COMPARISON OF IDEOGRAPHIC AND ALPHABETIC SCRIPTS IN RECOGNITION MEMORY OF KOREAN SUBJECTS FOR SEMANTIC INFORMATION

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Abstract

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The present research compared the recognition memory of Korean words presented in two different scripts, alphabetic and ideographic, to Korean subjects who are familiar with both systems of writing. In Experiment 1, words were presented in one script and recognition was tested in the same or alternate script. Recognition was better and faster when words were presented and tested in the same script. With the alternate script conditions, the ideographic-to-alphabetic condition was better and faster than the reverse. When using the same script, recognition memory was better, but not faster, with ideographs. In Experiment 2, either pictures or their verbal labels were presented (alphabetically or ideographically) and recognition memory was tested using the alternate mode. Ideographic script was superior when pictures were encoded and tested by words, but alphabetic script was better in the reverse condition. The results from the present study were interpreted by the dual coding theory which postulates separate verbal and visual codes for the processing of semantic information. Alternative explanations were also considered.

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Recent research in human memory has indicated that there may be two different encoding systems, the one auditory, verbal and sequential, the other visual, imaginal and spatial (Paivio, 1971). The purpose of the present study was to gain information about the nature of these encoding systems by comparing recognition memory for semantic information presented in two different graphic formats. These two formats, ideographic and alphabetic scripts, are both systems of writing words. The difference between them is that in an alphabetic system, such as English, the written version of a word encodes its spoken sound, whereas in an ideographic system, like Chinese, the written version of the word carries its own lexical value, that is, it symbolizes or encodes the basic meaning of the word. While most languages in the world are written in only one script, two languages, Korean and Japanese, are written both ideographically and alphabetically. Thus, the possibility exists of studying differences in the processing of ideographic and alphabetic scripts in subjects with one language but two well - practised ways of representing it by script.

The present research was carried out with Korean subjects who were familiar with both types of script. The Korean language can be written in an ideographic script using characters (symbols) borrowed from classical Chinese both to provide additional vocabulary items and to provide a way of writing already existing native words. It can also be written in the phonetic alphabet invented by King Sejong of Korea in 1446. The Korean alphabet, unlike most eastern scripts, distinguishes consonants and vowels and is thus a true alphabetic system (Hosking & Meredith-Owens, 1968). There are 14 consonants and 10 vowels in the Korean alphabet. Each graphic symbol corresponds to a syllable and is composed of at least one consonant and one vowel.

Chinese symbols, usually referred to as characters, are more complex in that although they often represent morphemes, they can also correspond to syllables. In old Chinese, a morpheme was usually also a word, but in modern Chinese, as well as in the Chinese used in Korean and Japanese, the word is often made up of more than one morpheme. Most frequently a word is made of two or more characters.

In the traditional classification of the Chinese writing systems (Wieger, 1965) all characters belong to one of the following categories; pictographs, ideographs, compound ideographs (logical aggregates), loan characters, and phonetic compounds. Historically, the earliest characters were pictographs. Soon it was necessary to extend this pictorial basis into more abstract or symbolic ideographs. Examples of ideographs include certain numbers, such as one (一), or three (三), and characters such as middle '中' which consists of an arrow '|' piercing its target '口'.

Pictographs and ideographs are all composed of one "signifier" (or "radical") and hence are complete in themselves. Compound ideographs, on the other hand, consist of more than one simple ideograph or pictograph and rely for their meaning on the interaction or association of their parts, e.g. the compound ideograph '好' consists of the character 'woman' on the left and 'child' on the right and means "good" or "to love". A loan character is one used for its phonetic value although originally it represented a different homophone. The most common type of character, the phonetic compound, consists of two parts, a 'signific' giving the meaning, and a 'phonetic' suggesting the pronunciation. The same radical can be used either as a 'signific' or as a 'phonetic' component, depending on the character. Whereas in the compound ideographs both parts are equally operative in symbolizing the total meaning, in the phonetic compounds only one part symbolizes the meaning and the other part gives the sound. When the Chinese language was first written down, there were too few characters for all the sounds, and thus certain signifiers were adapted to write homophones. However, modern Chinese characters, as well as the Chinese characters used in Korea and Japan, have not always retained their original phonetic value, because in general, pronunciation has undergone far more changes than the script. (Newnham, 1971).

In Korea, Chinese characters are taught in school to children after they have mastered the use of the alphabetic system. The Chinese symbols (called Hanja, literally meaning Chinese characters) that are commonly used in daily life usually do not exceed 1,800 characters according to the present list of the Ministry of Education. All Korean words, whether native or borrowed in origin, can be transcribed in the phonetic alphabet, but certain native words and grammatical indicators, as well as recently imported Western words, for example television and radio, cannot be transcribed in Chinese.

Japanese researchers have compared the processing of language represented in different forms, ideographic and phonetic, in the context of studies of language behaviour and brain mechanisms in aphasics. Like Korean, the Japanese language consists of two different types of orthography. The ideograms, or Kanjis (identical symbol and varied pronunciation of the Korean Hanja) are Chinese characters, and there are about 1,800 of them in standard use at present. The Japanese phonetic script, the Kanas, is a phonetic syllabary which represents 46 syllabic sound units.

Since the 1930s there have been scattered case studies in which aphasic patients were reported to have retained Kanjis better than Kanas, or vice versa. Overall, the research on Japanese aphasic patients has shown that some of these patients have different and selective impairments of Kanji and Kana, depending on the type of brain damage that has occurred. These findings suggest the possibility that each linguistic item might be encoded as both a graphic representation and a phonological representation and that each of these might be processed independently.

Sasanuma and Fujimura (1971 & 1972) showed that Japanese aphasics with apraxia of speech made significantly more errors in processing Kanji, both in tachistoscopic visual recognition and in writing tasks involving words that were transcribable in either script. However, aphasics without apraxia of speech showed no difference between the processing of the two scripts.

Sasanuma (1972) reports a case study of a patient who retained Kana systems much better than Kanji. This patient was diagnosed as alexic-agraphic, that is, he retained abilities in perception and production of spoken language whereas his reading and writing abilities were severely impaired. Sasanuma speculated that the patient was able to process phonetic symbols better because he was able to convert them into sound patterns (phonological mode) and thus to grasp their meaning, but was unable to process ideographic symbols (through a non-phonological mode) because there was no systematic way he could convert the graphic symbols into sounds. Thus he had much less difficulty in dealing with Kana characters than Kanji.

Sasanuma (1973) also reports a case study of a patient (alexia without agraphia) who showed severe impairment in reading material written in both Kanji and Kana, especially for Kana, but his writing ability was normal when the dictation was given orally. Using a visual recognition task, mean response latency of recognition for Kana words was much longer than Kanji words. This result is surprising because Kanji characters are generally more complex in the orthographic dimension and are learned almost like a second language. The explanation offered by Sasanuma is that words written in phonetic script have to be interpreted as a phonetic code, whereas words in ideographic script can be directly identified as a representation of the word, by-passing the phonological mode of interpretation. In the case of this particular patient, Sasanuma is assuming that the alexia reflects a loss of the ability to perform a graphic to phonological transformation, or in other words, that graphic representation is separate from phonological representation. The assumption is that with Kanji patterns one goes directly from graphic processing to semantic processing because the semantic features of Kanji patterns are supposedly built into the graphic features. In Sasanuma's study, the subject would have recognized Kanji words faster than Kana words because the semantic constraints of Kanji symbols result in the higher predictability of the whole word on the basis of partial data, whereas with Kana words of the same length, there are more possible combinations that can be made from each symbol.

Based on a comprehensive analysis of specific errors in Kanji and Kana, Sasanuma and Fujimura (1973) categorized aphasics according to the impairment patterns, selective impairment of Kana processing (Type I), selective impairment of Kanji processing (Type II), and impairment of both Kanji and Kana processing (Type III). Type I impairment was further subdivided into (1) verbal apraxia and, (2) specific impairment of phonemic discrimination accompanying aphasia. Both of these impairments appear to involve the phonological system. The first subdivision can be roughly identified with Broca's aphasia where the impairment is due to frontal lobe damage and produces a decrement in speech production. The second subdivision can be roughly identified with Wernicke's aphasia where the impairment is due to temporal lobe damage and the decrement is in speech perception and comprehension (Geschwind, 1965). Type II impairment affected the comprehension of word meanings, with relatively well retained phonological function, as evidenced by correct repetition, reading aloud, and writing to dictation, all three being done without comprehension of the meaning of the material. The pattern of impairment of this type was labelled "transcortical aphasia". Type III impairment was most common, and did not involve so-called "transmission disorders" such as verbal apraxia or impairment of phonemic discrimination. The best classification of this type of impairment is what is known as "simple aphasia" (Sasanuma & Fujimura, 1973).

The idea that words written in ideographs can have a direct access to the semantic representation of the lexical items with no reference to their sound representation has been put forward by Makita (1968) in his discussion of why there are ten times fewer cases of dyslexia in Japan than in Western countries. Makita claims that the rarity of reading disability in Japanese children is due to the fact that Kanjis provide a visual representation of semantic meaning whereas English and all other Western alphabetic scripts merely represent a sequence of sounds. The child learns each ideogram in terms of its meaning, whereas phonemes or "letters" are meaningless as such until they form a phonetic combination that the child can recognize through daily use of spoken language.

The differences in processing the two types of script that have been postulated by the Japanese researchers are in many ways analogous to the two information processing systems that have been proposed by North American theorists studying human memory. These theorists (e.g. Atkinson & Shiffrin, 1968; Bower, 1969; Paivio, 1971) have postulated the dual coding hypothesis, which states that incoming semantic information can be encoded and stored either in an auditory-verbal-linguistic form (verbal code) or in a visual-imaginal form (visual code).

According to the dual-coding hypothesis, pictures are remembered better than their corresponding verbal labels because pictures elicit both visual and verbal codes, whereas words elicit primarily a verbal code. Because the dual coding of verbal and visual cues in memory is stronger for pictures than for words, it can be predicted that items presented as pictures are significantly better remembered than those presented as words, when both picture and word test items are used. Research findings are consistent with the dual coding model in that recognition memory for pictures is significantly higher than for words (Shepard, 1967).

