Intra-linguistic categorization of obsolete Kanji

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In an intra-linguistic replication of a previous study (see Langman and Saito, 1984, this volume), the differential effects of top down information on perceived category structure were investigated. Native Japanese rated the prototypicality of "quasi-linguistic" categories consisting of eight Japanese and eight Chinese Kanji written in the five standard styles of calligraphy. It was hypothesized that the Japanese would perceive the unfamiliar Chinese Kanji in the same way that the Americans in the previous study perceived the unfamiliar Japanese Kanji. That is, the Japanese would rate the styles differently depending on the kind of meaning provided for the Chinese categories: No Meaning, the Chinese (Real) Meaning, and an Iconic and Non-iconic Meaning referenced to Tensho, the most pictographic style. The results for the Iconic meaning condition were in support of the hypothesis: the Japanese rated the Tensho style most prototypical. Otherwise, the Japanese tended to rate the styles in terms of their own cultural experience—the most useful styles were rated most prototypical.

Key words: cross-linguistic, categorization, Kanji, "quasi-linguistic," prototypicality, top down processing, iconicity.

In a previous cross-linguistic study, Langman and Saito (1984) investigated the differential effects of top down information on perceived category structure by Japanese and Americans. To permit cross-linguistic comparisons, "quasi-linguistic" categories consisting of Japanese Kanji written in the five standard styles of calligraphy were used. Accessibility for the Americans was achieved by providing various kinds of top down information (meanings) for each category. Category structure was determined by having the subjects rate the prototypicality of each style of calligraphy. As hypothesized, the Japanese rated the styles differently from the Americans, basing their ratings on the functional utility of the style while the Americans based their ratings on the interaction between the graphemic-semantic overlap for each style. For very iconic meanings, the Tensho style was most prototypical, otherwise overall visual similarity accounted for their ratings. However, two sources of possible cultural biases were noted for the Japanese: 1) they were far more familiar with the Kanji and certain of the Kanji styles than the Americans, and 2) their lexical entries for each Kanji were far more complex than the simple artificial meanings provided for the Americans: there were possible interactions of the pronunciation(s) of each Kanji with its graphemic and semantic portion. Therefore, in this follow-up study, we attempted to reduce the effect of these cultural biases by selecting different, but related quasi-linguistic categories in reference to an exclusively Japanese population. Fortunately, such categories are readily available in the form of obsolete Chinese characters written in the five standard styles of calligraphy. As

1 The authors wish to thank Professors Norihiko Kitao and Takeshi Hatta of Osaka University of Education for their assistance in obtaining subjects and selecting the Chinese stimuli, and Professor Kazuo Hara and the computer center staff at International Christian University who generously provided their facilities and assistance in the analysis of the data. Requests for reprints should be sent to Hirofumi Saito.
these Kanji are known only to a select few (teachers of calligraphy), their meanings can be manipulated in exactly the same way as in the previous study. In that study the stimuli were held constant while we compared two different cultures. In the present study, the culture was held constant while we varied the stimuli. In this intra-cultural replication of the first study our major hypotheses were 1) that there would be a top down effect on perceived category structure; that is, interactions between the graphemic and semantic representations would be observed; and 2) the overall patterns of the ratings of prototypicality of the Japanese (Study 2)\(^8\) rating the Chinese Kanji and the Americans (Study 1) rating Japanese Kanji would be the same for equivalent meaning conditions. Any differences in responding between these two groups would then be attributable to real differences in cultural experience.

Method

Subjects

The subjects consisted of 40 native speakers of Japanese who were students at the Osaka University of Education ranging in age from 18–22 years who had never studied Chinese and who were not students of calligraphy. They were randomly divided into four groups of 10 each.

Stimuli

The stimuli consisted of the eight Japanese Kanji categories used in Study 1, as well as eight unfamiliar, obsolete Kanji categories designated as "Chinese" for the subjects. These "Chinese" Kanji categories consisted of the same five standard styles of calligraphy as the Japanese Kanji and were chosen because of the iconic quality of their Tensho forms from

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\(^8\) Hereafter, "Study 1" will refer to Langman and Saito (1984), and "Study 2" will refer to the present study.
Results

A mixed analysis of variance (1-between and 2-within) was carried out on the mean ratings of prototypicality (P-ratings) for the 40 Japanese and 40 Chinese Kanji separately. The between factor was MEANING (four levels) and the within factors were KANJI (eight levels) and STYLES (five levels). While there was no manipulation of meaning for the Japanese stimuli, there was a possibility of an effect coming from the manipulation of meaning for the Chinese Kanji which in all cases were rated before the Japanese. Thus, in the mixed ANOVA for the Japanese Kanji, MEANING refers to the type of meaning (i.e., NO, REAL, ICONIC, NON-ICONIC) provided for the Chinese Kanji.

