IMPAIRMENT OF THE KANJI AND KANA PROCESSINGS IN APHASIC PATIENTS

- A Preliminary Report on Experiment 1 -

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The fact that the Japanese language has two different types of transcriptional symbols, viz., "kanji" (ideograms) and "kana" (phonograms), presents some interesting problems in the verbal behavior of aphasic patients.[1] Since the 1930's there have been scattered case reports in which patients have been reported to have retained kanjis better than kanas (Kimura, 1934; Kotani, 1935; Sakamoto, 1940; Imura, 1943; Imura, et al., 1962). Only limited information can be derived from these reports, however. They tend to fail, for instance, to supply data on some of the important subject variables, such as the educational level, pre-morbid reading and writing habits, and types and severity of overall aphasic disabilities of the patients. Nor do they seem to have given sufficient consideration to such linguistic variables as the grammatical functions and/or the frequency of usage of the kanjis or kanas under observation, as they analyze and interpret their findings.

In order to clarify the nature of the problem, a more systematic investigation with rigorous control and due caution with regard to these and other variables seems to be in order. A first step in such investigation, Experiment 1, is concerned with the visual recognition of one class of lexical items, i. e., common nouns, as they are represented by kanjis and kanas.

We may assume as underlying hypotheses for the experiment that:

(1) The kanji symbols are processed directly through the "semantic system" whereas the kana symbols are mediated through the "phonological system" before they reach the semantic system.

(2) Since some of the aphasics are more impaired in the phonological system than in the semantic system, and in some cases vice versa, the degree of kana or kanji impairments varies from patient to patient.

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We find it necessary to control the frequency of usage of the test words, since it has been empirically extablished that the frequency of word usage is a variable that significantly influences the performance of aphasic subjects (Bricker, et al., 1964; Schuell, et al., 1964). Moreover, as mentioned above, the syntactic functions of the test words also have to be controlled.

The specific questions to be asked, then, are:

(1) How does the performance in visual recognition of nouns vary depending on (a) the subject group (three aphasic subgroups and two control groups, see infra), (b) the kind of symbols used for representing the stimulus words (kanji, hira-gana, or kata-kana), and (c) the exposure duration of the stimulus word (1 second, 1/2 second, or 1/10 second)?

(2) How do these factors (factors a, b, and c) interact with each other in the visual recognition performance?

(3) For each of the aphasic subgroups, what is the relationship between the visual recognition performance and other aspects of verbal behavior involving kana and kanji processings, such as auditory recognition of kanji and kana words, reading them aloud, or producing them in writing?

In order to answer these questions, the following experiment has been designed as a preliminary exploration into the problem.

METHOD

Subjects

Three subgroups of aphasic subjects (Group 1 through Group 3), a group of left-hemiplegic subjects without aphasia (Group 4), and a group of normal subjects with no known history of brain damage (Group 5) are used. The three aphasic subgroups are: aphasia without any complication (Group 1), aphasia with an additional impairment in sequencing speech sounds in speech production (Group 2), and aphasia with an additional impairment in auditory discrimination of speech sounds (Group 3).[2)]

The subjects in each of the five groups are matched for age,

educational level, and pre-morbid reading and writing habits. All subjects in Group 1 through Group 4 are hospitalized patients in a large rehabilitation center while the Group 5 subjects are chosen from among the attendants of the hospital personnel. No individual who exhibits the problem of visual perception, hearing loss of more than 15 db in speech frequencies, dysarthria, or limb apraxia is included in the study.

Materials

Three sets of stimulus words and three sets of corresponding pictures are used:

Stimulus words:

Word Set 1. Ten very frequently used kanji words (names of daily encountered objects).

Word Set 2. The same ten words as those included in Word Set 1 but written in hira-gana (the pictures for Word Set 2 are identical with those for Word Set 1).

Word Set 3. Ten imported kata-kana words (names of daily encountered objects).[3] Frequency of use of each of these kata-kana words is in a comparable range with that of kanji words in Set 1.[4]

Other conditions in the selection of the test words are: (1) ease of portrayal in outlines, (2) a unique commonly acknowledged word for the object, (3) the word length in the number of syllables between two to four. (See Appendix A for the list of the 30 words used in the Word Set 1 through Word Set 3.)

