CASE REPORT

Revival of Historical Kana Orthography in a Patient with Allographic Agraphia

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Abstract:
Japanese people born before World War II learned Japanese kana (Japanese syllabograms) writing in a style that is not currently used. These individuals had to learn the current style of kana orthography after the war. An 85-year-old man was taken to our hospital by his family who were surprised by his diary. It was written with kanji (Japanese ideograms) and katakana using the prewar style. A neuropsychological examination revealed impaired recall of hiragana. Neuroimaging studies revealed atrophy of the left fronto-parietal lobe and hypoperfusion of the left frontal lobe. His allographic agraphia might have resulted from the disturbance of the current style of kana orthography.

Key words: allographic agraphia, Japanese language, hiragana, katakana, dementia

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Introduction

Japanese people use two types of writing: kana and kanji. Kana consists of syllabograms that represent sounds. Kanji consists of ideograms that simultaneously represent both sounds and meanings. Kana is divided into two groups: hiragana and other katakana; each of which contain 46 characters. A single sound can be written using either hiragana or katakana (Table 1). In current Japanese usage, katakana is mainly used for foreign words, onomatopoeic words, and the names of living things. Hiragana is more commonly used in combination with kanji for the construction of typical sentences. In the English and Japanese literature, numerous articles have discussed the differences in the pathways involved in the cognition or writing of kana and kanji. However, few reports have investigated the differences between hiragana and katakana.

With regard to writing systems, two processes have been proposed. “Central processes” include “sublexical” (or “phonological”) routes and “lexical” routes; these processes generate spelling, regardless of the modality of output (handwriting, oral spelling, typing, etc.). “Peripheral processes” are specific to one particular output modality. For handwriting, three successive stages are described. In the first stage, which is referred to as the “allographic system”, the allograph, the appropriate font, and the case of the letter to be written are selected. In the second stage, the graphic-motor pattern specifies the direction, relative size, position, and order of strokes. In the final stage, graphic coding takes place; this corresponds to the execution and control of neuromuscular commands (1, 2).

There are few reports on allographic agraphia. When the alphabetical scripts are used, allographic agraphia appears as the misuse of upper and lower cases (e.g., “mIXeD CasES”) (3, 4). In other cases patients have been observed to be unable to write in a single specific font or case (5-10). We herein describe the case of a man with dementia who used kana letters in an unusual manner, which differed from simple allographic agraphia.

Case Report

An 85-year-old right-handed man presented with dementia. He was accompanied by his family. He had been educated until fourteen years of age. The patient kept a diary. His family was surprised to see that his diary was written in kanji and katakana instead of kanji and hiragana. His diary

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Table 1. The Japanese kana characters (hiragana, katakana) and Their Pronunciation.

| Katakana | Kana | Katakana | Kana | Katakana | Kana | Katakana | Kana | Katakana | Kana | Katakana | Kana |
|----------|------|----------|------|----------|------|----------|------|----------|------|----------|------|----------|------|
| あ,ア, a | か,カ, ka | さ,サ, sa | た,タ, ta | な,ナ, na | は,ハ, ha | ま,マ, ma | や,ヤ, ya | ら,ラ, ra | わ,ワ, wa | ん,ン, n |
| い,イ, i | き,キ, ki | し,シ, shi | ち,チ, chi | に,ニ, ni | ひ,ヒ, hi | み,ミ, mi | り,リ, ri | り,リ, ri | り,リ, ri |
| う,ウ, u | く,ク, ku | す,ス, su | つ,ツ, tsu | ぬ,ヌ, nu | ふ,フ, fu | は,ハ, ha | ゆ,ユ, yu | る,ル, ru | り,リ, ri |
| え,エ, e | え,エ, e | お,オ, o | こ,コ, ko | そ,ソ, so | と,ト, to | の,ノ, no | ほ,ホ, ho | ほ,ホ, ho | ほ,ホ, ho |

In addition to the standard letters described in Table 1, the addition of two dots on the upper right corner of letters in the ‘か,カ(ca), き,キ(ki), う,ウ(u), え,エ(e), お,オ(o)’ and ‘ハ,ハ(ha), ハ,ハ(ha)’ columns (e.g., ば) modifies the pronunciation to ‘ば’, ‘ざ’, ‘だ’, and ‘ば’, respectively. The addition of a circle on the upper right corner of the ‘は,ハ(ha)’ column (e.g., ぱ) modifies the pronunciation to ‘ぱ’. A small ‘つ,ツ’ denotes a double consonant. The small ‘や,ヤ’, ‘ゆ,ユ’, and ‘ら,ラ’ produce contracted sounds.