Jenkins, Neale and Deno (1967), Bencomo and Daniel (1975) and Standing and Smith (1975) studied recognition memory under typical conditions in which stimuli were presented and tested in the same mode as well as in "mixed" conditions where presentation and test modes were different. This yielded four conditions; P-P, in which items were presented and tested in the picture mode, W-W, in which items were presented and tested in the word mode, P-W in which pictures were originally presented and tested by words, and W-P, in which words were presented and tested by pictures.

The findings from these studies show that recognition was best in the P-P condition, intermediate in the P-W a[illegible]-W conditions, and worst in the W-P condition. The fact that the P-P condition is significantly better than all conditions involving words is generally consistent with the dual coding hypothesis since the picture mode is assumed to be superior in coding (both visual and verbal codes) to the word mode. The fact that the W-W condition is significantly better than the W-P condition and does not differ significantly from the P-W condition does appear to be contrary to the dual coding hypothesis, but it may be that the "transformation" in the P-W and W-P condition, in going from pictures to words or vice versa, produces additional errors or longer latencies in retrieval. The superiority of the P-W condition over the W-P condition is not obviously explicable in terms of dual coding. Snodgras, Wasser and Finkelstein (1975) have attributed this difference to the fact that there are fewer ways of naming a picture as compared to visualizing a word. In other words, pictures usually evoke only one or a very few verbal labels, whereas words evoke many different images. If the item was presented as a word, the visual (imaginal) code may be quite different from the actual picture given as a test item, thus requiring additional search using the verbal code. It has also been pointed out that subjects presented with pictures receive more information than do subjects presented with words in that visual images of pictures contain more distinctive characteristics than do words, while words have fewer distinctive cues that make them discriminable from other words.

One of the most important functional distinctions made by the dual coding theory is that the imagery system is more efficient in encoding and processing concrete information and the verbal system is more efficient in encoding and processing abstract information. Thus, the superiority of pictures over words can be explained in terms of the assumption that imagery increases as a function of concreteness. Empirical evidence from studies of recognition and recall memory indicates that pictures are remembered better than their verbal labels (concrete words), and that concrete words are remembered better than abstract words, (Gorman, 1961; Paivio & Yarmey, 1966; Paivio & Csapo, 1969).

Tong (1971) defines a Chinese character as a "concrete sign or symbol that represents either a figurative object or an abstract idea by reason of relationship, association, convention, or pictorial aptness". He claims that Chinese writing was designed to express thoughts and feelings by means of visual symbols directly representing the mind, whereas alphabetic writing directly represents the auditory forms of speech. Certain poets who work in the area of concrete poetry and imagist technique in poetry follow the theory that Chinese written symbols are "thought pictures" (Pound, 1969) that could convey thought processes in a vivid and concrete form. As Chao (1968) puts it, "although symbols need not be iconic, symbol complexes in iconic relations with object complexes will have certain advantages".

It may therefore be speculated that, if the pictorial qualities are inherent in ideographic script, words written in that script might be superior in evoking sensory images which might facilitate recognition memory, when compared to words written in alphabetic script. Further, concrete words written in ideographic script might have a kind of compound advantage because of their greater visual imagery and the perceptual information built into the script, the perception being directly linked to the meaning represented by the writing itself. Abstract words written in ideographic script should be superior to those represented in phonetic script, because the visual representation inherent in the script should, in the absence of imagery, concretize the abstract information.

The purpose of the present study is to explore further the suggestion arising from the work with Japanese aphasics that there may be different modes of processing verbal information depending upon whether it is written in ideographic or alphabetic script, and to relate these modes of processing to the verbal and imaginal systems postulated by the dual coding hypothesis.

The set of experiments to be reported in this thesis examined the recognition memory of Korean subjects for lexical items and for pictures presented tachistocopically. In Experiment 1 (word recognition task) subjects were tested for recognition memory for words that were written in one script at time of presentation and in the same or alternate script at time of testing. On the basis of the dual coding hypothesis and research on pictures and words, it can be speculated for the "same script" condition that stimulus words presented and tested in ideographic script will produce better recognition in subjects than the same words presented and tested in alphabetic script. In the "mixed" conditions, in which items are presented in one script and are tested in the other, the previous research on pictures and words suggests that the ideographic - to - alphabetic condition will be superior to the reverse condition.

Since Chinese symbols are assumed to be more concrete in the representation of the object or even of abstract concepts, the concreteness level of the stimulus items was also manipulated in this study. It may be speculated that concrete words written in ideographic script would produce better recognition memory than the same words written in alphabetic script, because the ideogram have the potential advantage of having both perceptual-symbolic features and imagery while the concrete phonograms have imagery only. Abstract words, because of the lack of visual imagery, would yield poorer recognition than concrete words regardless of script. However, abstract words written in ideographic script would be predicted to have an advantage over the same words written in alphabetic script, if ideograms do evoke perceptual images and thus give a certain degree of concreteness to the abstract word.

The paradigm of Experiment I used four script conditions: a) words written in Chinese at both presentation and test (C C); b) words written in Korean at both presentation and test (K K); c) words written in Chinese at presentation and in Korean at test (C K), and d) words written in Korean at presentation and in Chinest at test (K C). The questions being asked with respect to probability and latency of correct recognition under these conditions are: a) Do the same mode conditions (CC and KK) differ significantly from mixed mode conditions (CK and KC)? b) Does the ideographic same mode condition

(CC) differ significantly from the phonetic same mode condition (KK)?
c) Are the mixed conditions, CK and KC, significantly different from each other?

With regard to concreteness, the following questions are being investigated in Experiment 1.

1. Are the concrete words recognized faster and better than abstract words as would be predicted by the dual-coding hypothesis?

2. Does the effect of concreteness level depend on the type of script used? Specifically, the questions here are: does the difference between abstract and concrete nouns vary as a function of whether a) the nouns are presented and tested in the same graphic mode versus different modes; b) the nouns are presented and tested in the ideographic versus in the alphabetic mode, and c) the nouns are presented and tested under CK versus KC conditions.

The other question with which this research is concerned is the relationship between pictures, ideograms and phonograms. Pictorialism is certainly involved in Chinese systems of writing, but ideograms are still linguistic symbols and not pictures. Experiment 2 (matching pictures and words) investigates this problem by testing recognition memory for pictures (line drawings) and their verbal labels, the latter being represented ideographically or phonetically. Half the subjects see the item in picture form at presentation and in verbal form at test, the remaining subjects are presented with the verbal form and are tested with the pictorial form. In their verbal form the items may be written in either the ideographic or the phonetic script. The purpose of this experiment is to examine the effects of script conditions when items are also presented in pictorial form and to test for the possible interactions between type of script and picture-word versus word-picture presentation-test order.

General Method

Subjects

Thirteen adult male and eleven adult female Koreans residing in metropolitan Montreal served as subjects. Due to the limited number of Koreans in the area, it was impossible to select a homogeneous group of subjects. Although there were large individual differences in age, educational level, years abroad, and competence in Chinese, all subjects had completed at least their high school education in Korea, and had resided outside of Korea for not more than 10 years. All subjects were offered $5 payment for their participation.

A summary of subjects' age, educational level, years abroad, self-rated use of Chinese script in writing is given in Appendix 1, Tables A and B.

Procedure

The subjects were tested individually and most testing was carried out during the evening hours. The experiment was introduced as a memory task for words written in Chinese and Korean scripts. Great effort was made to assure subjects that individual records were not of interest to the experimenter. Most subjects were unfamiliar with the nature of psychological experiments and were as a result quite apprehensive about their performance. The subjects were then introduced to the operation of the tachistoscope (Scientific Prototype 3-channel Tachistoscope, Model CTB) by briefly exposing the word "practice" written in both Chinese and Korean script. The following instructions (in Korean) were given to each subject. "I will now show you several words, one at a time. Later I will show you these words, combined with new words you have not seen. Your task is to determine whether or not you have previously seen the word. For certain items you may not be sure whether to say yes or no, but you must make a decision one way or the other. Therefore, try to make a decision of yes or no as quickly and as accurately as you can."

In addition, the subject was told that the words he has seen in one script may appear in the other, but his response should be based on the word itself, not the way it appeared. This was done to communicate to the subject that he was being tested for the "word" recognition, not "script" recognition. The subject was then shown how to press the buttons corresponding to "yes" or "no" on the response panel. The response panel was attached to a timer which recorded automatically the latency in milliseconds, and a light signal device which indicated the subject's "yes" or "no" choice (green for yes and red for no). The experimenter transcribed the latency for each test item.

The two experiments were conducted in the same session, with a short break between Experiment 1 and Experiment 2. The rate of presentation was set at 5 seconds throughout the entire procedure, which took approximately one hour per subject.

After the testing was completed, the subject was taken to the experimenter's office where he filled out the questionnaire and was asked to express his impressions about the experiment. The subject was then paid for his participation. The testing was carried out during the months of March and April, 1974.

Experiment 1

Method

Materials. Forty concrete nouns and 40 abstract nouns were drawn from a list of 925 words based on Paivio, Yuille, and Madigan (1968). Each word was translated into the best equivalent in Korean (Minjungsuguan's Pocket English-Korean Dictionary, 1958). Only words that were two-symbol (2-syllable) and that could be transcribed both in ideographs and in phonetic symbols were used. Suitable abstract words were not difficult to find because most abstract Korean words can be written in ideographic symbols and most nouns that are transcribable in Chinese are two-syllabic words. The choice of concrete words was more limited although it was possible to find 40 such words which were on Paivio et al's list.

The 40 concrete nouns and the 40 abstract nouns were then randomly subdivided into 4 sets of 10 words each, and each set was randomly divided into two groups of 5 words each, one group serving as the presentation words (old items), and the other as foils (new items) (Appendix I, Tables C and D). The mean imagery ratings and concreteness ratings based on the Paivio et al norms is shown in Appendix I, Table E for the old and new items of each set.

Each word was separately written on 11 x 7 white cards, for tachistoscopic presentation. Each symbol was approximately one inch high, centered in the visual field on the lower half of the card. Each word was written twice, once in Chinese script, and once in Korean script. Altogether 80 cards were prepared for the presentation phase, and 160 cards for the test phase. Each subject saw 40 cards in the presentation phase and was tested on a yes-no response for 80 cards on the test phase.

