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GOGI APHASIA: THE EARLY DESCRIPTION OF SEMANTIC DEMENTIA IN JAPAN

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SUMMARY

Background Thirty years preceding the first detailed reports of semantic dementia (SD) in western countries, Imura described a unique aphasic syndrome exhibited in Japanese patients, which he called *gogi* (literally, "word-meaning") aphasia. Gogi aphasia directly corresponds to the pattern of language impairments described in SD, with the additional, language-specific deficit of kanji processing. Given the importance and apparently early appearance of this symptom in gogi aphasia/SD, in the present study we examined kanji and kana processing in patients with very mild semantic dementia.

Material/ Methods: Fifteen mild or very mild gogi aphasia/SD patients from the Dementia and Higher Brain Function Clinic participated in this study. Each participant's language function was evaluated using the Japanese Standard Language Test for Aphasia (SLTA), comprising 26 subtests.

Results: In all cases and across all tests, the SD patients' performance was considerable better with kana than kanji processing. This pattern was consistent across all patients and was observed even in very mild SD patients.

Conclusions: These results are consistent with the hypothesis that the early discovery of gogi aphasia/SD in Japan depended, at least in part, on the demanding nature of the Japanese written language. We wish to introduce Western researchers to the fundamental contribution of Tsunero Imura, a Japanese neuropsychiatrist, who discovered gogi aphasia and was one of the first to describe the core symptoms of SD.

Key words: Pick's disease, kanji, kana

INTRODUCTION

Although the striking and unique clinical picture of semantic dementia was first described by Pick in a case of left temporal lobe atrophy (Pick, 1892), the first detailed description in the Western literature was provided by Warrington (1975). Via her seminal and detailed neuropsychological investigation, Warrington was the first to highlight the patients' progressive, yet selective impairment of semantic memory in both the visual and verbal domains with relative preservation of episodic memory. The term 'semantic dementia' (SD) was later coined by Snowden et al. (1989) for degenerative disease with these distinct clinical features, referring to the earlier report by Warrington (1975). Two of Warrington's three patients were subsequently reported with histopathology of ubiquitin-positive but tau-negative inclusion bodies (Rossor et al, 2000). Hodges et al (1992) defined the clinical features more precisely as follows: (1) selective loss of semantic memory causing severe anomia, impaired spoken and written single-word comprehension, reduced generation of exemplars on category fluency tests and an impoverished fund of general knowledge; (2) relative sparing of other components of language output and comprehension, notably syntax and phonology; (3) normal perceptual skills and nonverbal problem-solving abilities; (4) relatively preserved autobiographical and day-to-day (episodic) memory; and (5) a reading disorder with the pattern of surface dyslexia.

Thirty years preceding the reports of SD in western countries, Imura (1943) described a unique aphasic syndrome exhibited in Japanese patients and gave it the designation of gogi (literally, "word-meaning") aphasia. As Imura emphasized, the core feature of gogi aphasia is a selective loss of word meaning or impairment of "dictionary-like" meaning for words together with well-preserved phonological and syntactic aspects of language, which is reflected in written language in the form of surface dyslexia and dysgraphia. A defining feature of the syndrome is a marked impairment in processing kanji or Chinese characters, which are semantic in nature, combined with a relatively preserved capacity to process kana or phonemic signs (Sasanuma & Monoi, 1975). Thus, gogi aphasia directly corresponds to the pattern of language impairments described in SD by Snowden et al. (1989) and Hodges et al. (1992), with the additional, language-specific deficits of kanji processing (the manifestation of surface dyslexia and dysgraphia within the Japanese reading system: Fushimi et al., 2009).

