AN ANALYSIS OF WRITING ERRORS IN APHASIC PATIENTS

- Kanji Versus Kana Words -

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I. Methods

Subjects

Fifty aphasic patients and 30 non-aphasic hemiplegic patients, matched for age, education and post-onset months, served as subjects of this experiment. All the subjects had incurred cerebral vascular accidents as etiology and had confirmed brain lesions limited to one hemisphere. Any subjects with signs of visual agnosia, visuo-motor problems, spatial disorientation, or upper limb apraxia, were excluded from the experiment.

Procedure

Each subject performed a task of writing 20 high-frequency nouns. Ten of these nouns are of foreign origin (imported words) which, as a rule in the Japanese orthography, are represented in katakana; and another ten are non-imported words for which kanji transcriptions are most commonly used but hiragana transcriptions can also be used (Sasanuma, Itoh, and Fujimura, 1969).

Combined visual-auditory stimuli were employed for eliciting responses from the subject. Twenty picture cards, 10 representing imported words, and the other 10 representing non-imported words were presented to each subject together with the name of each picture uttered by the examiner.

Out of the data obtained from the 50 aphasic patients, the data of 6 patients which showed either zero error scores or 100% error scores on both kanji and kana transcriptions, were excluded from the analysis. Thus the results reported here pertaining to the aphasic performance are based on the analysis of the data obtained from the remaining 44 aphasic subjects. The age, educational level, and post-onset months for these 44 aphasic patients are summarized in Table 1 together with the corresponding data for the non-aphasic subjects.

Table 1. Age, educational level, and post-onset months for aphasic and non-aphasic groups.

		age (years)	educational level (years)	post-onset duration (months)
aphasic N=44	range	29 - 71	8 - 18	2 - 24
	median	50.0	11.0	10.0
	mean	50.9	10.8	11.2
non-aphasic N=30	range	32 - 68	8 - 16	3 - 26
	median	51.5	10.0	11.0
	mean	51.7	10.6	12.3

II. Results

· The major findings may be summarized as follows:

1. Both aphasic and non-aphasic subjects made errors in kanji transcriptions of non-imported words, but only aphasic subjects made errors in kana transcriptions of imported words (katakana) and/or non-imported words (hiragana). (cf. Table 2).

Table 2. The range, median, and mean percentage of errors of kanji- and kana-words for the aphasic and non-aphasic groups.

		kanji	hiragana	katakana
aphasic N=44	range	0 - 70	0 - 100	0 - 100
	median	40.0	60.0	60.0
	mean	37.6	56.8	53.4
non-aphasic N=30	range	0 - 80	0	0
	median	15.0	0	0
	mean	21.8	0	0

2. Aphasic subjects showed a larger mean percentage of kanji errors (37.6%) than non-aphasic subjects (21.8%), but the types of errors exhibited by the two groups were essentially similar. They were, in the order of magnitude: substitutions of other strokes or units (Fujimura and Kagaya, 1969) for similar configurations (graphical errors), no response (or "don't know" response), incomplete responses (only some of many characters for the word correct), and substitutions by other characters that represent similar meanings (semantic confusions). (cf. Table 3).

Table 3. Types of kanji errors and percentage of words falling into each type for aphasic and non-aphasic groups.

	graphical confusions	no response, "don't know"	incomplete responses	semantic confusions
aphasic N=44	49.3	30.4	14.5	5.8
non-aphasic N=30	39.2	35.2	18.8	6.8

3. Of the graphical errors, the most common sub-type for both aphasic and non-aphasic groups was one in which errors took place on the level of compounding various units contained in a character, with at least one constituent unit remaining correct (e.g. 供→陜, 袋→袈).

The second in frequency of occurrence was the sub-type of extraneously adding or omitting a stroke to or from the correct character (e.g. 糸→系, 太→大).

For aphasic subjects only, there were found small groups of errors constituting the third and fourth sub-types. In the third sub-type, errors took place on the level of concatenating various strokes within a constitutent unit, in which at least one stroke remained correct (e.g. 手→毛), while in the fourth sub-type, the configuration of a character was substituted by another as a whole with no part remaining unchanged (e.g. 着→糸介) (cf. Table 4).