Design. The design of the experiment was a 2 x 4 factorial where there were two levels of concreteness of meaning, abstract and concrete, and four combinations (levels) of script at presentation and test: Chinese at presentation followed at test (CC); Chinese at presentation followed by Korean at test (CK); Korean at presentation followed by Chinese at test (KC); and Korean at presentation followed by Korean at test (KK). The three degrees of freedom available for script conditions were used to make three planned comparisons: 1) a comparison of recognition of words which had the same script at presentation and test (CC and KK) with recognition of those which had a different script at presentation from that used at test (CK and KC); 2) a comparison of recognition of words presented and tested in Chinese script with recognition of words presented and tested in Korean script (CC versus KK), and 3) a comparison of the relative effectiveness for recognition memory of presenting words in Korean and testing them in Chinese versus the reverse sequence (KC versus CK).

The three degrees of freedom available for the script condition x concreteness interaction were split in an analogous set of three planned comparisons, designed to answer the same set of questions in the context of different levels of concreteness. Thus, the three comparisons were designed to answer the following questions:

(1) does any difference in recognition of items presented and tested in the same script (CC and KK) versus those presented and tested in altered script (KC and CK) vary as a function of level of concreteness of the items?

(2) does the relative effectiveness of Chinese and Korean scripts for recognition memory (CC versus KK) differ with level of concreteness of the items?

(3) is the relative effectiveness of the two mixed script conditions on recognition of items (CK and KC) altered by level of concreteness of the items?

Half the subjects were given all the combination of script at presentation and test, first using the abstract words and then using the concrete words, while the remaining half of the subjects received the alternate sequence, concrete words first followed by abstract words.

For each type of word, abstract or concrete, the assignment of the four sets of five presentation words and five foils to the four script conditions was systematically counterbalanced across subjects using a Greco-Latin square (Appendix I, Table F). Sequence of words in the presentation phase was blocked by script condition with sequence of script conditions being counterbalanced across subjects and with the order of words within each condition being randomly determined but constant for all subjects.

Sequence of words in the test phase was blocked by script condition with order of script conditions being systematically counterbalanced across subjects. Order of presentation items and foils within each script condition was randomly determined with the restriction that not more than three presentation items or foils could be tested in a row. The same random order was used for all subjects.

<u>Results</u>

<u>Hits</u>. A "hit" refers to the correct recognition of an item that was in fact shown to the subject at time of presentation; that is, a correct "yes" response to an old item. Probability and latency of hits under the different combinations of word type and script condition are shown in Table 1. The probabilities represent the total number of old items that were correctly recognized across all subjects and items tested under each condition divided by the total number of old items actually tested under each condition (24 subjects x 5 old items per condition = 120 tests per condition). Analysis of the arcsin transformation (Murdock & Ogilvie, 1968) of these probabilities (Appendix II, Table A) showed that significantly more hits were made when the same script was used on both presentation and test than when the script was mixed, $F\ (1,\infty) = 29.87$, $p < .01$. When same mode conditions were compared, significantly more hits were made under CC condition than under the KK condition, $F\ (1,\infty) = 12.36$, $p < .01$. In addition, in the mixed-mode conditions, more hits were made when

Table 1

Probability and Latency of Hits as a Function of Word Type and Script Condition

Word Type	Script	Probability	Latency	
			Subjects[a]	Items[b]
Concrete	CC	.96	982	980
	KK	.84	972	960
	CK	.84	1069	1074
	KC	.77	1262	1146
Abstract	CC	.93	1012	967
	KK	.86	1061	1029
	CK	.81	1050	1040
	KC	.67	1349	1219

(a) Mean of median response latencies in milliseconds, per subject. (Medians based on latencies for all items correctly recognized by a given subject under a given condition).

(b) Mean of median response latencies in milliseconds, per item. (Medians based on latencies for all subjects correctly recognizing a given item under a given condition).

Chinese script was used at presentation and Korean at test than when Korean was used at presentation and Chinese at test, F (1, ∞) = 7.48, $p < .01$. There was no significant difference between the two levels of concreteness nor were any of the three comparisons made on the interaction between script condition and concreteness level statistically significant. The absence of any interactions means that the effects of script condition noted above did not differ as a function of level of concreteness.

The analysis of the latency of hits made use of a procedure suggested by Clark (1973) which required the data to be analyzed twice, first in terms of subjects collapsed across items in order to assess the generalizability of the findings to new samples of subjects, and second in terms of items collapsed across subjects in order to assess the generalizability of the findings to new samples of items. The two sets of F ratios were then combined into one set of Quasi F ratios (Clark, 1973; Equation 2 for minimum F') in order to test the generalizability of the effects to new samples of both subjects and items combined. The data used in these analyses were the median latencies of hits, these medians being calculated across subjects when the analysis was in terms of items and across items when the analysis was in terms of subjects. Latencies of "misses", that is of failures to recognize old items, were not combined with latencies of hits because their inclusion would have biased the analysis since misses were not randomly distributed across treatments and tended to have considerably longer latencies than did the hits.

The individual analyses on the median latency of hits with subjects and with items as the random factor are given in Appendix II, Tables B and C respectively. The Quasi F analysis on the hits (Appendix II, Table D) confirmed the findings of these two separate analyses in that the two significant effects found in the individual analyses were also significant in the combined analysis. Specifically, the mixed mode conditions, CK and KC, yielded significantly longer latencies than the same mode conditions, CC and KK, across subjects and items, $F'(1, 37) = 9.68$, $p < .01$, and the KC condition yielded significantly longer latencies than the CK condition across subjects and items, $F'(1, 37) = 5.75$, $p < .05$.

Correct Rejections. Correct rejection refers to the correct recognition of a foil as being a new item, that is, a correct "no" response to new items. Probability and latency of correct rejections are shown in Table 2. Because the correct rejection data are for items that are presented for the first and only time during the test phase, the only question about script condition that is meaningful to ask is whether the script in which they appear in the test phase affects the probability or latency of recognition. However, since the sequence in which old and new items were tested was blocked by the four presentation-test combinations of script condition, it was possible that the effects of presentation script and presentation-test combination of scripts on the recognizability of the old items could serve to enhance or diminish the discriminability of the foils that were interspersed with them. Thus, in the analyses of correct rejections, the

Table 2

Probability and Latency of Correct Rejections

Word Type	Script	Probability	Latency	
			Subjects[a]	Items[b]
Concrete	CC	.98	1200	1165
	KK	.89	1094	1038
	CK	.96	1137	1109
	KC	.93	1224	1195
Abstract	CC	.98	1167	1168
	KK	.86	1188	1196
	CK	.93	1232	1208
	KC	.92	1485	1365

(a) Mean of median response latencies in milliseconds, per subject. (Medians based on latencies for all items correctly recognized by a given subject under a given condition).

(b) Mean of median response latencies in milliseconds, per item. (Medians based on latencies for all subjects correctly recognizing a given item under a given condition).

three degrees of freedom available for script conditions were partitioned into one for script at time of testing, which would answer the question of whether foils written in one script were correctly rejected any better or faster than foils in the other script, and one each for presentation script and for the interaction between presentation and test script, which would get at the question of whether there were any contextual effects on the recognition of foils as a function of presentation condition of the old items that surrounded them. An analogous set of three comparisons was used to partition the three degrees of freedom available for the script condition x concreteness interaction.

Analysis of the arcsin transformation of the probabilities (Appendix II, Table E) showed that significantly more correct rejections were made with Chinese script than Korean script, $F\ (1,\infty) = 7.38$, $p < .01$. There are also a significant effect due to presentation script of the old items, $F\ (1,\infty) = 15.71$, $p < .01$, indicating that the foils were recognized better in the context of old items presented earlier in Chinese than in the context of old items presented earlier in Korean. The presentation-test interaction was not significant. There was also no significant effects due to word concreteness or to any interaction between word concreteness and the script conditions.

The individual analyses of variance on the latencies of correct rejections with subjects and with items as the random factor are given in Appendix II, Tables F and G, respectively. When these analyses were combined into the Quasi F analysis (Appendix II, Table H), there were no significant effects but there was a trend toward a significant effect of script condition of the new items, with Chinese foils having longer latencies than Korean foils, $F' (1, 43) = 3.46$, $p < .10$. This trend towards an effect of test script was modified by a trend toward a significant interaction between the presentation script of the old items of the set and the script in which the set of old items and foils was tested, $F' (1, 41) = 3.17$, $p < .10$. The nature of this interaction, shown in Fig. 1 for both subject latencies and item latencies is that foils in Korean script were recognized slightly faster if the surrounding old items of the set were originally presented in Korean rather than in Chinese, whereas foils written in Chinese script were recognized very much faster if the old items of the set were originally presented in Chinese rather than in Korean.

Neither the word concreteness nor any of the interactions between concreteness and script conditions yielded significant effects or trends on the Quasi F tests, although the individual analysis based on subjects as the random factor did show a significant interaction between concreteness and presentation script of old items, and also a significant 3-way interaction between concreteness, presentation script and test script (Appendix II, Table F). However, the individual analysis of variance based on items as the random factor did not yield the same pattern of significant results (Appendix II, Table G), which indicates that the effects noted in the subject's analysis were probably an artifact of the particular sample of foils.