As Sasanuma noted (Sasanuma & Monoi, 1975), profound deficits of kanji processing is one of the core feature of gogi aphasia, and this may be the reason why gogi aphasia was discovered so early in Japan (i.e., the demanding nature of kanji processing makes this a sensitive and early measure of semantic degeneration). Despite its potential importance for basic neuroscience and clinical diagnosis, there are few systematic investigations that focus on this striking dissociation between two kinds of Japanese written symbols (kanji and kana) in gogi aphasia/SD. The two exceptions, with reported case-series of gogi aphasia/SD, are our initial report (Tanabe et al., 1992) and our more recent study of surface

dyslexia in SD (Fushimi et al., 2009). Given the importance and apparently early appearance of this symptom in gogi aphasia/SD, in the present study we examined kanji and kana processing in patients with very mild semantic dementia.

METHODS

Fifteen patients from the Dementia and Higher Brain Function Clinic of the Department of Neuropsychiatry at Kumamoto University Hospital and Ehime University Hospital participated in this study; all conformed to published criteria for SD (Hodges et al., 1992; Neary et al.,1998) and gogi aphasia (Tanabe, 2007). The severity of dementia, evaluated using the Clinical Dementia Rating (CDR: Hughes et al, 1982), was very mild (CDR 0.5) or mild (CDR 1). To focus on milder patients, we excluded patients whose Mini Mental State Examination (MMSE: Folstein et al., 1975) was less than 20/30. Structural magnetic resonance imaging in all cases revealed atrophy of both anterior/inferior temporal lobes; eight of the fifteen patients had the more common SD asymmetry of greater left- than right-sided atrophy and seven cases (HH, HHI, TS, NOB, MN, SO, YO) had the reverse. All patients were right-handed. The demographic information and major clinical features are summarized in Table 1. Patients are listed in descending order of MMSE score. The research was conducted with the understanding and consent of each patient, and was approved by the ethics committees of the Kumamoto and Ehime University Schools of Medicine.

Each participant's language function was evaluated using the Japanese Standard Language Test for Aphasia (SLTA: SLTA Committee, 1997), comprising 26 subtests, each assigned to one of five linguistic functions (listening, speaking, reading, writing, and calculating).

We compared accuracy on the kanji and kana versions of the reading, written naming, writing, and word-to-picture matching subtests using the Wilcoxon Signed Ranks test. The performance of each SLTA subtest between the left-predominant atrophy group and the right-predominant atrophy group was compared with the Mann-Whitney U test. The significance level was set at $P<0.05$. Statistical analysis was carried out with SPSS version 17.0.

RESULTS

Table 2 summarizes the patients' performance on each subset of the SLTA. Patients scored significantly below non-aphasic controls on spoken and written comprehension, picture naming of nouns and verbs, scene description, category fluency, sentence repetition, written naming of pictures with kanji characters, and writing to dictation with kanji characters. In stark contrast and in alignment with the classical pattern of gogi aphasia, all patients' scores for word repetition and reading kana words were perfect.

In terms of comprehension performance, kanji word–to–picture matching was relatively impaired compared to kana word–to–picture matching ($p=0.08$). In contrast and in keeping with the kanji-processing deficits in SD/gogi aphasia, kana

Table 1. Demographic information and results of standard cognitive assessments

Patient	Sex	Age	Years of education	Duration (year)	atrophy	MMSE (30)	CDR
YI	M	57	12	1	L > R	28	0,5
TI	M	57	16	3	L > R	28	0,5
TAM	M	78	15	2	L > R	28	0,5
YO	M	50	16	2	L < R	28	0,5
TU	F	68	12	3	L > R	28	0,5
MN	F	64	12	1	L < R	28	0,5
HHI	F	62	12	1	L < R	28	1
TMO	M	54	12	2	L > R	27	0,5
SO	F	65	12	2	L < R	27	0,5
NOB	M	61	12	5	L < R	27	1
ST	M	76	9	3	L > R	25	0,5
SK	M	58	16	2	L > R	23	0,5
HH	F	63	9	2	L < R	23	1
TS	M	52	9	3	L < R	21	1
HY	M	83	10	6	L > R	21	1
mean±SD		63.2±7.3	12.3±1.9	2.5±1.0		26±2.3	0.7±0.2

