike were represented by the same sign although the meanings were unrelated. These were substitutions for the *whole word*, but the same principle could be applied by syllable. The syllabary evolved from a logography and represented a deliberate and consistent use of a phonographic principle by which signs consistently represented the syllable. The Japanese syllable signs are derived from the Chinese logograms in this way. Later, in development of the alphabetic orthography, a further refinement of this prin-

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principle occurred: Signs came to represent phonemes. By developing an orthography in which phonology is specified, more precise communication was possible with a reduced quantity of signs. It is apparent that the introduction of a phonologic principle renders an orthography more exact but its import to the reader is more equivocal.

The present study will investigate the role of orthographic structure in reading aloud. Baron (1977) delineates two plausible strategies by which naming or access to phonology can occur for an alphabetic script: an orthographic mechanism that uses letter-sound correspondences and focuses on component elements and a word-specific mechanism that relies on larger visual patterns — whole words, transgraphemic features or morphological units. The Japanese language is written in two scripts whose characteristics suggest this distinction by strategy. Of the two orthographies, only one is phonographic and would permit a (modified) orthographic mechanism. In Kana, a syllabary, the phonetic characterization of each syllable is represented by a character. By contrast, in Kanji, a logography, each word is represented by one character such that no reliable description of pronunciation is available within the written form. With respect to Baron's (1977) distinction, naming in Kana, as in English, would seem to permit exploitation of either strategy, while naming in Kanji, because of its nonphonographic property, must entail a word-specific mechanism.

Baron's (1977) word-specific mechanism can be interpreted as a lexical mediation of phonology. If naming a word occurs *after* lexical access, then naming latencies and lexical decision latencies should correlate since they both require lexical access. This hypothesis rests on the assumption either that a common lexicon supports naming and lexical decision or that there are two lexicons, one semantic and one phonologic, with an identical principle of organization. In fact, Forster and Chambers (1973) found that for English words naming and lexical decision times do correlate, especially for words of high frequency. Their conclusion was that lexical access mediates availability of a phonological code for naming. A general facilitation by frequency of occurrence has been demonstrated in many lexical tasks and is often incorporated into models of lexical organization so that, e.g., more frequent words should be named more quickly than less frequent words. If phonological structure is always derived by a lexical intermediary, then the value of a phonographic orthography is unclear and it is difficult to account for the results of Baron and Strawson (1976). These investigators showed that for skilled readers, latency to vocalization (naming) is faster for words which adhere to regular spelling-sound correspondences, e.g., *tone* v. *gone* or *sweet* v. *sword* (Venesky, 1970), than for exception words which occur with greater frequency. This suggests the continued facilitation of a reliable sound-referencing or phonographic orthography for naming and implies that lexical access is not the only factor in latency to vocalization.

Brooks (1977) (also Baron and Hodge, 1978) provides a similar demonstration of the effects of a phonology-referencing orthography. Using a small set of stimuli presented over several hundred trials, Brooks measured speed of naming. In the alphabetic condition, words were constructed from an artificial alphabet which adhered to a regular character-sound correspondence. They were compared with another condition in which the same responses were arbitrarily paired with the same visual configurations so that no functional alphabet obtained. While the arbitrary pairs were initially better, after practice the sound-

correlated orthography proved superior in terms of shorter latencies to vocalization. When Brooks (1977) exaggerated the visual interaction within the forms by combining the component parts into a glyphic pattern, he found that this enhanced visual compactness and also facilitated naming. In subsequent studies, he introduced controls both by expanding the stimulus vocabulary and by creating other artificial orthographies, but the reliance on contrived orthographies and extensive practice leaves lingering fears about the application of these results to skilled reading of natural orthographies.