For the Japanese Kanji categories, the main effect of MEANING was not significant \((F(3, 36)=1.79, \text{n.s.})\) indicating that collapsed over the eight Kanji and five styles, the manipulations of meaning for the Chinese Kanji (rated first) had no differential effects on the P-ratings for the Japanese Kanji. As for the main effect of STYLE, there was a non-significant trend \((F(4, 144)=2.06, p<.09)\) for Tensho to be rated the lowest (most prototypical) of the styles. Note, this is in marked contrast to the results of Study 1 in which Tensho was rated the highest (least prototypical) by the Japanese subjects and shows that there was an order effect of rating the Chinese categories first. (This order effect will be discussed later.) Finally, the main effect of KANJI was significant \((F(7, 252)=4.97, p<.01)\) indicating that the eight Kanji categories were not perceived in a similar fashion by the subjects. Post hoc analysis revealed that as in Study 1, ‘forest’/‘mori,’ the category with the greatest visual overlap of the styles, was rated lowest overall. Of the four interactions, only the MEANING × KANJI interaction was non-significant \((F(21, 252)=1.19, \text{n.s.})\) indicating that collapsed over the five styles, there was no differential effect of meaning on any of the eight Kanji categories. An unexpected finding, however, was the significant MEANING × STYLE interaction \((F(12, 144)=4.71, p<.01)\). It was unexpected, because for the Japanese categories, it was impossible to manipulate the meanings for the subjects, since they already knew the meanings of all the stimuli. This interaction shows, rather, that it was the manipulation of the meanings for the Chinese stimuli that influenced the subjects’ perceptions of the Japanese categories. Post hoc analysis revealed that, indeed, Tensho was rated most prototypical by the group of Japanese who first rated Chinese categories having iconic meanings. This is clear evidence of the influence of the first task upon the second. As in the previous study, the STYLE × KANJI and the MEANING × KANJI × STYLE interactions were significant \((F(28, 1008)=5.46, p<.01 \text{ and } F(84, 1008)=2.43, p<.01, \text{respectively})\), indicating that the perception of a style was not constant across categories and that the influence of the Chinese rating task differentially affected the perception of a style depending on the category. Thus, for the category ‘heart’/‘kokoro,’ when preceded by a rating task for Chinese categories with non-iconic meanings, the Tensho style was rated the least prototypical (5.00), but when the meanings were iconic, the Tensho style was rated most prototypical (1.00). Again, this result was unexpected and reflects an order effect of meaning.

For the Chinese categories, the results are more straightforward as there was no possibility of an order effect. None of the main effects (MEANING, KANJI, STYLE) were significant \((F<2)\) indicating that collapsed across the other two factors, no single factor had a differential effect on category structure. As expected, there was a significant MEANING × STYLE interaction \((F(12, 144)=6.55, p<.01)\), coming from the direct effect of the manipulation of top down information on perceived
category structure. Post hoc analysis revealed that for the ICONIC meaning condition the overall pattern of P-ratings for the five styles was quite similar to that of the Americans rating Japanese Kanji categories with iconic meanings. Figure 1 shows the pattern of P-ratings for both groups as a function of the kind of meaning provided. A Spearman Rank Order Correlation (rho=.90, p<.05) confirmed the graphic similarity for the ICONIC condition. The non-significant MEANING×KANJI interaction (F<1) indicated that the manipulations of top down information did not affect the perceived category structure of one category more than another. Finally, the KANJI×STYLE and the MEANING×KANJI×STYLE interactions were significant (F(28, 1008)=8.59, p<.01, and F(84, 1008)=3.17, p<.01, respectively). The first interaction shows that the relationship between the styles and the overall category structure was not constant. Reisho, for example, in the category 'bison' has less visual overlap with the other members of the category than it does in the category 'little box.' Thus, it appears that while the overall feeling of a style was maintained, there was no uniform standard for the modification (simplification) of the Tensho style from which the Reisho style is derived (cf. Nakata, 1973, pp. 14-17). The second interaction follows logically from the first. Given the