Table 4. Sub-types of the graphical errors of kanji-words and percentage of words falling into each type for aphasic and non-aphasic groups.

	compounding	addition or omission of a stroke	concatenating	a whole-character substitution
aphasic N=44	57.1	28.6	11.7	2.6
non-aphasic N=30	76.3	23.7	0.0	0.0

4. Aphasic subjects as a group exhibited a larger mean percentage of kana errors (53.4% for imported and 56.8% for non-imported words) than kanji errors (37.6%). (cf. Table 2).

5. There was no fixed correlation, however, between kanji and kana performances of the same subject, i.e., some of the subjects with a relatively greater total number of kana errors made a relatively smaller total number of kanji errors, and vice versa. (cf. Figure 1).

6. Characteristic kana errors found for both imported and non-imported words were quite different from those found for kanji errors. More than two-thirds of the total kana errors (69.9%) were those reflecting phonological confusions, i.e., substitutions (including metatheses and assimilations), omissions and additions of kana, rather than graphical errors. These confusions took place on the level of either a syllable, a phoneme (including the elongation and consonantal gemination) or a distinctive feature, in a given word, either alone or in combination. The next in frequency was the "no response" (or "don't know") category, accounting for nearly all of the remaining errors (29.7%). The errors reflecting graphical confusions (with no other possible interpretations) were minimal in number (.4%).

7. When all the kana errors, except graphical confusions, were analyzed in terms of the degree of phonological deviations from the correct

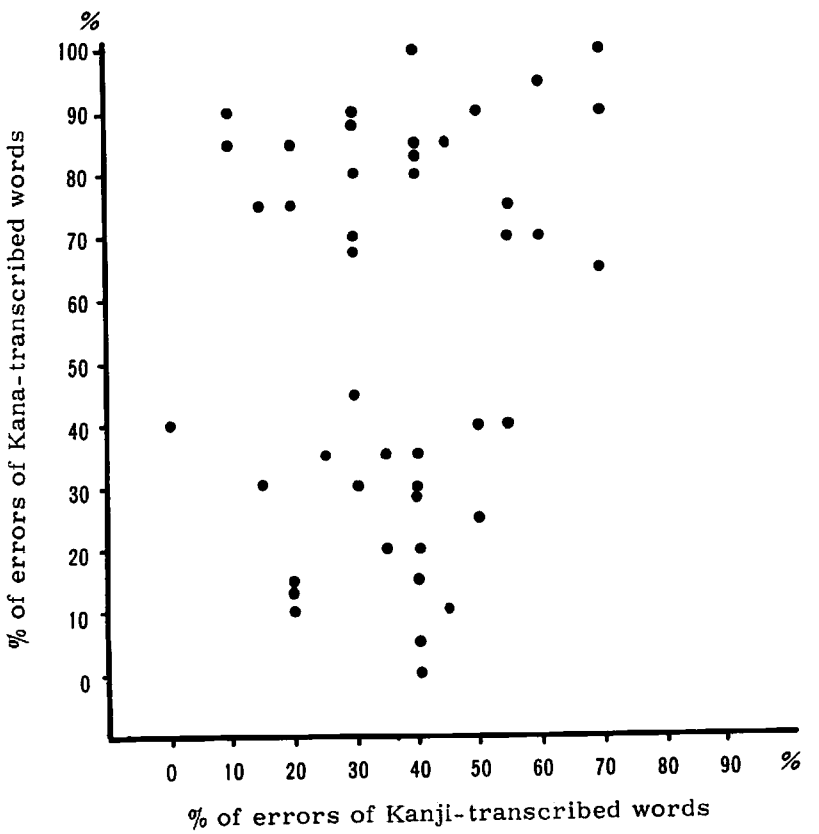

Figure 1. The relationship between the percentage of errors of kana-transcribed words and of kanji-transcribed words for 44 aphasic subjects. Each dot represents each subject, its ordinate his errors in kana transcription and abscissa those in kanji.