The structure of the two writing systems in Japanese permits a natural language variation on the Brooks latency-to-vocalization procedure. Kana is a syllabary in which the phonetic specification of each syllable (more precisely mora) is depicted by a character. By virtue of this sound-referencing or phonographic orthography, similar sounding words look alike. In contrast, the Kanji script is logographic; there is no structure internal to the whole character that denotes pronunciation. Moreover, where Kana are generally used to designate tense, prepositions, new words and foreign terms, Kanji characters are used for nouns, verbs and adjectives. Finally, the Kanji tend to be compact and square, whereas the Kana tend to be a horizontal arrangement of discrete curved segments. By analogy with Brooks (1977), we compared latency to vocalization for Japanese color names written in Kana and in Kanji.

Phonographic writing systems specify the sounds of speech. Given the major outcome to Brooks' experiments, we should expect the latency of naming to be shorter for Kana than for Kanji. Against this expectation, however, are the following: First, Forster and Chambers (1973) demonstrated a strong positive correlation between the frequency of English words and naming time. Based on this evidence, we might suppose that because color names in Japanese literature appear more frequently in Kanji than in Kana, naming the colors written in Kanji should be *faster* than naming the colors written in Kana. Second, Brooks demonstrated, as noted above, that glyphic patterns were named more rapidly than their discrete counterparts. Therefore, we might expect *shorter* naming latencies for the somewhat glyphic Kanji forms than for the somewhat discrete Kana forms of the color names.

PROCEDURE

Stimuli consisted of six Japanese color names whose English equivalents ranged in frequency from three to 203 occurrences based on the Kučera-Francis (1967) corpus of 50,000 word types. Each word had between two and four syllables when pronounced. Each color name occurred equally in its Kanji and its Kana form. Half of the Kanji were composed of two characters and half contained only one. See Table 1 for a summary of stimulus-item structure.

Two native Japanese served as subjects. They were instructed to read as rapidly as possible the stimulus words handwritten on slides displayed on two fields of a Scientific Prototype Model GB Tachistoscope. Each item was exposed for 500 msec and followed by a dark interval of about a second. The signal to light the display also triggered a timer which stopped at the onset of vocalization. In the course of three sessions, the two ortho-

TABLE 1

Summary of stimulus-item structure

Japanese Words	English Equivalents	Number of Characters	Number of Syllables	Number of Strokes	Frequency of Occurrence
Kuro	black	1	2	11	203
Midori	green	1	3	14	116
Chairo	brown	2	3	9 + 6	176
Hairo	gray	2	4	6 + 6	80
Shuriro	vermilion	1	3	6	3
Kuriiro	chestnut	2	4	10 + 6	5

graphic forms (Kanji/Kana) of the six color names were each presented 100 times in a randomized order.

In summary, the experimental design consisted of subjects' vocalizations of two orthographic forms (script) of each of six color names (stimulus items) presented in three sessions. Each session was composed of six trials per item where each trial was the average of approximately five observations, and data were then averaged over the six trials.

RESULTS AND DISCUSSION

An analysis of variance pooled across all six stimulus items in each script condition for each subject revealed significant main effects for script $F(1,10) = 66.88$ $p < 0.001$, session $F(2,20) = 43.77$ $p < 0.001$ and subject $F(1,10) = 25.02$ $p < 0.001$. The script \times session interaction was significant $F(2,20) = 8.48$, $p < 0.01$. As evident in Table 2, the facilitation of Kana relative to Kanji increases over sessions. The subject \times session interaction was significant $F(2,20) = 75.45$ $p < 0.001$.

When subjects' data were pooled, only script was significant $F(1,1) = 192.15$ $p < 0.046$. Stimulus items approached significance $F(5,5) = 4.48$ $p < 0.063$.

A significant facilitation of vocalization for the sound-referencing Kana orthography relative to the logographic Kanji orthography obtained for almost all stimulus words throughout all sessions. Naming latencies to the Kana averaged 18 msec faster than to the Kanji. (Any comparison of specific stimulus items must be made cautiously, as the acoustics of differing initial segments may have triggered the timer at different points in the utterance). This result is impressive, as it violates documented effects of word structure related both to general usage, i.e., word frequency, and to visual scanning of discrete linear v. compact glyphic patterns. By convention, Japanese color words are usually written in Kanji, but the familiarity of this form proved to be of no significant