![Fig. 1. Mean ratings of prototypicality for the five styles of calligraphy for the Japanese and Chinese Kanji in the present study and for the Japanese Kanji in the previous study as a function of the top down information (meaning) available. (Δ) Chinese Kanji and (●) Japanese Kanji (Study 2), and (■) Japanese Kanji, U.S. subjects and (□) Japanese Kanji, Japanese subjects (Study 1). All meanings are referenced to Tensho.](image-url)
Table 1

Patterns of prototypicality ratings for the Japanese and Chinese Kanji categories

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Meaning</th>
<th>Rank order*</th>
<th>Subjects</th>
<th>Meaning</th>
<th>Rank order*</th>
</tr>
</thead>
<tbody>
<tr>
<td>American (Study 1)</td>
<td>No</td>
<td>K R G T S</td>
<td>Japanese (Study 2)</td>
<td>No</td>
<td>K G R S T</td>
</tr>
<tr>
<td></td>
<td>Non-iconic</td>
<td>K R G T S</td>
<td>Non-iconic</td>
<td>K G S R T</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Real</td>
<td>K R T G</td>
<td>Real</td>
<td>T S G K</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Iconic</td>
<td>T K R G S</td>
<td>Iconic</td>
<td>T R K G S</td>
<td></td>
</tr>
<tr>
<td>Japanese (Study 1)</td>
<td>—</td>
<td>K G R S T</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Rank order was determined using the mean ratings of prototypicality for Kaisho (K), Reisho (R), Gyosho (G), Sosho (S), and Tensho (T). Prototypicality increases from right to left.

The position of Tensho reflects the iconic nature of four of the real meanings for the Kanji.

The unexpected position of Tensho as the most prototypical style reflects the iconic nature of several of the real meanings for the Kanji.

Lack of uniformity of the styles among the Kanji categories, the manipulations of the meanings would be expected to have differential effects on category structure. Thus, for the Gyosho style for the categories 'to do a favor' and 'to catch a bird,' the manipulation of meaning had opposite effects. For the REAL condition, the respective values were 2.00 and 4.30, while for the ICONIC condition these values then became 5.60 and 3.10.

Since the P-ratings for the Japanese Kanji were biased by the Chinese rating task, no comparisons were made between these Kanji and the Kanji in Study 1. Table 1 contains a summary of the overall patterns of P-ratings for the Japanese Kanji in Study 1 (Japanese and American subjects) and the Chinese Kanji in Study 2 (Japanese subjects). Most noteworthy is the pattern of responding for the Americans (excluding the ICONIC condition): Kaisho < Reisho < Gyosho < Tensho < Sosho. The most block-like styles are rated most prototypical while the most abstract style is rated least prototypical. The Japanese, on the other hand, excluding the ICONIC and REAL conditions, produced the following pattern: Kaisho < Gyosho < Reisho < Sosho < Tensho. Here, the most functional styles were rated the most prototypical while the rarest style was rated the least prototypical. For the ICONIC conditions for both groups of subjects, the most important result is the position of Tensho as the most prototypical style and the position of Sosho as the least prototypical. Gyosho being semi-cursive is rated slightly more prototypical than Sosho the most cursive style. This suggests that the influence of cultural experience may not be as strong as the influence of iconicity.

As for the REAL condition for the Chinese Kanji, the position of Tensho may be explained in that the real meanings for four of the eight Kanji were, in fact, iconic.

Discussion

The major hypothesis that top down information would affect the perceived category structure of the Chinese Kanji categories was supported by the significant MEANING × STYLE interaction. Moreover, for one of the four meaning conditions, the ICONIC condition, the overall pattern of P-ratings for the Chinese Kanji was almost the same as that for the Japanese Kanji with iconic meanings rated by American subjects in Study 1. It appears, then, that the amount of graphemic-semantic overlap determines a
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style's prototypicality, and that this overlap is at a maximum when highly iconic meanings are provided for unfamiliar symbols (Kanji). However, when no meanings or noniconic meanings are provided, one's available top down information (i.e., the cultural experience of the Japanese subjects) determines the prototypicality of a style. In this case, the overall pattern of P-ratings for the Chinese Kanji was almost the same as that for the Japanese in Study 1, because even though the Kanji themselves were unfamiliar, the styles were exactly the same (see Fig. 1). As stated before, an unexpected finding was the influence of the top down information provided for the Chinese Kanji on the ratings for the Japanese Kanji. This may indicate the relatively greater power of iconic top down information in this kind of task, and it suggests that a different method be employed in future studies to obtain bias-free P-ratings for the Japanese Kanji.