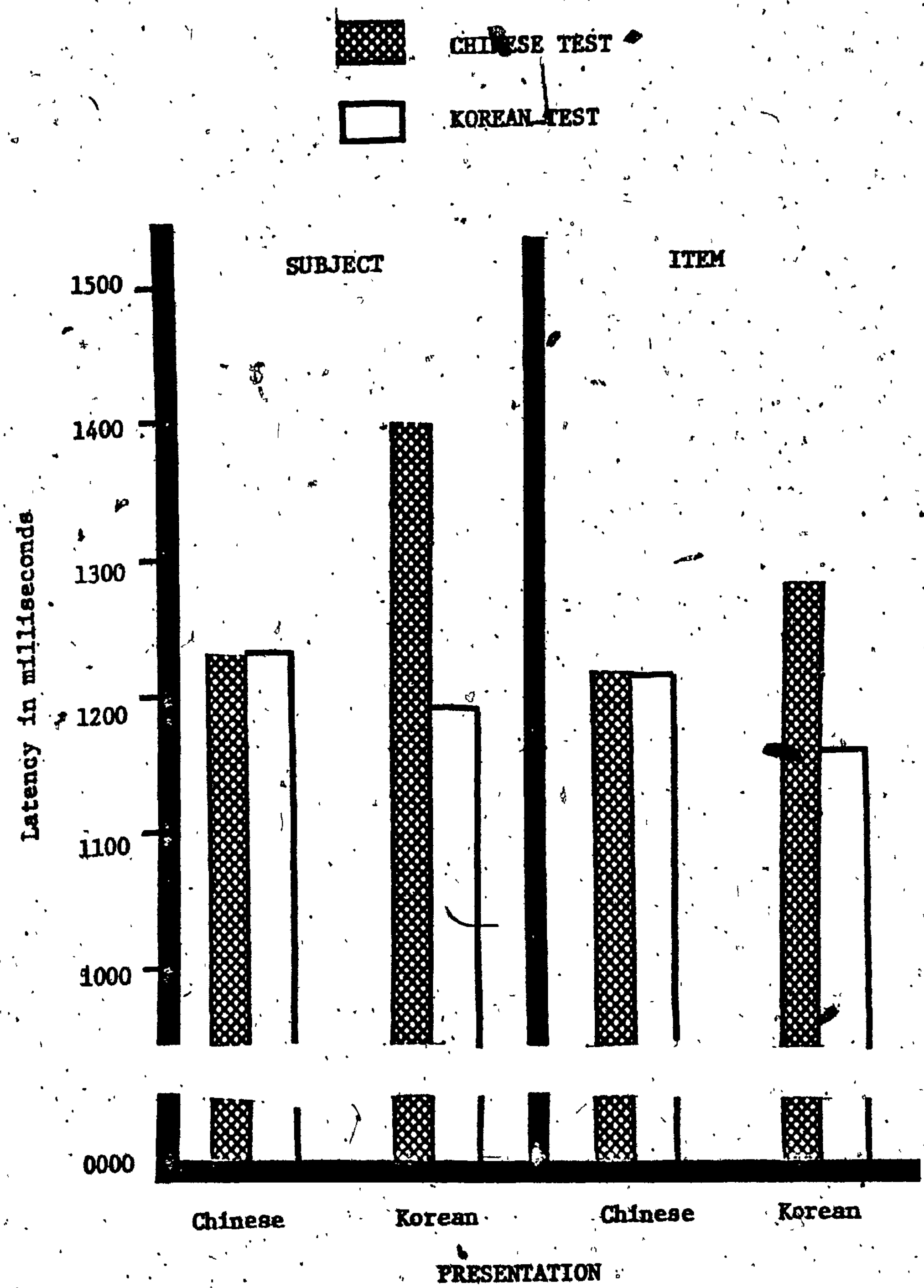

Figure 1. Mean of Median Subject and Item Latencies of Foils as a function of Presentation and Test Condition

To recapitulate, the following were the major findings of Experiment 1. First, with respect to hits, same script condition (CC and KK) yielded better and faster recognition than did mixed script conditions (CK and KC); the CC condition produced better but not faster recognition than did the KK condition, and the CK condition gave better and faster recognition than the KC condition. With respect to correct rejections, foils written in Chinese script had a higher probability of being correctly rejected and a trend towards a longer latency of correct rejection in comparison with foils written in Korean script. The script condition of the old items of each set had some effect on the recognition of the foils, as indicated by a significant effect of presentation script with the probability measure and a trend toward a significant presentation script x test script interaction with the latency measure.

Experiment 2

Method

Materials. Thirty concrete nouns representing common objects were drawn from a list of 220 picturable nouns (Carroll & White, 1973). The 30 words and the frequency rating of these words were shown in Appendix I, Table G. Ten of these 30 words could be transcribed in Korean script, but could not be transcribed into ideographic script. These will be designated Native Korean (NK) because they cannot be rendered in Chinese script. They are to be distinguished from Korean words which can be written in both Chinese and Korean scripts. The remaining 20 words could be transcribed into either phonetic or ideographic script. The latter 20 words were randomly divided into two sets of 10 words each, making in total three 10-word sets. Each set was subsequently randomly subdivided into 5 study words and 5 foils. All words were written in india ink on the lower half of 11" x 7" cards. Thirty pictures (line drawings) representing the 30 nouns described above were made on 3" x 5" index cards and were mounted onto the lower half of 11" x 7" cards for tachistoscopic presentation.

Design. A 2 x 3 between-within design with two levels of presentation-test mode, words at presentation to be recognized in pictures at test (WP), and pictures at presentation to be recognized in words at test (PW), and the three levels of script type, Chinese (C), Korean (K), and native Korean (NK). It should be noted that the inclusion of the native Korean words meant that the design was not orthogonal in that, whereas the items which were transcribable in both Chinese and Korean could be balanced across two levels of script type, C and K, the native Korean (NK) words obviously could not be so balanced.

A subject was presented either with words followed by pictures during test, or with pictures followed by words at test. The following instruction was given to each subject: "I will now show you several words (or pictures) and later you will be tested for your memory in pictures (or in words)". The order of words at presentation was newly randomized for each subject, but order of items at the test phase was always fixed in all three sets combined (See Appendix III, Table G).

Results

Hits. Probability and latency of hits is shown in Table 3, as a function of script type (Chinese, Korean, native Korean) and the presentation-test order (picture-word versus word-picture).

Analysis of the arcsin transformation of the proportion of hits (Appendix III, Table A) showed no significant effect of script type or of presentation-test order, but did show a significant interaction between script type and presentation-test order, $F(1, \infty) = 5.98$, $p < .05$. Table 3 shows that the differences among the scripts depended on whether the words were presented to be later recognized as pictures, or vice versa. When the presentation-test sequence was word-picture, Chinese was recognized better than Korean, and Korean better than native Korean words. When the presentation-test sequence was picture-word, native Korean was recognized better than Korean, and Korean better than Chinese.

Because the main interest in the experiment lay in the comparison of the same words represented in both of the scripts and, as well, in pictures, the native Korean words were excluded (since, by definition these could not be written in Chinese characters) and a further 2 x 2 analysis was performed on the arcsin transformation of proportions of hits for the Chinese and Korean script conditions only. This analysis (Appendix III, Table B) showed a significant main effect of presentation-test order, $F(1, \infty) = 4.41$, $p < .05$, indicating that recognition was better when words were encoded to be tested by pictures than when pictures were encoded to be tested by words.

Table 3

Probability and Latency of Hits as a Function of Script and Presentation-Test Order

Condition	Script	Probability	Latency: Subjects[a]	Latency: Items[b]
Word-Picture	Chinese	1.00	1034	1000
	Korean	.92	1072	1088
	Native Korean	.87	1092	1097
Picture-Word	Chinese	.90	1246	1280
	Korean	.93	973	964
	Native Korean	.95	1015	1085

(a) Mean of median response latencies in milliseconds, per subject. (Medians based on latencies for all items correctly recognized by a given subject under a given condition).

(b) Mean of median response latencies in milliseconds, per item. (Medians based on latencies for all subjects correctly recognizing a given item under a given condition).

Whether the words were written in Korean or Chinese script had no main effect, but there was a significant interaction between order and script, $F(1, \infty) = 5.73$, $p < .01$. As may be seen from Figure 2 the difference between Chinese and Korean scripts depended upon the presentation-test sequence, that is, when the sequence was word-to-picture, pictures whose verbal labels were originally presented in Chinese script were recognized better than were pictures whose verbal labels were originally presented in Korean script but when the sequence was picture-to-word, verbal labels in Korean script were recognized better than were verbal labels in Chinese script.

A 3 x 2 analysis of variance on the latencies of the hits, analyzed with subjects as the random factor (Appendix III, Table C) showed only a significant interaction of script type and presentation-test sequence, $F(1, 22) = 3.85$, $p < .05$. As may be seen from Table 3, this interaction reflects the fact that in the word-to-picture condition, Chinese was recognized faster than Korean, and Korean faster than native Korean, while in the picture-to-word condition, Korean was recognized faster than native Korean, and native Korean faster than Chinese.

Because of the non-orthogonality of the design with respect to the items in the native Korean condition, it was impossible to do a comparable 3 x 2 analysis with item latencies as the random factor. Therefore the native Korean condition was omitted from the analysis, reducing the design to 2 x 2 balanced factorial, and permitting the parallel subject and item analyses and the calculation of Quasi-F