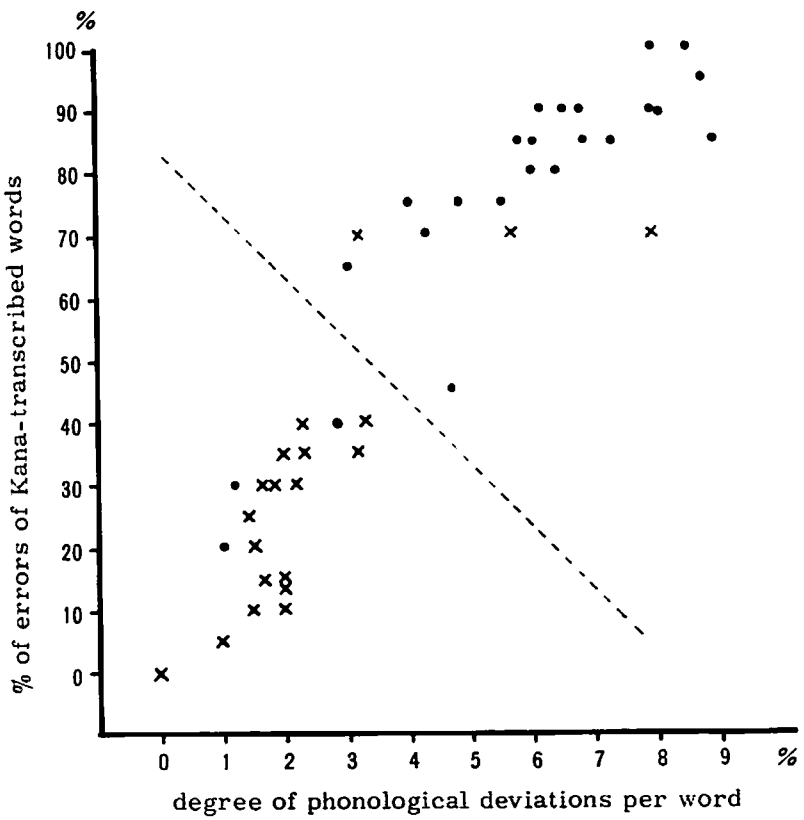

Figure 2. The relationship between the percentage of errors of kana-transcribed words (ordinate) and the degree of phonological deviations per word (abscissa) for 44 aphasic subjects. Dots represent individual subjects with apraxia of speech and crosses without it.

(target) forms for each word,* a linear correlation was found between the total number of words with kana transcription errors and the average degree of deviations per word, ($r = .92$). In other words, subjects with a greater total number of words with kana errors had a tendency to exhibit a greater degree of phonological deviations from the target form of each of these words (i. e. a greater incidence of phonological errors per word and/or a greater number of distinctive features involved per incidence), while subjects with a fewer total number of words with kana errors tended to show an opposite trend. (cf. Figure 2).

8. There seems to be a relationship between the clinical types of aphasic impairment and the levels of kana transcription performance of individual subjects (expressed either by the percentage of words with errors or by the degree of phonological deviations per word). Of 24 subjects clustering on the upper right of Figure 2 (above the dashed line), all but three, or 90%, were those with apraxia of speech accompanying aphasia (dots), while 17 of 20 subjects (85%) clustering on the lower left of Figure 2 (below the dashed line) did not have such a problem (crosses).

This is in agreement with the previous findings that the aphasic subjects with the accompanying problem of apraxia of speech exhibited, as a group, a selective impairment of processing kana or phonetic transcriptions of words both in reading and writing, while the subjects with simple aphasia did not. (Sasanuma and Fujimura, 1970).

9. Among the different sub-types of phonological errors, by far the highest in frequency of occurrence were substitutions of syllables, phonemes or distinctive features (54. 9%), followed by omissions of syllables or phonemes (19. 4%), elongation or consonantal gemination errors including omissions, additions, or substitutions of the moraic phoneme H or Q (11. 4%), metatheses of syllables, phonemes or features (9. 1%), and insertion of extraneous syllables (5. 2%).

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* In order to quantify the degree of phonological deviations of each word, a system was devised tentatively in which a score (weight) of one through four was assigned to different sub-types of errors according, basically, to the number of features involved in the error and these scores were added up for each word (cf. Appendix).

More than half of the total incidences of substitutions were accounted for by progressive (perseverative) or regressive (anticipatory) assimilations of syllables, phonemes or features.