and spoken word-picture matching were equally good (p=0.56). With regards to reading aloud, kanji word reading was significantly worse than the perfect performance on reading kana words (p =0.007), even though both kanji and kana words corresponded to the same items and had the same pronunciation (i.e., phonological form). In written naming of pictures, kana written naming was better than kanji written naming (p=0.003). Several patients showed profound deficits in writing with kanji yet almost perfect performance for written kana. In writing to dictation, kana dictation was better than kanji dictation (p=0.003) and several patients again demonstrated profound deficits on writing with kanji, while most of the patients exhibited perfect performance when required to write with kana. There were no significant correlations between MMSE and any of these language measures. This is as expected because in SD/gogi aphasia there is a selective semantic impairment and not a generalised dementia.

There were no significant differences in age, education, disease duration and dementia severity between the left-dominant atrophy and right-predominant atrophy groups. For performance on each subset of the SLTA, the left-sided group was significantly better than the right-sided group only in kana word-to-picture matching (p=0.022). The right group was significantly better than the left group only in written command comprehensions (p=0.042). The scores on the other subtests were equivalent in the two groups.

DISCUSSION

This case-series, systematic evaluation using a standard, comprehensive language test battery found a strong discrepancy between kanji and kana. In all cases and across all tests, the SD patients' performance was considerably better with kana than kanji processing. This pattern was consistent across all patients regardless of predominant brain atrophic side and was observed even in very mild SD patients. As such, these results are consistent with the hypothesis that

Table 2. Resultas for each patient on SLTA

	Spoken word-to-picture matching (10)	Kanji word-to-picture matching (10)	Kana word-to-picture matching (10)	Spoken sentence comprehension (10)	Written sentence comprehension (10)	Spoken command comprehension (10)	Written command comprehension (10)	Picture naming (noun) (20)	Picture naming (verb) (10)
YI	10	10	10	9	10	6	7	12	8
TI	10	10	10	10	9	9	9	9	8
TAM	10	10	10	8	10	6	7	14	7
YO	10	10	10	10	10	10	10	10	9
TU	10	9	10	8	9	3	5	8	7
MN	10	10	10	10	10	8	10	13	8
HHI	10	10	10	10	10	8	10	12	10
TMO	9	10	10	10	10	5	8	8	7
SO	9	6	9	7	10	10	8	7	7
NOB	10	8	10	10	10	3	9	6	7
ST	10	9	10	9	9	6	4	13	8
SK	10	10	10	9	10	5	8	9	9
HH	10	8	9	8	9	8	9	7	7
TS	10	10	9	7	7	6	8	6	8
HY	10	10	10	10	9	4	6	8	8
Control	10.0±0.2	9.9±0.8	10.0±0.1	9.5±0.8	9.6±1.0	9.6±0.7	9.4±1.5	19.6±0.8	9.9±0.4

	Scene description (6)	Word fluency (animal within 1min)	Word repetition (10)	Sentence repetition (5)	Reading aloud kanji words (5)	Reading aloud kana words (5)	Written naming with kanji (5)	Written naming with kana (5)	Writing to dictation with kanji (5)	Writing to dictation with kana (5)
YI	4	5	10	3	4	5	2	5	3	4
TI	4	3	10	5	5	5	0	4	1	5
TAM	5	6	10	3	5	5	5	5	5	5
YO	3	10	10	5	5	5	4	5	4	5
TU	4	6	10	3	4	5	2	4	3	4
MN	5	2	10	5	4	5	3	5	3	5
HHI	6	7	10	5	5	5	5	5	5	5
TMO	5	2	10	4	5	5	0	5	3	5
SO	1	5	10	3	4	5	0	4	2	5
NOB	3	4	10	3	4	5	2	4	4	4
ST	4	3	10	4	5	5	4	4	1	5
SK	5	13	10	4	4	5	3	5	2	5
HH	3	5	10	5	5	5	4	4	4	5
TS	2	4	10	5	4	5	2	5	3	5
HY	2	1	10	5	3	5	3	5	5	5
Control	5.8±0.6	12.6±4.5	10.0±0.1	4.5±0.8	5.0±0.4	5.0±0.1	4.2±1.1	4.8±0.7	4.3±1.0	4.8±0.8

*) Control : nonaphasic 150 subjects

the early discovery of gogi aphasia in Japan depended, at least in part, on the demanding nature of the Japanese written language (see below).