General Discussion

Our original purpose was to compare the categorization of linguistic categories by two very different linguistic groups (native speakers of Japanese and American English). To overcome the difficulties of finding linguistic categories that were accessible to both groups of subjects, we attempted to use “quasi-linguistic” categories. These categories were real categories used by one linguistic group, the Japanese. Accessibility was made possible by providing various kinds of top down information (the four meaning conditions) to the American subjects. The results of both experiments clearly demonstrate the feasibility of using “quasi-linguistic” categories in cross-linguistic comparisons. In particular, significant differences between the Japanese and Americans were revealed. These differences can be attributed to the special cultural experience that the Japanese have with their writing system. That is, they are aware of the rules for creating a well-formed Kanji and the rules for graphemically transforming the most functional styles (Kaisho → Gyosho → Sosho). In this respect they were less sensitive to the standard modifications in the overall configurations of the common styles but were more sensitive to odd or unfamiliar configurations (Reisho and Ten-sho). The Americans, on the other hand, were most sensitive to differences in the overall configuration of the Kanji which for them were all unfamiliar. This result leads one to postulate that young Japanese children who have not yet learned the rules for reading and writing the various Kanji styles might rate the Kanji categories in the same way as the Americans. That is, overall visual similarity, in the absence of top down information (rules for Kanji), will determine prototypicality. Anglin (1977) and Bowerman (1978) offer evidence that children tend to categorize (overextend category labels) on the basis of similarity to the first category member (prototype). Iwata (1982) has suggested that in addition to the configuration of the Kanji, the kinesthetic feedback of writing the various styles also enters into judgements of category membership. This would account for the predominance of the Kaisho and Gyosho styles for the Japanese since they are written everyday. But Reisho is not written, yet it was rated slightly above the most prototypical styles. In this case, the visual similarity to Kaisho probably accounts for its low rating.

Apart from the differences between the Japanese and American subjects, the most striking result was the similarity between the two groups when rating unfamiliar Kanji with iconic meanings. The use of iconicity in conveying important meanings is all around us, from WALK—DON'T WALK signs to NO SMOKING signs to MEN and WOMEN signs. Moreover, in

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3 For purposes of brevity and unity, the General Discussion will include both Studies 1 and 2.
clinical settings iconic symbols have been used with the communicatively impaired to establish degrees of communication not possible with traditional orthographies. Thus, a child unable to read the words “wheel” or “chair” can easily learn and use the following Bliss symbols (Bliss, 1949): $\mathcal{Q}$, $\mathcal{R}$. Why iconic symbols are easier to learn than traditional orthographies is under investigation. Rozin, Poritsky, and Stotsky (1971) used Chinese Kanji to teach English to elementary school students with reading disabilities. They attributed their success to the logographic quality of the Kanji. That is, there is no sound symbol correspondence, a correspondence that is present in the English symbol system which the authors feel is unnatural or highly abstract. Clinical data from Japan (Sasanuma & Fujimura, 1971; Sasanuma, 1974; Sasanuma & Monoi, 1975; Yamadori, 1975) in which left hemispheric lesions produce disruptions in the phonetically based symbols (the Kana) but to a much lesser degree in the pictographically based Kanji suggest that the Kana and Kanji are processed differently, the Kana primarily in the left hemisphere and the Kanji primarily in the right. Given this result, iconic symbols such as Bliss Symbols may bypass a defective phonological processor in the left hemisphere and be processed by an intact right hemisphere (cf. Sasanuma & Fujimura, 1971). This clinical pattern would be related to the word-picture research in which pictures are more quickly processed than words. The current theories (see te Linde, 1982 for a review) argue that pictures are processed more quickly because they access the semantic representation directly without an intervening graphemic-phonemic step. If the graphemic-phonemic decoding is primarily a left hemisphere responsibility, it would account for the difficulty the left-lesioned patient has in reading Kana or other phonetically based orthographies (Sasanuma & Fujimura, 1971). But what is the relationship between these past studies and the present study?