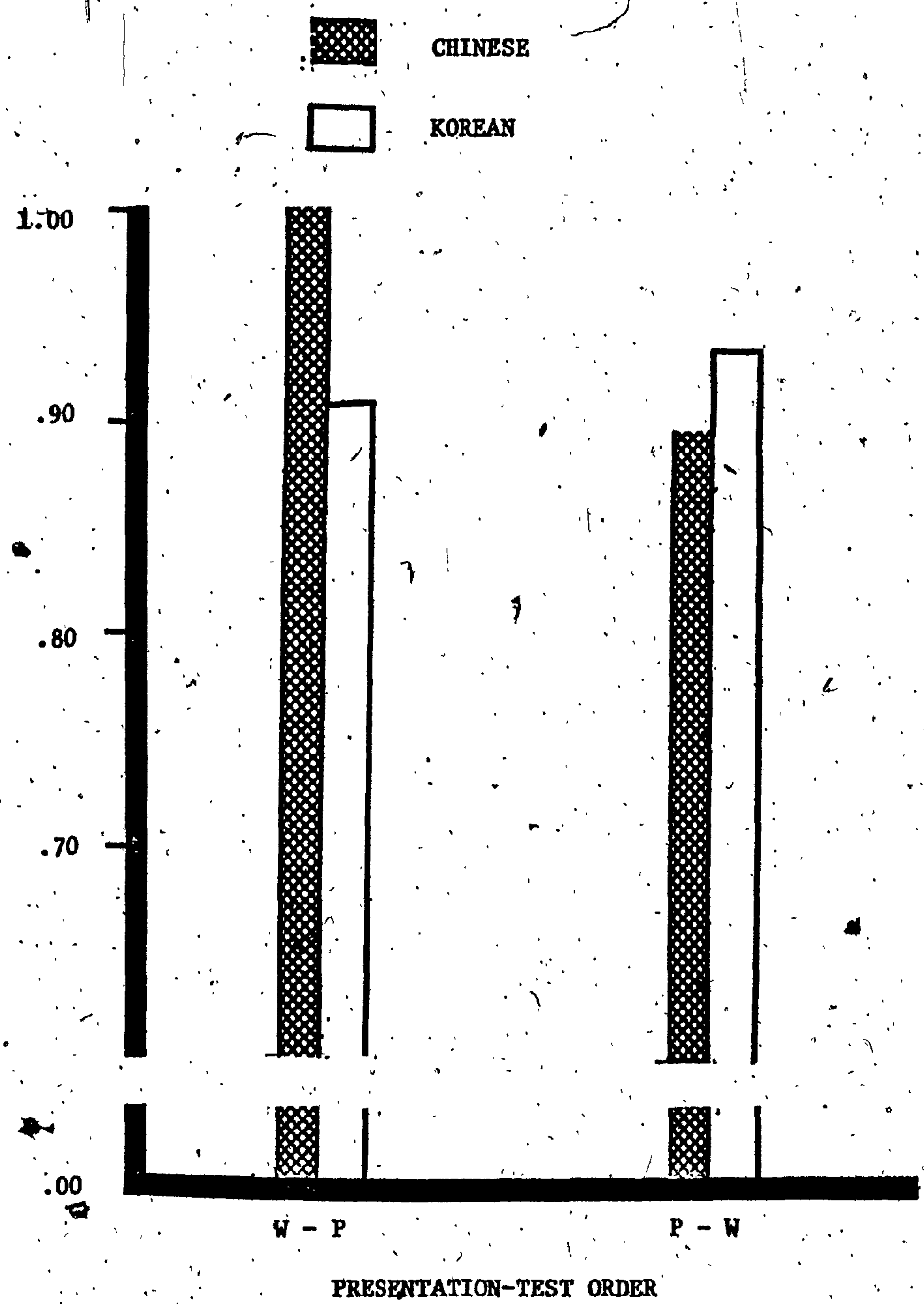

Figure 2. Probability of Hits for Chinese and Korean Items as a function of Presentation-Test Order

ratios.

The individual analyses or variance on the latencies of hits with subjects and with items as the random factor are given in Appendix III, Tables D and E respectively. When the subject and item analyses were combined in the Quasi F analysis, the only effect to approach significance was a trend toward a significant interaction, F' (1, 30) = 3.16, $p < .10$ (Appendix III, Table F). As may be seen from the subject and item latencies plotted in Figure 3, this interaction was similar to what observed with the probability measure. In the word-to-picture condition pictures whose verbal labels were presented originally in Chinese were correctly recognized slightly faster than those whose verbal labels were presented in Korean, while in the picture-to-word condition, verbal labels in Korean script were recognized much faster than verbal labels in Chinese script.

Correct Rejections. Probability and latency of correct rejections are shown in Table 4 as a function of script type and presentation-test sequence. Analysis of the arcsin transformation of the proportion of correct rejections using the 3 x 2 design (Appendix III, Table G) showed no significant effects; when the native Korean condition was dropped and the data were reanalyzed (Appendix III, Table H), the only significant effect was that of script, $F (1,\infty) = 5.66$, $p < .05$, with Korean script at presentation or test producing greater recognition of both picture foils and word foils than did Chinese script.

Analysis of the latency data for correct rejections was done with subjects as the random factor both for all three script conditions

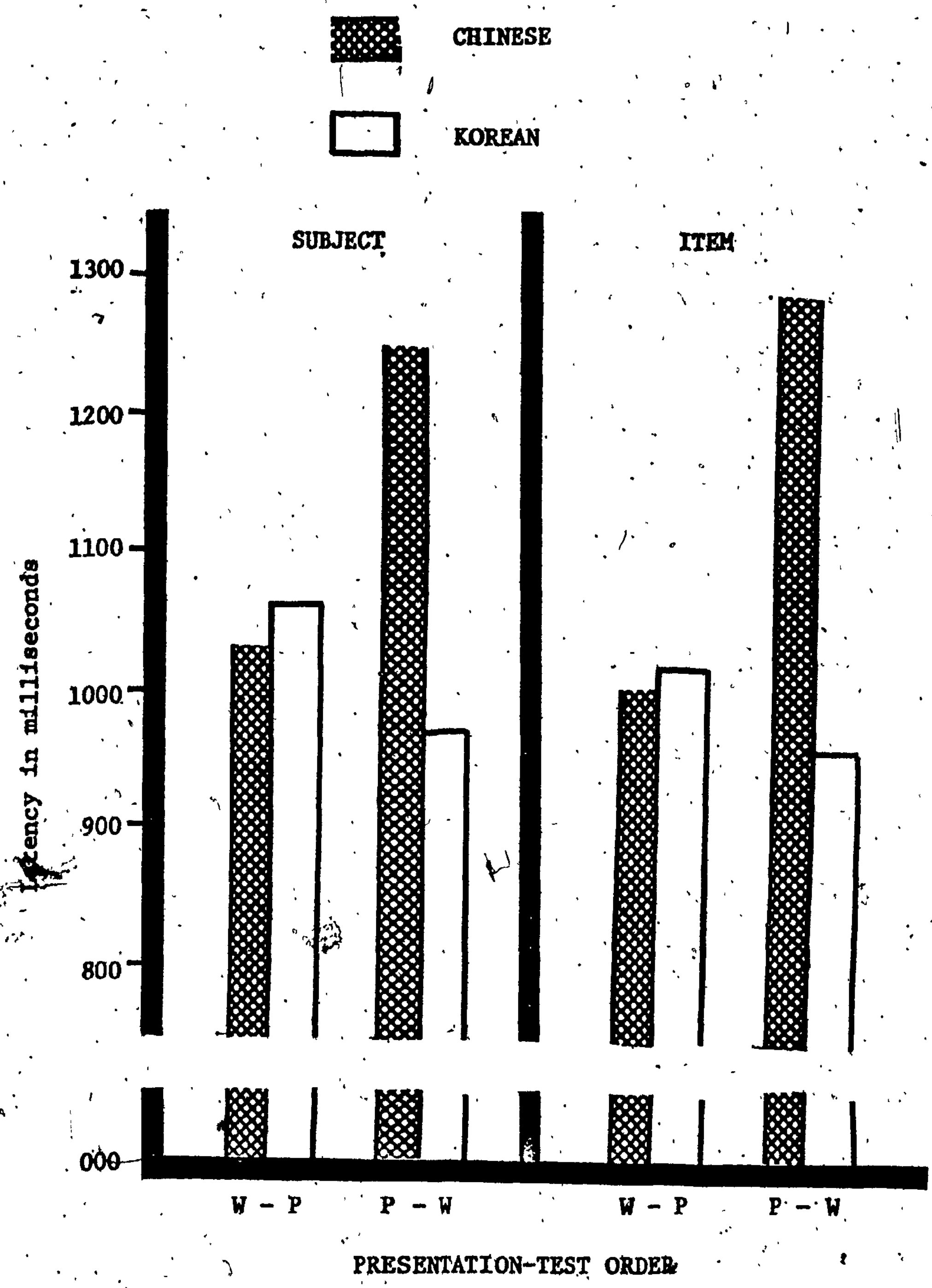

Figure 3. Mean of Median Subject and Item Latencies of Hits as a function of Order and Script

Table 4

Probability and Latency of Correct Rejections as a Function of Script and Presentation-Test Order

Condition	Script	Probability	Latency	
			Subjects[(a)]	Items[(b)]
Word-Picture	Chinese	.97	1485	1510
	Korean	.98	1462	1470
	Native Korean	.95	1262	1275
Picture-Word	Chinese	.92	1603	1576
	Korean	1.00	1207	1260
	Native Korean	.98	1160	1145

(a) Mean of median response latencies in milliseconds, per subject. (Medians based on latencies for all items correctly recognized by a given subject under a given condition).

(b) Mean of median response latencies in milliseconds, per item. (Medians based on latencies for all subjects correctly recognizing a given item under a given condition).

and then for the two orthogonal conditions. In the 3 x 2 analysis (Appendix III, Table 1), there was a significant effect of script type, F (1, 44) = 27.75, p < .01, and a significant interaction, F (1, 44) = 8.63, p < .01. The significant interaction was further analyzed by post hoc Tukey tests (Appendix III, Table Ia). The post hoc analysis showed that in picture-to-word condition, foils written in Chinese script were rejected significantly more slowly than foils in Korean script, for both native Korean and transcribable Korean words. In the word-to-picture condition, picture foils representing NK words were recognized faster than picture foils representing words that could be transcribed in both scripts. The latter effect was probably due to the differential recognizibility of pictures in the NK set, since NK condition was not balanced with the other two conditions.