10. In general, the relative frequency of occurrence of each sub-type, except elongation and consonantal gemination errors and insertions of extraneous syllables, kept its relative position through all levels of performance of subjects, expressed either in terms of word errors or of phonological deviations.

11. Elongation and consonantal gemination errors were distributed evenly throughout all levels of total error scores, i. e., from high-error-rate subjects through low-error-rate subjects. This may be interpreted as suggesting that the prosodic features make a separate group in the hierarchy of the phonological system. Insertion of extraneous syllables, on the other hand, were exhibited only by those subjects with the lowest performance levels.

12. With regard to metatheses, there were some high-error-rate subjects whose relative frequencies of occurrence of metatheses were somewhat deviated from the parallel relationship to their total error scores: two showing unproportionately greater incidences of metatheses and four showing unproportionately smaller incidences.

Although all these subjects had apraxia of speech accompanying aphasia, the articulatory errors of the two special groups had different characteristics, i. e., the performance of the two in the former group was characterized by predominant difficulty in sequencing a set of phonemes in an utterance (close to Luria's efferent type) with frequent incidences of metatheses, while the major problem of the three in the latter group lay in combining a set of features into individual phonemes (similar to Luria's afferent type) with an extremely limited amount of utterances (oral speech production) (Luria, 1964 ; cf. pertinent accounts in Jakobson, 1966).

It may be inferred that in these cases at least, the specific types of phonological impairment in oral language production are reflected in the performance of graphic language production.

13. Another characteristic exhibited by the three subjects in the latter special group above was an unproportionately high incidence of "no response" category in their graphic performance. This may again be interpreted as

suggesting that there is a common underlying impairment which emerges in both oral and graphic performances.

14. When an analysis was made of the difficulty level of each of the 10 kanji transcriptions (in terms of the percentage of subjects making errors), it ranged from 6.8% to 81.8% for aphasic and 3.3% to 66.7% for non-aphasic subjects. For kana, in the case of the aphasic subjects, the range was from 22.7% to 63.6% for imported words and from 40.8% to 75.0% for non-imported words, respectively.

With regard to kanji words, the number of strokes contained in a word seemed to hold a gross proportional relationship to the difficulty level of that word (the larger the number of strokes in a word the more difficult it becomes) while in the case of kana words, the number of letters or morae plus the kana appendant marks for voiced consonant (i.e. dakuten) (if there is any) contained in the word seemed to be the factor related to the difficulty level.

15. Frequency of occurrence of various sub-types of kana errors seemed to be influenced, partially at least, by some particular characteristics of each word. For instance, prosodic errors occurred more frequently in those words which contain one or more of the prosodic special marks in them. Thus, for example, errors often occurred in such patterns as "se ta H, " "se H ta", and "se Q ta H", for "se H ta H", but seldom occurred in such possible patterns like "ba su H" or "ba H su" for "ba su".

Appendix. The system of quantifying the degree of phonological deviations in each word.

A. Assignment of Scores to Different Error Types:

score	types of errors	examples
1	a) Substitution, omission, and addition of the consonant features: voicing, nasality, place and manner.	ba su → pa su (voicing) ke i to → ke i ko (place) yu bi wa → yu mi wa (nasality)
	b) Substitution, omission and addition of vowels.	ki mo no → ki ma no (substitution) to ke i → to ke ϕ (omission)
	c) Substitution, omission, and addition of Q and H.	be Q to → be H to (substitution) ka H te N → ka ϕ te N (omission)
2	a) Metathesis of adjacent syllables or phonemes.	ka me ra → ka ra me (syllable) te re bi → te be ri (phoneme)
	b) Metathesis of non-adjacent features.	te re bi → de re pi (voicing)
3	Omission and addition of a CV syllable.	ko do mo → ko do ϕ (omission) ko do mo → ko do mo do (addition)
4	Metathesis of non-adjacent units.	ne ku ta i → te ku na i (phonemes) ne ku ta i → ta ku ne i (syllables)

B. Additions of Scores for the Combination of Errors in Each Word:

Example: ne ku ta i → te mo na i

ne ku ta i → te ku na i ⟶ te mo na i

(metathesis: non-adjacent phonemes)

k → m/ __n (substitution: voicing, nasality and place features)

u → o/ __a (substitution: a vowel)

Score: 4 + 3 + 1 = 8

References

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