Stimulus pictures:

Line drawings are made for all of the 30 words in Word Set 1 through Word Set 3.

The three sets of stimulus words (as well as the three sets of stimulus pictures) are, then, arranged in a randomized order and divided into five sub-series (Series A through Series 3), each consisting of six items from different sets (two each). For minimizing the order effect in stimulus presentations, the ordering of the series is changed from subject to subject

and from task to task.

Tasks

The task has three parts, Part 1 through Part 3.

Part 1:

Each subject is required to perform two preliminary tasks: pointing to one out of four drawings according to the specification via speech (Task A, 20 items), and pointing to one out of four printed words according to the specification via speech (Task B, 30 items).

Part 2:

The subject is required to point to the drawing which matches the given printed word (one out of four). The word is displayed by a tachystoscope for a duration of 1/10 second (Task C, 30 items), 1/2 second (Task D, 30 items), or 1 second (Task E, 30 items). The response latency is measured as the time elapsed between the end of the stimulus presentation and the completion of the act of pointing.

Part 3:

Oral reading of each of the 30 printed words (Task E, 30 items) and production in writing of the 30 words according to the specification of the word by the drawing (Task G, 30 items) constitute Part 3. In task G the subject is instructed to write in both kanas (either hira-ganas or kata-kanas[5]) and kanjis for ten of the drawings representing non-imported words, and to write in kata-kanas for the other ten drawings representing imported words.

The three parts of the experiment are conducted in three separate sessions on three consecutive days, Part 1 on the first day, Part 2 on a second day, and Part 3 on the final day.

Data Processing

The number of error responses are calculated for each subject and for each word set in each task, and from these data, the mean of the number of errors for each group of subjects and for each word set in each task are derived. For the Tasks C, D, and E, respectively, means of the response latencies are also calculated for each subject and for each word

set, and from these means of the response latencies for each group and for each word set are estimated.

Preliminary Findings

Table 1 summarizes some of the findings obtained to date from a preliminary experiment using three aphasic subjects: a Group 1 subject with reduction of language behavior in all modalities (Subject 1), a Group 2 subject with an additional impairment in sequencing speech sounds correctly in speech production (Subject 2), and a Group 3 subject with an additional impairment in auditory discrimination of speech sounds (Subject 3). As is shown, Subject 1 made errors only in Task C and Task G, and exhibited no specific tendency with regard to the different versions of the stimulus words. Subject 2, on the other hand, made more errors in Word Set 2 (the kana version) than in Word Set 1 (the kanji version) in all the tasks. The error rate for Word Set 3 (imported kata-kana words) was intermediate between those for the other two sets. Subject 3 exhibited a weaker indication of the same tendency, except that in Task G he was unable to produce any version of the written symbols at all.

Figure 1 illustrates in a graph the performance of the same three subjects dealing with the different versions of written symbols in the tachystoscopic tasks, with the exposure time as the parameter. It is clear from the figure that Subject 2 has particular difficulty in using the phonetic transcriptions (kanas) even though he can read the same words in the apparently more complex kanjis. Familiarity with the kata-kana transcriptions as patterns probably explains the better score for the imported words which have no other way of transcription (cf. frequency of use of imported words are made comparable to that of kanji words, page 64). The same explanation can be given to the similar tendency shown by Subject 3 in dealing with the different word sets. The performance of Subject 1, on the other hand, did not show any such trend. Thus, it can be concluded that Subject 2 and Subject 3, who have specific difficulties in sequencing and in discriminating speech sounds, respectively, suffer from a selective impairment of the phonological function in addition to the general reduction of language behavior.

Table 1. The number of error responses made by three aphasic subjects in the Task A through Task G.