The individual 2 x 2 analysis of variance on the correct rejections analyzed with subjects and with items as the random factor are given in Appendix III, Tables J and K respectively. When subjects and item analyses were combined in the Quasi F analysis, the only significant effect was the interaction between script condition and presentation-test order, F' (1, 28) = 6.99, p < .05. As may be seen from Figure 4, the difference in latency between foils as a function of script condition was great when the foils were presented as words, and, not surprisingly, minimal when the foils were presented as pictures. The fact that the "script" effect was in the same direction with picture foils as it was with word foils meant that there was also a trend to-

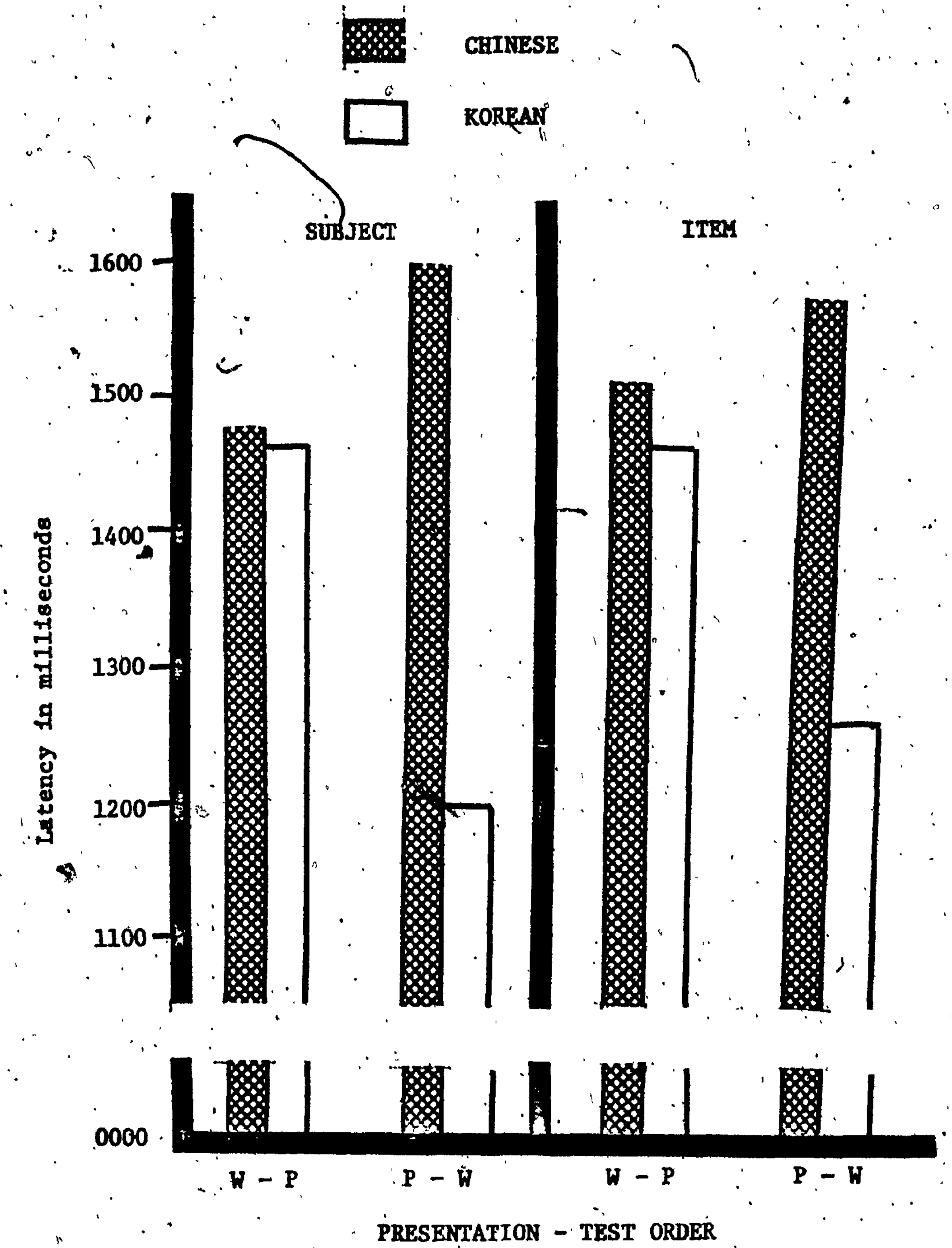

Figure 4. Mean of Median Subject and Item Latencies of Foils as a function of Order and Script

wards a main effect for script condition with foils associated with Chinese script taking longer to recognize than those associated with Korean script, $F(1, 28) = 3.17$, $p < .10$.

To recapitulate, the following were the main findings of Experiment 2. With respect to hits, recognition of pictures whose verbal labels were originally presented in Chinese script was better and quicker than the pictures representing words originally presented in Korean in the word-to-picture order, but the reverse was true in the picture-to-word order. With regard to correct rejections, picture and word foils did not differ in probability or latency of correct rejection, but word foils in Korean script were correctly rejected more frequently and more quickly than word foils in Chinese script.

Discussion

Results from Experiment I showed that when words were presented and tested in the same script, the recognition was significantly better and faster than when the same words were presented in one script and tested in the other. Comparisons between words presented and tested in ideographic script versus same words presented and tested in phonetic script showed that ideographic-to-ideographic condition was significantly better recognized than phonetic-to-phonetic condition, although there was no statistical difference in the recognition latency. When words were presented in one script followed by recognition of them in the other script, both the probability and latency measures consistently showed superiority of ideographic-to-phonetic condition over the phonetic-to-ideographic condition.

Finally, when recognition foils were tested in ideographic script, correct rejection was better, although it took longer, than when foils were tested in Korean script.

Taken altogether, these findings strongly suggest that the same words are remembered differently depending on whether they are written ideographically or phonetically, and that subjects do not process the words in the two scripts in an identical manner.

It can be argued that pictures are visual and non-verbal whereas words are just the opposite. Pictures are closer to physical realities and representations whereas words are more second-level symbolizations of the physical reality. Even concrete words are more indirect and are more symbolic than pictures. Thus, one could make a distinction between visual and verbal processes, in that the processing of visual information involves processes that are more perceptual in nature, whereas the processing of verbal information involves processes that are more symbolic in nature.

The dual coding hypothesis postulates that both visual and verbal processes are operative in memory for semantic information. The theory assumes that images are more suitable for dealing with concrete information, and are also supposed to be better adapted for parallel and spatial processing while the verbal system is better adapted for sequential or serial ordering (Paivio, 1971).

The important distinction between verbal and visual processing may be based on the difference between linear and parallel modes of information processing. According to Arnheim (1970), language is, in general, a linear mode of thought and linking words in linear fashion makes intellectual, logical, uni-directional successions. It is harder to piece together visual pictures in a linear manner.

On the level of lexical items, most phonetic scripts represent linear combinations of individual letters representing the sound, whereas an ideographic symbol is recognized as a whole semantic configuration. Furthermore, with the phonetic word, as with the Arabic numeral, there is no natural connection between thing and sign; all depends on sheer convention. But ideographic notation is more than arbitrary symbols. Thus, the written script in ideographic language may share more similar properties to pictures than phonetic script.

Under the assumption that Chinese script is indeed more similar to pictures than is phonetic script, the present findings can be explained by the dual coding model based on the differential processing of visual-imaginal cues compared to verbal-auditory cues. The processing of Chinese-Chinese condition was better than Korean-Korean condition because Chinese script provided higher imagery which facilitated the recognition. The C-C and K-K conditions were better than C-K and K-C conditions because the latter conditions involved an additional transformation task (Standing & Smith, 1975). The C-K condition was better than K-C condition because ideograms were encoded by the more dominant visual-perceptual code plus the distinctively namable verbal code whereas phonograms were encoded by the predominantly verbal code and the weaker visual code.

Therefore an obvious explanation for the present findings is that ideographic script is more similar to pictures than phonetic script is, and hence is superior in evoking visual images which facilitates recognition memory. In fact, the findings from the Experiment I are quite similar to those of previous research dealing with pictures and words which showed that recognition was best in the picture-picture condition, intermediate in the picture-word and word-word conditions, and worst in the word-picture condition (Jenkins, Neale & Deno, 1968; Bencomo & Daniel, 1975; Standing & Smith, 1975).

The analyses of correct rejections in Experiment I showed, apart from the effects of script that the foils were written in, that the presentation condition of the old items of the set affected the recognition of the foils, with correct recognition of foils being more frequent when the surrounding old items had been presented in Chinese, and correct recognition of foils being faster when the surrounding old items were being tested in the same script as they had been presented in. These findings suggest that subjects retained more information about the original presentation under one condition than under the other, and, since five old items and five new items were always given as a set under each condition, the subjects were able to make a better decision in correctly rejecting foils. The data from Experiment 2 indicated that, when pictures were incorporated into the design, the difference between the two scripts was obtained only as a function of presentation-test order, that is, whether words were presented first followed by recognition in pictures (W-P) or pictures were presented first followed by recognition in words (P-W). The data consistently show this interaction between script and order, that is, pictures of words originally presented in Chinese are better and more quickly recognized than pictures of words originally presented in Korean in the word-to-picture condition, but words written in Korean are better and more quickly recognized than words written in Chinese are in the picture-to-word condition.

The experiment by Snodgras et al (1974) implies that picture superiority is due to the fewer ways of naming a picture as compared to visualizing a word. Pictures and words are encoded both as visual images and as verbal codes. However, when a picture is encoded by the verbal code, a reliable trace is provided which aids in recognition of the same word, whereas a word is encoded as a visual image, the image does not provide the exact code for recognizing a picture since there are many more ways of visualizing a word than naming a picture.

In the Experiment 2, the subject received an instructional set such that when pictures are encoded he is set to look for their verbal labels at the time of recognition and therefore is most likely to be naming the picture at the time of encoding. Since the naming process requires primarily a verbal-linguistic-auditory representation, it makes sense that subjects will do better with the Korean scripts at tests than with the Chinese script. When trying to match another visual representation (Chinese script) with the original picture which has been named and represented predominantly in verbal code, the recognition task would become more difficult.

In the reverse condition, where words were encoded in order to be recognized as pictures, the subject is most likely to imagine the object represented by the word, and Chinese script is more likely than Korean to evoke this image.

The same interaction between script and order is found in the correct rejection data, that is, foils written in Chinese script were more difficult and took longer to reject correctly than did foils written in Korean. This difference was a function of presentation-test order, and found only in the picture-to-word condition (See Figure 3). This finding further supports the notion that naming was the predominant encoding process when pictures were presented to be recognized as words. To correctly reject Chinese foils, the subject must first switch from processing on the basis of naming (phonological processes) and search on the basis of pictorial similarities between the picture and the Chinese script. This would increase the probability of error in recognition and latency of recognition most for foils, as is the general case.

However, the second experiment needs replication with better design and better control. Not only did the inclusion of native Korean words complicate the matter, but also the particular 30 words chosen for the experiment were not best suited for the purpose. Many of the words are rarely seen in Chinese script by Koreans, and it is quite possible that a subject might have missed one or two symbols in the series due to lack of competence in Chinese. No such report was made from any subject, but they would be reluctant to reveal their possible lack of knowledge of Chinese script since it is often closely correlated with a person's level of education and knowledge.

While the results of the present research can be explained fairly well in terms of dual coding, other explanations can also be offered. One such explanation can be found in the perceptual theories of character recognition in terms of distinctive features and feature synthesis. The concept of distinctive features implies that it is various attributes of the shape of letters and words that trigger recognition (Neisser, 1968). For example, a visual pattern may be recognized in terms of attributes such as concavity or horizontality which are the characteristics of the whole rather than of the parts.