Figure 1. (A) A sample of the patient’s writing from March 15th to April 14th in 2013. The sentences are written horizontally from the left to the right with the current style of kana orthography. Katakana is only used for foreign words or for writing the type of rice (underlined). “March 16. From 7:50 AM on March 15 to 8:00 AM Disinfection of 11 kg unhulled rice with Sporutak®. On the 16th take them out of the fluid/March 16. Put them in water at 5:00 PM March 25. Prepare the soil in order to plant 53 cases of Kinuhikari (a type of rice) from 8:30 AM to 11:00 AM April 1. Prepare the ground in the morning. April 3. Sprout from 10:00 AM until 5:00 PM on April 4. April 4. Take the cases out of the water. April 6. Scatter 55 cases of unhulled Kinuhikari rice from 3:30 AM to 10:30 AM. April 6. Turn the electric nursery chamber on April 8. Cover the rice nursery with sheets from 8:00 AM. April 8. Take 55 seedlings out from 3:50 PM to 4:30 PM. April 14. Take the Nylon sheets off and spray with water at 10:15 AM”. (B) A sample of his writing dated May 3 of 2014. Here, the sentences are written vertically with kANJI and katakana using the historical kana orthography (arrowheads). Hiragana is mixed into some words (dots). “Breakfast menu. Breakfast. Rice, soup, spinach. From 7:45. Noritama seasoning powder. Radish and carrot soup. Lunch menu. Lunch menu. A piece of sea bream, potatoes, rice, radish and carrot, Harusame, and fruits” (the first three columns).

had been written in kanji and hiragana until November of 2013. His usage of katakana was normal. He only used katakana for foreign words and to describe varieties of rice (Fig. 1A). After May 2014, the patient’s diary was written in katakana and kanji with a historical form of kana orthography - as if it had been written before World War II (Fig. 1B). Neurologically, he was alert and his manner was polite. His spontaneous speech was fluent and paraphasia was not observed. His auditory comprehension was good. There was no external ocular palsy, facial palsy, masked
face, or bulbar palsy. He displayed no weakness, involuntary movement, sensory disturbance, ataxia, or parkinsonism. His deep tendon reflexes were all normal, and no pathological reflex was evoked. A neuropsychological examination revealed low Wechsler Adult Intelligence Scale (Third edition) scores: verbal intelligence quotient (VIQ), 67; performance IQ (PIQ), 58; and full IQ (FIQ), 60. Standard language tests for aphasia revealed decreased scores for “Following verbal commands”, “Word listing”, “Writing kanji words”, “Dictating kanji letters”, “Writing kana words”, “Dictating sentences”, and “Calculation”. In spontaneous written naming, he wrote all entries using katakana. When he was asked to write them using hiragana, he wrote some letters using katakana (Fig. 2). A standard performance test for apraxia (Japan Society for Higher Brain Dysfunction) revealed constructional disability. His visual perception test score for agnosia (Japan Society for Higher Brain Dysfunction) was normal. Brain magnetic resonance imaging revealed atrophy of the left frontoparietal lobe (Fig. 3). Single photon emission computed tomography using $^{99}$Tc-ethyl cysteinate dimer revealed hypoperfusion at the left middle and inferior frontal gyrus and the anterior area of the left Sylvian fissure (Fig. 4). Treatment with donepezil chloride (5 mg/day) improved his handwriting. He was able to write sentences with kanji and hiragana as he had previously written them. However, with regard to the dictation of kana words that were spelled differently in the prewar style, he used the prewar style for 11 of 52 cases. He wrote words with a mixture of hiragana and katakana in 4 of 52 cases.

**Discussion**

The most striking feature of the patient’s presentation was the change in the script in his diary. Currently, Japanese people use kanji and hiragana in normal sentences. The use of katakana is limited to foreign words, onomatopoeic words, and the names of living things. In his diary, most of the letters that would normally be written hiragana were
written in katakana. Although he also used kanji and hiragana in his dairy, he wrote some words using both hiragana and katakana. Similarly to the use of upper case and lower case letters in countries where alphabetical scripts are used, one single sound can be written using either hiragana or katakana; however, the use of a mixture of hiragana and katakana in a single word is grammatically incorrect in the Japanese language. We concluded that the patient’s use of script was a form of allographic agraphia. There were also errors in the configurations of both kanji and katakana characters. In the present case, impaired character recall for kana, especially hiragana, might have been responsible for the patient’s allographic agraphia.