Subjects	Word Sets / Tasks	Part 1		Part 2			Part 3	
		A	B	C	D	E	F	G
1	1. Kanji	0	0	1	0	0	0	4
	2. Kana		0	1	0	0	0	3
	3. Kana (Imported)	0	0	1	0	0	0	2
	Total	0	0	3	0	0	0	9
2	1. Kanji	0	0	5	2	0	7	6
	2. Kana		2	10	6	5	10	10
	3. Kana (imported)	0	0	6	3	2	9	8
	Total	0	2	21	11	7	26	24
3	1. Kanji	1	1	4	0	0	7	10
	2. Kana		5	5	4	3	10	10
	3. Kana (Imported)	5	3	4	2	1	9	10
	Total	6	9	13	6	4	26	30

The modes of stimulus presentation and response for each task are:

Task A. Auditory - Pointing (drawings).

Task B. Auditory - Pointing (printed words).

Task C. Visual (printed words) 1/10 second - Pointing (drawings).

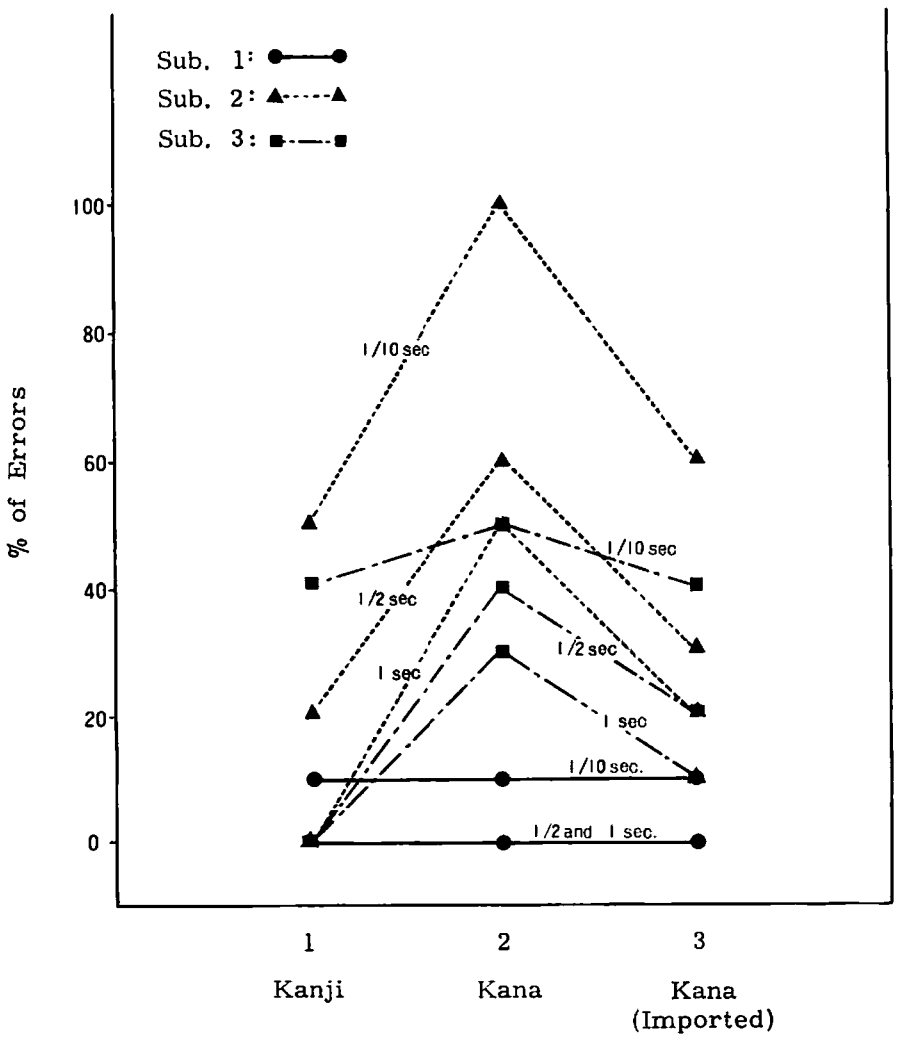
Task D. Visual (printed words) 1/2 second - Pointing (drawings).

Task E. Visual (printed words) 1 second - Pointing (drawings).