TABLE 2

Individual word latencies as a function of writing system
and session

Word	Session I		Session II		Session III	
	Kana	Kanji	Kana	Kanji	Kana	Kanji
1. Kuro	458	470	423	440	409	424
2. Midori	429	445	401	436	401	424
3. Chairō	495	488	444	466	434	454
4. Hairō	478	487	430	447	425	443
5. Shurirō	488	507	460	480	443	468
6. Kuriirō	532	539	456	486	468	501

benefit. In addition, enhanced visual compactness, characterized by the square glyphic pattern and demonstrated by Brooks (1977) to be easier to scan than discrete linear forms (such as Kana), did not obscure the outcome. For latency to vocalization, Kana is faster than Kanji.

Japanese Kanji has been cited as an example of a script that does not contain information about phonology and recruited as evidence that readers must be able to access the lexicon visually in order to obtain a phonological specification. Another perspective on the same issue is the role of the lexicon in providing phonological codes for tasks such as naming. The structure of Kanji would seem to imply that such mediation is mandatory. In contrast, the lexical mediation of phonology may be optional in Kana, given its phonographic character.

At this point, it is perhaps useful to appreciate orthographic structure relevant to particular conditions in an attempt to account for the continued facilitation for reading aloud of Kana relative to Kanji. There is some developmental evidence that reflects this influence of orthographic structure on lexical performance. Steinberg and Yamada (1978-79) found that among three- and four-year-olds, the relative difficulty of learning Kana symbols far exceeded that of learning Kanji words. Sakamoto (in press) reports that while a small set of Kanji characters is systematically introduced by grade in the school curriculum, learning to read in Kana is completed in a relatively short period once the child begins to read.

Evidence of selective impairment and hemispheric superiority in word recognition also supports a distinction in processing the two Japanese orthographies. On both a visual recognition and a writing task, (Sasanuma, 1974; Sasanuma and Fujimura, 1971) apraxic aphasics make more errors on the Kana than on the Kanji while simple aphasics perform comparably on Kanji, but make fewer errors on Kana. It seems that the Kana specification of phonology is not exploited by the apraxic. One interpretation (Sasanuma and

Fujimura, 1971) is that the phonology-related pathology of the apraxic aphasic renders impossible the recognition of graphic forms as particular phonological patterns. Since Kana forms must be treated by the phonological processor in order to be identified, they are more vulnerable to left hemisphere damage than a Kanji transcription which can be directly identified without any phonological interpretation. Tachistoscopic recognition by normals presents a different balance of hemispheric activity for Kana and for Kanji. Hatta (1977) reports a right hemisphere superiority for recognition of Kanji words which complements the Sasanuma, Itoh, Mori and Kobayashi (1977) finding of left hemisphere superiority for Kana. A nonsignificant right hemisphere effect for Kanji (Sasanuma *et al.*, 1977) may reflect differences in stimulus structure between these two experiments. Where Hatta used individual Kanji characters, Sasanuma *et al.* used random pairs of characters, but the combination of Kanji characters will often determine the semantic and phonological interpretation of each character (Martin, 1972).

Phonology is specified in the component elements of a Kana orthography such that the name of *any* previously unencountered words or nonwords may be generated; however, more *specific* experience with a *particular* character (or some combination of characters) is required to name Kanji. In some sense, there are *more* visual units to be considered by the orthographic mechanism for Kana than by the word-specific mechanisms for Kanji, but the redundancy of orthographic characters must get exploited in Kana. It is the sound-referencing or phonographic quality that permits the set of characters to be limited and generative.

These results represent an extension of the Brooks (1977) finding. The mora-sized graphemes of Kana are analogous to the phoneme-sized graphemes of an artificial alphabet. They both adhere to a phonographic principle. In a naming task, the advantage of a phonographic script relative to a logographic script is again manifest. To conclude, it seems that a delineation of strategies appropriate for a reading task such as naming must consider the particular properties of the writing system as well as the specific task, and that it is the specification of phonology intrinsic to its orthographic form that accounts for the facilitation of Kana relative to Kanji.

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