One can assume that phonetic script has less variability or discriminability, that is, the visual features of letters and words are less complex than visual features of ideographic units. If the assumption that there is greater complexity in the visual features among the units of ideographic script than in those of the phonetic script is valid, then any ideographic unit should carry more information than the analogous phonetic unit, i.e., the syllable or word. Thus the present result would be explained in terms of increased information transmission (correct recognition) with ideographic scripts due to increased redundancy (Garner, 1962, see p. 183) of distinctive visual features.

The recently presented notion of "graphemic" coding also may be relevant to the outcome of the present study. Kolers (1974) has shown that English sentences that were read in distorted typography (inverted or reversed) were later recognized far better than sentences originally presented in normal typography. The explanation for such a result was that distorted sentences were "graphemically" more complex and therefore required more extensive analysis at the pattern recognition level. Subjects, at the time of recognition, remembered them better because of the analytical operations used for initial encoding, in addition to pure semantic memory. A similar notion can be found in Zechmeister (1972) who suggested orthographic distinctiveness as a variable in word recognition. He showed that, of lower frequency words scaled for orthographic distinctiveness, the structurally unusual or interesting words were recognized better. If the words written in ideographic script did receive a more intensive structural analysis, either because of the assumed greater structural complexity of the Chinese characters or because of the subjects' less frequent usage of the Chinese script, then the finding of generally better recognition memory for items written in ideographic script would be consistent with Zechmeister's findings.

The direct access notion put forward by Japanese researchers, of course, is an alternative explanation for the findings of the present study. The direct access explanation assumes that ideograms encode meaning, and therefore is a more direct link between script and meaning, bypassing sound, while phonetic scripts encode sounds, and therefore is more indirect since the script is linked to meaning via sound.

However, recent theories of word recognition suggest that there is a minimal relationship between word recognition and phonology, in that meaning is independent of sound (Smith, 1972; 1973). The general conclusion reached by many in the area of psycholinguistics and reading is that the whole word is treated in a single act of focal attention, rather than a series of acts corresponding to each letter, and without first activating its auditory representation. This theory is somewhat contradictory to the conclusions reached by Japanese researchers in explaining direct and indirect processing of Kanji vs. Kana script. Although there has been some interest among psychologists in the process of word recognition in nonalphabetic writing systems (Kavanagh & Mattingly, 1972), there has been virtually no research investigating the processing of Kanji vs. Kana scripts. Carroll (1972) points out that since skilled recognition of a word in phonetic languages seems to depend on the total configuration of its component letters, the language processing of ideographic system should be similar to that of the phonetic system. Much discussion has been raised on the nature of ideographic system of writing (Kavanagh & Mattingly, 1972) but the issue is still unresolved.

The data from Experiment 1 showed no effect of concreteness at any level of analysis for the hits. The only significant effects were obtained for the latency of correct rejections with subjects as the random factor, but these effects were not obtained with items as the random factor and disappeared in the Quasi F analysis. Overall the experiment did not confirm the prediction set out by the study that concrete words would be easier to process than abstract words, and that ideographic script would be more effective than phonetic script when processing abstract words. One speculation that can be proposed to explain this result is that merely knowing an ideographic script for an abstract word concretizes its meaning and thereby reduces the distance between abstract and concrete concepts. Future research is necessary to test this speculation.

Failure to obtain significant effects due to word concreteness might have been due to the particular assignment of the words in this experiment. As described in the method section, the words were chosen in order to meet the requirements that Korean words be transcribable in both scripts and that words be uniformly of two-syllables. While most abstract words in Korean can be transcribed in ideographic script, and are of two syllables, the choice of concrete words was relatively more restricted. It is possible that, for Koreans, the concrete words might have been lower in meaningfulness. Even though the words were equated for meaningfulness for English speakers according to the Paivio et al scale, it is quite possible that these nouns were not appropriate for estimating the meaningfulness of these words for Koreans.

The only meaningfulness ratings for Chinese words available for this study were those done by Liu and Chuang (1972) from Taiwan, but not all symbols used in this study were found in this list and it is not certain whether nouns based on Chinese usage in Taiwan are any better predictions of word meaninfulness for Koreans. Although we may generally agree upon the relative concreteness and abstractness of a word across different cultures, the dictionary equivalent of an English word in another language may not represent the same level of concreteness, familiarity, or any other such variable. The Whorfian hypothesis which emphasizes cultural differences in the interpretation of dictionary equivalents is appropriate here (Whorf, 1956).

The present research is an exploratory attempt at answering some of the most rudimentary questions about nonalphabetic writing systems. The study adopted a strict verbal learning paradigm, involving only sets of lexical items and pictures that are distinctively namable. It may be of interest to determine the particular interactions of the two scripts on the level of sentence processing, since pictures depicting a situation as a sentence can represent the same situation.

The present study has certain implications for the use of ideograms in general. There are, indeed, numerous signs and symbols that are pictograms and ideograms in Western culture. At present, these are mainly used for traffic signs, industrial purposes, international communication and advertising (Dreyfuss, 1972). However, these symbols are not universally interpretable, especially with certain culturally-bound signs. Thus, Kolers (1969) raises the argument that pictograms can only be useful in locating or conveying instructions.

Much more ambitious claims are made by C. K. Bliss (1965), whose symbol system consists of ideographs some of which look like simple Chinese characters but are morphologically simpler than stylized Chinese. Bliss began working on ths symbol system, influenced by the Chinese history that the writing system was the main unifying factor which brought together people of different tongues. Bliss' symbols have recently found applicability and success with Canadian handicapped children who up to now never demonstrated any type of language behavior.

Future research should be geared to studying the basic properties of pictorial language, be it ideograms, Bliss symbols, or actual two-dimensional picture representations. Jerome Bruner (1966) noted three basic modes which are important in cognitive development: performance (enaction), depictions (imagery, the iconic), and verbal statements (the symbolic).

If we can understand the exact advantage of incorporating pictorial elements in semantic processing, it may open up new channels and new conceptions about the way we process information, which might lead to devising a different method of teaching children to read or to learn a new language. As Richards (1968) points out, we have neglected "the power of planned cooperation of eye and ear", two receptors that are skilled in collaboration. It is vitally important that future experimentation should include the study of both the iconic and symbolic aspects of cognition.

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APPENDIX I

Method: Subject Information
Materials
Design

Table A

Subject Questionnaire

Age: ________

Sex: ________

Profession: ________

Educational Level (Check One)

1. Highschool Graduate _____
2. University Graduate _____
3. Graduate School _____

Years Abroad:

_____

Current Use of Written Korean Language

(Check where appropriate)

1. Letter Writing _____
2. Diary or Personal Essay _____
3. Business Related _____

Self-rated Use of Chinese Script in Writing

(in percentage)

____

Table B

Description of Subjects Based on Questionnaire Data

	Age	Sex	Occupation	Years Abroad	Education	Use of Korean	Use of Chinese
1	28	M	student	1	2	1	30
2	30	F	technician	10	1	1	0
3	30	F	housweife	½	2	1	5
4	25	F	student	3	2	1	0
5	31	M	student	7	2	1	0
6	31	M	student	½	2	1	0
7	25	F	student	½	3	1	0
8	27	M	student	¼	3	1	10
9	58	F	housewife	3	1	2	50
10	35	M	student	5	3	1	0
11	27	F	technician	8	1	2	2
12	29	F	pharmacist	3	2	2	2
13	30	F	clerk	2	2	2	0
14	30	M	student	2½	2	1	0
15	31	M	computer eng.	3	2	1	5
16	29	M	technician	3	2	1	0
17	25	F	housewife	½	2	2	20
18	39	M	med. assist.	5½	2	1	5
19	29	M	student	3	3	1	0
20	31	M	clerk	2	2	1	10
21	31	M	businessman	4	2	1	10
22	35	M	clerk	½	2	3	20
23	27	F	student	1	2	1	0
24	31	F	housewife	½	1	1	10

Table C

Concrete Words (Experiment 1)

	Set 1	Set 2	Set 3	Set 4
Old Items				
	lake	revolver	boy	table
	hospital	doll	chair	market
	artist	volcano	church	clock
	earth	newspaper	building	letter
	umbrella	pencil	flag	street
Foils				
	restaurant	garden	professor	coin
	magazine	teacher	house	doctor
	inn	machine	animal	girl
	door	ocean	nun	prison
	city	photograph	factory	army
Order of Appearance in Testing				
1.	earth	volcano	professor	table
2.	umbrella	teacher	nun	street
3.	restaurant	revolver	house	prison
4.	magazine	pencil	flag	market
5.	lake	ocean	factory	letter
6.	inn	newspaper	church	girl
7.	hospital	machine	chair	doctor
8.	door	garden	building	coin
9.	city	doll	boy	clock
10.	artist	photograph	animal	army

Table D

Abstract Words (Experiment 1)

		Set 1	Set 2	Set 3	Set 4
Old Items					
		health	incident	history	necessity
		justice	silence	mind	expression
		position	theory	custom	effort
		method	ignorance	opinion	honor
		unification	moral	development	science
Foils					
		memory	opportunity	belief	situation
		hope	tendency	research	fate
		freedom	ability	attitude	time
		law	truth	obedience	heredity
		responsibility	life	knowledge	agreement
Order of Appearance in Testing					
	1.	unification	truth	research	time
	2.	position	theory	attitude	science
	3.	method	tendency	mind	heredity
	4.	memory	silence	obedience	necessity
	5.	law	opportunity	knowledge	honor
	6.	justice	life	history	fate
	7.	hope	incident	development	expression
	8.	health	ignorance	custom	effort
	9.	freedom	moral	belief	situation
	10.	duty	ability	opinion	agreement

Table E

Mean Concreteness and Imagery Value For Words Used Experiment I as Given By Paivio, Yuille and Madigan (1968)

Concrete Words

Old Items	Set 1	Set 2	Set 3	Set 4
Concreteness	6.40	6.49	6.57	6.41
Imagery	6.68	6.99	6.88	6.72
Foils				
Concreteness	6.40	6.34	6.40	6.51
Imagery	6.77	6.68	6.77	6.70

Abstract Words

Old Items	Set 1	Set 2	Set 3	Set 4
Concreteness	3.21	3.26	3.25	3.49
Imagery	2.75	2.23	2.75	2.29
Foils				
Concreteness	3.53	2.94	3.25	3.19
Imagery	2.10	2.03	1.95	2.52

Table F

Greco-Latin Square Used for Counterbalancing

A1	B2	C3	D4
B4	A3	D2	C1
C2	D1	A4	B3
D3	C4	B1	A2

Letters refer to conditions:

A: Chinese-Chinese

B: Chinese-Korean

C: Korean-Chinese

D: Korean-Korean

Numbers refer to sets of words.