Task F. Visual (printed words) - Reading aloud.

Task G. Visual (drawings) - Writing.

Figure 1 - The percent of error responses made by three aphasic subjects in the tachystoscopic tasks (Task C, Task D, and Task E).



Notes

1) The kanas, which appear in two versions, hira-gana and kata-kana, represent a total of 46 sound units (moraic units), or 69 if we count those with diacritics, mostly representing consonant-vowel type syllables. There is a minimal set of about 1,800 kanji characters for standard use at present according to the Educational Ministry's List, each of which bears an inherent meaning as well as a phonetic reading. Compared to the kanas, the kanjis are usually more complex as graphic patterns with certain structural regularities in the way their component units (or strokes) are combined at some structural levels (Fujimura and Kagaya, in this issue).

Written forms in newspapers, magazines, and books as well as in street signs, employ both kinds of characters, kanjis being used only for lexical items and as a rule not for grammatical formatives. In school, a child is first taught to recognize and produce the kanas, and then to represent the lexical items by kanjis, one by one. The acquisition of the kanjis proceeds at an increasingly accelerated rate so that a child can be taught to handle both types of characters after a few years of schooling. Because of the larger number of kanjis to be mastered, the degree of proficiency in handling them depends, to a large measure, upon the years of schooling as well as upon reading and writing habits of the individual. It is a common observation, for instance, that the average person forgets how to write the kanjis for certain infrequently used words and represent the words for the time being by the kana equivalents. The opposite phenomenon is never seen, however, in the non-brain-injured population at least; there is no difficulty at all for literate people to transcribe any (even unknown) Japanese word in kanas, except in a few special cases, because the phonetic transcription is a general unambiguous system for representing all Japanese sound shapes.

The contrast between the two types of characters may not be as clearcut or simple as the generally assumed distinction between "ideograms" and "phonograms" would seem to suggest. There appears to be

varying degrees of the graph-meaning and sound-meaning associational strengths for different kanjis, and thus it is more reasonable to assume that there is no such clear dichotomy.

2) The diagnosis of aphasia and its sub-group classifications are given on the basis of a comprehensive language examination administered to each patient. Symptoms of the subjects in Group 1 are characterized by reduction of language behavior in all modalities, in the absence of specific perceptual, apraxic, or dysarthric components (subjects in this category are comparable to the Group 1 patients in the classification by Schuell, et al., 1964). Group 2 subjects, on the other hand, show, in addition to reduction of language behavior in all modalities, a problem of verbal apraxia or faulty programming of movements and sequences of movements required for speech production (isolated sounds as well as sound sequences) with no demonstrable paralysis or weakness of the speech musculature (this subgroup is comparable to Group III in Schuell's classification). Group 3 subjects exhibit partial auditory imperception in addition to general reduction of language behavior, and behave as if they do not hear speech sounds (spoken utterances) even though pure-tone audiometry reveals no hearing loss (this subgroup is comparable to Minor Group A in Schuell's classification).

3) As a rule, imported nouns are represented only by kata-kanas.

4) This was accertained by means of a questionnaire study preceding the experiment, using a group of 100 in-patients drawn randomly from the same hospital population from which all the subjects in this experiment are also drawn.

5) Some individuals, especially those in older generations, use the two versions of kana symbols, hira-ganas and kata-kanas, interchangeably in transcribing non-imported lexical items as well as grammatical formatives.

References

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Appendix A

Three Sets of Stimulus Words

Word Set 1.

子	毛	着	指	帽	時	封	太	大	手
供	糸	物	輪	子	計	筒	陽	根	袋

Word Set 2.

こ	け	き	ゆ	ぼ	と	ふ	た	だ	て
ど	い	も	び	う	け	うと	いよ	いこん	ぶくろ
も	と	の	わ	し	い	う	う	ん	ろ

Word Set 3.

バ	コ	カ	ボ	ベ	テ	セ	カ	ト	ネ
	ッ	メ	ー	ッ	レ	ーター	ーテン	ラック	クタイ
ス	プ	ラ	ル	ド	ビ				