In contrast to the present study, all of the previous studies have made a distinction between word and picture, Kana and Kanji, verbal and non-verbal, etc. However, when iconic meanings were provided for the unfamiliar Kanji, the meaningfulness (linguisticness) of each style varied according to the amount of graphemic-semantic overlap so that there was a continuum from the most meaningful symbol (Tensho) to the least meaningful (Sosho). If one can equate meaningfulness with linguisticness—one can if one remembers that a linguistic symbol is one which represents some experience of the organism —then linguisticness is not either/or, but rather resembles our categories and can vary from very linguistic (iconic meanings for Tensho) to non-linguistic (no meanings for the Kanji). If these same Kanji were then used in a visual half field study, what might the results be? Hatta (1978, 1981) and Sasanuma, Itoh, Mori, and Kobayashi (1977) have provided evidence that single Kanji are processed primarily in the right hemisphere. On the other hand, using a levels of processing approach (Craik & Lockhart, 1972), Hayashi and Hatta (1982) found that if a semantic decision is required (i.e., same or different category), then the left hemisphere is primarily involved. Sasanuma, Itoh, Kobayashi, and Mori (1980) have offered a more general solution to the problem of hemispheric asymmetry and Kanji processing by showing that it is the interaction between the Kanji and the nature of the task that determines which hemisphere is primarily involved. It would be very interesting to observe such an interaction using the present stimuli and a task involving a higher level of linguistic processing. Moreover,

4 This does not mean that the authors of these studies believe that these binary distinctions hold. Rather, it indicates our lack of an adequate terminology to describe continuous concepts.
while we have demonstrated cross-linguistic differences in categorization on the basis of the P-ratings for the five styles of Kanji, a question arises as to the validity of these ratings. Recalling that Rosch (1975; Rosch, Simpson, & Miller, 1976) found that P-ratings were highly correlated with RT’s in a (SAME/DIFFERENT) category recognition task, one wonders if our P-ratings would correlate not only with RT’s but also with hemispheric processing. That is, for Kanji with iconic meanings, Tensho would have the lowest P-rating and would also be the same as a simple picture, while Sosho would have the highest rating and would be the most abstract. In this case, if iconicity does activate the right hemisphere, despite level of processing, one would expect Tensho to be processed in the right hemisphere and rather quickly because there would be no graphemic-phonemic transformation necessary. Sosho, on the other hand, would be processed in the left hemisphere and more slowly since the lack of iconicity would require the graphemic-phonemic transformation. As for Kaisho, Gyosho, and Reisho, varying degrees of right or left hemispheric processing might be expected depending on the amount of iconicity (similarity to Tensho) they possess. A study to examine these possibilities is now in its initial stages.

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### Appendix

The eight Chinese categories and their associated meanings

<table>
<thead>
<tr>
<th>Real</th>
<th>Iconic</th>
<th>Non-Iconic</th>
<th>Style of calligraphy</th>
</tr>
</thead>
<tbody>
<tr>
<td>eki/to pile up</td>
<td>flying birds</td>
<td>to think</td>
<td>女 女 女 女 女 女 女 女</td>
</tr>
<tr>
<td>hi/rustic</td>
<td>to lay an egg</td>
<td>Thursday</td>
<td>黃 黃 黃 黃 黃 黃 黃 黃</td>
</tr>
<tr>
<td>ji/bison</td>
<td>frog</td>
<td>distinct</td>
<td>児 児 児 児 児 児 児 児</td>
</tr>
<tr>
<td>sho/fence</td>
<td>a bow and arrow</td>
<td>to apologize</td>
<td>牆 十 十 十 十 十 十 十</td>
</tr>
<tr>
<td>ju/to do a favor for someone</td>
<td>a cat and mouse</td>
<td>frequently</td>
<td>匚 匚 匚 匚 匚 匚 匚 匚</td>
</tr>
<tr>
<td>kafu/a small box</td>
<td>a train coupler</td>
<td>angry</td>
<td>匠 匠 匠 匠 匠 匠 匠 匠</td>
</tr>
<tr>
<td>shitsu/a big koto</td>
<td>ribs (bones)</td>
<td>to wake up</td>
<td>窯 窯 窯 窯 窯 窯 窯 窯</td>
</tr>
<tr>
<td>yoku/to catch a bird with string</td>
<td>a pair of scissors</td>
<td>a jacket</td>
<td>弓 弓 弓 弓 弓 弓 弓 弓</td>
</tr>
</tbody>
</table>

Note. K = Kaisho (Block Style), R = Reisho (Scribe's Style), G = Gyosho (Semi-cursive Style), S = Sosho (Cursive Style), and T = Tenso (The Seal Style).