See Table C and D

Table G

Words and Thorndike-Lorge Frequency Ratings for Experiment 2

	Chinese and Korean Sets				Native Korean Set	
Old Items						
	desk	A	swan	19	bag	AA
	hat	AA	tent	A	cigarette	22
	eyeglass	1	window	AA	duck	49
	lion	A	telephone	A	dog	AA
	eggs	AA	boots	37	pants	6
Foils						
	automobile	A	ring	AA	scissors	1
	book	AA	sheep	A	tree	AA
	bell	A	train	AA	comb	19
	stamp	A	lamp	A	flower	AA
	fish	AA	ship	AA	hammer	34

Order of Appearance in Testing

1.	telephone	11.	bag	21.	tent
2.	book	12.	stamp	22.	hammer
3.	cigarette	13.	fish	23.	bell
4.	lamp	14.	hat	24.	duck
5.	ship	15.	pants	25.	eyeglasses
6.	lion	16.	scissors	26.	ring
7.	automobile	17.	window	27.	boots
8.	swan	18.	comb	28.	dog
9.	sheep	19.	train	29.	tree
10.	eggs	20.	flower	30.	desk

APPENDIX II

Tables of Analyses: Experiment 1

Table A

Analysis of Variance on Probability of Hits

Arcsin Transformation

Source	df	MS	F
Abstractness (A)	1	.0170	2.04
Script Conditions:			
C_1 same vs. mixed	1	.2489	29.87***
C_2 CC vs. KK	1	.1030	12.36***
C_3 CK vs. KC	1	.0623	7.48***
Abstractness x Script Conditions			
A x C_1	1	.0070	.84
A x C_2	1	.0080	.96
A x C_3	1	.0052	.63
Error		.0083	

*** $p < .01$

Table B

Analysis of Variance on the Latency of Hits

Subject Latencies

Source	df	MS	F
Abstractness (A)	1	103974	1.023
Error	23	101663	
Script Conditions	1		
C_1 same vs. mixed	1	1481513	16.50***
C_2 CC vs. KK	1	8400	< 1
C_2 CK vs. KC	1	1451912	16.17***
Error	69	89804	
Abstractness x Script Condition			
A x C_1	1	7500	< 1
A x C_2	1	20829	< 1
A x C_3	1	66782	1.35
Error	69	459850	

*** $p < .01$

Table C

Analysis of Variance on the Latency of Hits

Item Latencies

Source	df	MS	F
Abstractness (A)	1	38813	.98
Error	38	39492	
Script Conditions			
C_1 same vs. mixed	1	820823	23.29***
C_2 CC vs. KK	1	25347	< 1
C_3 CK vs. KC	1	314252	8.92***
Abstractness x Script Conditions			
A x C_1	1	5336	< 1
A x C_2	1	3572	< 1
A x C_3	1	55968	1.59
Error	114	35246	

*** $p < .01$

Table D

Quasi F Analysis on Latencies of Hits

Source	F_1	F_2	F'	df
Abstractness (A)	< 1	< 1	< 1	
Script Conditions				
C_1 same vs. mixed	16.50	23.29	9.68***	(1, 48)
C_2 CC vs. KK	< 1	< 1	< 1	
C_3 CK vs. KC	16.17	8.92	5.75**	(1, 37)
Abstractness x Script Conditions				
A x C_1	< 1	< 1	< 1	
A x C_2	1.65	< 1	< 1	
A x C_3	< 1	1.65	< 1	

*** $p < .01$

** $p < .05$

Table E

Analysis of Variance on the Arcsin Transformation

Probability of Correct Rejections of Foils

Source	df	MS	F
Abstractness (A)	1	.0046	< 1
Script Condition	(3)		
Test script of the foil (T)	1	.0612	7.38***
Presentation script of old item in block (P)	1	.1304	15.71***
P x T	1	.0004	< 1
Abstractness x Script Conditions			
A x T	(3)	.0017	< 1
A x P	1	.0028	< 1
A x P x T	1	.0021	< 1
Error		.0083	

*** $p < .05$

Table F

Analysis of Variance on the Latency of Correct Rejections of Foils with Subjects as the Random Factor

Source	df	MS	F
Abstractness (A)	1	531407	7.43**
Error	23	71526	
Script condition			
Test script of the foil (T)	1	553089	6.70**
Presentation script of old items in block (P)	1	189317	2.29
P x T	1	563008	6.82**
Error	69	82520	
Abstractness x Script Condition	(3)		
A x T	1	3477	< 1
A x P	1	262996	5.84**
A x P x T	1	254407	5.64**
Error	69	45069	

** $p < .05$

Table G

Analysis of Variance on the Latency of Correct Rejections of Foils with Items as the Random Order

Source	df	MS	F
Between			
Abstractness (A)	1	38813	0.98
Error	38	39492	
Within			
Script condition	(3)		
Test script of the foil (T)	1	290702	7.17**
Presentation script of old items in block (P)	1	52708	1.30
Abstractness x Script x Condition			
A x T	1	17893	< 1
A x P	1	126788	3.13
A x T	1	29376	< 1
Error	114	40548	

** $p < .05$

Table H

Quasi F Analyses on the Correct

Rejection Latencies of Foils

Source	F_1	F_2	F'	df
Abstractness (A)	7.43	0.98		
Script condition				
Test (T)	6.70	7.17	3.46*	(1, 43)
Presentation (P)	2.29	1.30	0.3	
P x T	6.82	5.94	3.17*	(1, 41)
Abstractness x Script				
A x T	< 1	< 1	< 1	
A x P	5.84	3.13	2.04	
A x P x T	5.64	< 1	< 1	

* $p < .10$

APPENDIX III

Table of Analyses: Experiment 2

Table A

Three x Two Analysis of Variance on the
Arcsin Transformation of the Probability of Hits

Source	df	MS	F
Order	1	.0109	< 1
Script	1	.03336	2.00
Order x Script	2	.09963	5.98**

** $p < .05$

Table B

Two x Two Analysis of Variance on the Arcsin Transformation of the Probability of Hits

Source	df	MS	F
Order	1	.0747	4.41**
Script	1	.0404	2.43
Order x Script	1	.0956	5.73**
Error		.0167	

** $p < .05$

Table C

Three x Two Analysis of Variance on the Latency of Hits with Subjects as the Random Factor

Source	df	MS	F
Between			
Order	1	2592	< 1
Error	22	173306	
Within			
Script	1	88456	1.88
Script x Order	2	180915	3.88**
Error	44	47033	

** $p < .05$

Table D

Two x Two Analysis of Variance on the Latency of Hits with Subjects as the Random Factor

Source	df	MS	F
Between			
Order	1	38138	< 1
Error	22	107349	
Within			
Script	1	164385	2.75
Order x Script	1	290941	4.86**
Error	22	59859	

** $p < .05$

Table B

Analysis of Varicnce on the Latency of Hits

With Items as the Random Factor

Source	df	MS	F
Order	1	60918	1.86
Order x Item	9	32766	
Script	1	130302	5.05**
Script x Item	9	25824	
Order x Script	1	401434	9.00**
Order x Script x Item	9	45271	

** $p < .05$

Table F

Quasi F Analysis on the Latency of Hits

	$F_1(1, 22)$	$F_2(1, 19)$	F'	df
Order	< 1	1.86	< 1	
Script	2.75	5.05	1.78	(1, 30)
Order x Script	4.86	9.00	3.16*	(1, 30)

* $p < .10$

Table G

Analysis of Variance on the Probability of Correct Rejections

Arcsin Transformation

Source	df	MS	F
Order	1	.0054	< 1
Script	2	.0482	2.89
Order x Script	2	.2694	1.62
Error		.0167	

Table H

Two x Two Analysis of Variance on the Probability of Correct Rejections

Source	df	MS	F
Order	1	.000025	< 1
Script	1	.0943	5.66*
Order x Script	1	.0413	2.48
Error		.0167	

* $p < .05$

Table I

Analysis of Variance on the Latency of Correct Rejections with Subjects as the Random Order

Source	df	MS	F
Between			
Order	1	112892	< 1
Error	22	306316	
Within			
Script	2	680107	27.75***
Order x Script	2	211475	8.63***
Error	44	24512	

*** $p < .01$

Table Ib

Post-hoc Tukey Test on the Latency of Correct Rejections

	MS	n	q	Crit. diff.
Script	24512	24	3.44	2638.48

Chinese	Korean	Native Korean
37052	32030	29059

	MS	n	q	Crit. diff.
Order x Script	24512	12	4.04	2191.10

Word-Picture

Chinese	Korean	Native Korean
17814	17544	15138

Picture-Word

Chinese	Korean	Native Korean
19238	14486	13912

Table J

Two x Two Analysis of Variance on the Latency of Correct Rejections with Subjects as the Random Factor

Source	df	MS	F
Between			
Order	1	55624	< 1
Error	22	238359	
Within			
Script	1	525427	15.53***
Order x Script	1	418507	12.37***
Error	22	33826	

*** $p < .01$

Table K

Analysis of Variance on the Latency of Correct Rejections with Items as the Random Factor

Source	df	MS	F
Order	1	51768	< 1
Order x Item	9	57774	
Script	1	315595	4.02**
Script x Item	9	78429	
Order x Script	1	190854	16.01***
Order x Script x Item	9	1123	

*** $p < .01$

** p .05

Table L

Quasi F Analysis on the Latency of Correct Rejections

	$F_1(1, 22)$	$F_2(1, 19)$	F'	df
Order	< 1	< 1	< 1	
Script	15.53	4.02	3.18*	(1, 28)
Order x Script	12.37	16.10	7.00**	(1, 41)

* $p < .10$

** $p < .05$