However, in addition to the patient’s allographic agraphia, the patient also used historical kana orthography. The current style of kana orthography was established after the end...
of World War II (in 1946). In some words, although the pronunciation is the same, the spelling differs between the two styles (Fig. 5). Our patient first learned the prewar style in elementary school. At that time, students learned styles (Fig. 5). Our patient first learned the prewar style in

Table 2. The Reported Cases of Allographic Agraphia.

| Reference | Age (years) | Aetiology | Imaging | Location | Complicating focal signs |
|-----------|-------------|-----------|---------|----------|-------------------------|
| 5         | 54          | CVA       | CT      | L-P      | R hemianopia, R monoparesis |
| 3         | 48          | Tumor     | CT      | L-T, P, O| R hemianopia, Gerstmann’s syndrome |
| 6         | 67          | ?         | CT      | Normal   | Global intellectual impairment |
| 7         | 72          | Infarct   | CT      | L-P, O   | R hemianopia, R monoparesis |
| 8         | 20          | Injury    | CT      | L-P, R-F, O | Memory deficit, alexia, L hemiparesis |
| 9         | 70          | Stroke    |         | L-hemisphere | R hemianopia, R paresthesia, alexia |
| 10        | 52          | AD        | CT      |          | Diffuse atrophy |
| 11        | 70          | Infarct   | MRI     |          | Multiple lacuna |
| 12        | 81          | FTD       | CT, MRI | L-P, O   | R quadrantanopia, Gerstmann’s syndrome |
| 2         | 68          | Encephalitis | CT, MRI, SPECT | L-T, O | Amnestic aphasia, R hemianopia, R hemiparesis |

CVA: cerebrovascular attack, AD: Alzheimer’s disease, FTD: frontotemporal dementia, CT: computed tomography, MRI: magnetic resonance imaging, SPECT: single photon emission computed tomography, L: left, R: right, p: parietal, T: temporal, O: occipital

In countries where alphabetical scripts are used, allographic agraphia was also observed in patients with lesions of the left temporo-parieto-occipital region. There were four cases (1, 4, 6, 10) in which the lesion responsible for allographic agraphia was unclear (Table 2). Although it was impossible to determine, the lesion responsible for allographic agraphia in our patient seemed to be located in the left middle and inferior frontal gyrus and the anterior area of the left Sylvian fissure. The writing of our patient improved after the administration of donepezil chloride. This fact suggests that his writing disorder might have been due to attention disturbance rather than a focal sign of the cerebral cortex (13).

The authors state that they have no Conflict of Interest (COI).

References

1. Menichelli A, Rapp B, Semenza C. Allographic agraphia: a case study. Cortex 44: 861-868, 2008.
2. Menichelli A, Machetta F, Zadini A, Semenza C. Allographic agraphia for single letters. Behav Neurol 25: 233-244, 2012.
3. De Bastiani P, Barry C. A cognitive analysis of an acquired dysgraphic patient with an “allographic” writing disorder. Cogn Neuropsychol 6: 25-41, 1989.
4. Forb es KE, Venneri A. A case for Case: handling letter selection in written spelling. Neuropsychologia 41: 16-24, 2003.
5. Patterson K, Wing A. Processes in handwriting: a case for a case. Cogn Neuropsychol 6: 1-23, 1989.
6. Kartsounis LD. Selective lower case letter ideational dysgraphia. Cortex 28: 145-150, 1992.
7. Trojano L, Chiacchio L. Pure dysgraphia with relative sparing of lower-case writing. Cortex 30: 499-501, 1994.
8. Weekes B. A cognitive-neuropsychological analysis of allographic errors from a patient with acquired dysgraphia. Aphasiology 8: 409-425, 1994.
9. Hanley JR, Peters S. A dissociation between the ability to print and write cursively in lower-case letters. Cortex 32: 737-745, 1996.
10. Venneri A, Pestell SJ, Caffarra P. Independent representations for cursive and print style: evidence from dysgraphia in Alzheimer’s disease. Cogn Neuropsychol 19: 387-400, 2002.
11. Pearce JM. A note on aphasia in bilingual patients: Pitres’ and Ri-bot’s laws. Eur Neurol 54: 127-131, 2005.
12. Sakurai Y, Asami M, Mannen T. Alexia and agraphia with lesions of the angular and supramarginal gyri: evidence for the disruption of sequential processing. J Neurol Sci 288: 25-33, 2010.
13. Kimura R, Safari M-S, Mirnajafi-Zadeh J, et al. Curtailing effect of awakening on visual responses of cortical neurons by cholinergic activation of inhibitory circuit. J Neurosci 34: 10122-10133, 2014.

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