As Sasanuma and Monoi noted in their case report of gogi aphasia (1975), the dual orthographic systems in Japanese serve as a useful indicator of phonological and semantic types of impairment. Indeed, in his seminal report of gogi aphasia, Imura (1943) argued that "it is possible to add novel observations about aphasic syndromes, which seem to have been fully investigated in Western countries, by considering the characteristics of the Japanese language."

We have already introduced the characteristics of Japanese written language in our previous SD reports (Fushimi et al, 2003; Fushimi et al, 2009). Briefly, the two different forms of orthography, neither of them alphabetic, are required to write any sentence in Japanese. Morphographic kanji, derived originally from Chinese characters, is used to write most nouns and the stems of verbs and adjectives. Syllabic (or more accurately, moraic) kana, specifically hiragana, is used to write function words and the obligatory inflections on verbs and adjectives. The orthographic-to-phonological translations of kana are regular: each kana character corresponds, in a perfectly predictable fashion, to a single mora of spoken Japanese. A mora is the time-based phonological unit of spoken Japanese, mostly either a vowel on its own, like /a/, or a consonant + vowel combination, like /ka/. The important point here is that the hiragana symbol 'い' is always pronounced /i/ and the hiragana symbol 'き' is always pronounced /ki/, independent of context. The orthographic-to-phonological translation of kanji is only quasi-regular and it is less systematic than for English orthography. About two-thirds of the kanji characters used in everyday Japanese writing/reading have two or more different pronunciations, and the pronunciation appropriate for a given word depends upon the other component character(s). Furthermore, the multiple pronunciations may have no similarity whatsoever. For example, the two-character kanji word '外科' is pronounced /ge-ka / and means surgery. Its first character '外', which is pronounced /ge/ in this word, is pronounced /so-to/ in other words; i.e., not a single phoneme is in common between the two pronunciations. Kanji differs from alphabetic writing systems, not only in the degree of orthography→phonology systematicity, but also in the relationship between orthography and semantics. In English, segments of words on their own reveal little about whole-word meaning (for example, the semantics of cabinet have nothing to do with cab, bin or net), and single letters typically convey no semantic information. In contrast, individual kanji characters always have meaning, although the meaning of the single character is not always transparently related to the meaning of a multi-component word containing that character. For example, as mentioned above, the two-character kanji word, pronounced /ge-ka/, means surgery; but the first character of this word on its own, pronounced /so-to/, means outside.

A few limitations may be identified with respect to the current study. First, our study contains a relative small sample size. However, it is one of the largest case-series of mild SD cases (in western or Japanese reports). Second, we did not

compare the SD patients directly against a new group of controls. SLTA is a standardised test with extensive normative control data. So we compared the patients against these published norms rather than comparing to new controls.

The first case of SD was described by Arnold Pick, a neuropsychiatrist in Prague, followed by a few cases at the beginning of the 20th century. It was believed that this unique clinical syndrome then reappeared in Warrington's seminal report after a gap of three-quarters of a century (Hodges et al., 2007). Indeed, Warrington's (1975) seminal report was the first Western paper to note the theoretical importance of the patients' selective semantic impairment and the links with Tulving's then new theory of an episodic and semantic memory dichotomy (Tulving, 1972). However, in addition, we wish to introduce Western researchers to the fundamental contribution of Tsunero Imura, a Japanese neuropsychiatrist, who discovered gogi aphasia and described the core symptoms of SD. He, like Warrington, understood the unique nature of word meaning loss with profound deficits of kanji processing, which are the core features of gogi aphasia in Japanese SD patients. In his later work (Imura, 1967), he had the foresight to argue that "there is some overlap between the symptom of gogi aphasia and dementia. Gogi aphasia looks like a kind of dementia from a different point of view."

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