belonging to the category "concerning" mentioned above. It is also true that the multi-word prepositions and subjunctions allow the speaker to put more stress on the expression – although prepositions and subjunctions are normally destressed. Politicians often use the "concerning" type of preposition to signal which topics they are going to express their opinions about. The long prepositions and subjunctions furthermore allow the speaker to prolong the speech, which is of importance in certain ritual or ceremonial circumstances. The multi-word prepositions and subjunctions even allow the speaker to rest a little while planning what to say next (cf. Sigurd 1987).

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Some Acoustic Characteristics of Glottal and Palatal Fricatives in Japanese and German

Mechtild Tronnier and Masatake Dantsuji*

Introduction

In classifying Japanese consonants, there are different ways to group the so-called *h-sounds*. In a /hi/-sequence the /h/-part could be realized as either [ç] or as a voiceless high front vowel [i̥], the latter being the devoiced counterpart of the following vowel. The occurrence of either realization can go together with vowel devoicing in specific environments. In Japanese, high vowels are often devoiced between voiceless obstruents, and can even be deleted, either in rapid speech (Vance 1987) or if a fricative or affricate precedes, although coarticulatory effects remain on that fricative (Kawakami 1977). Some linguists point out that [ç] always occurs when followed by a high front vowel. Others, however, have shown, that [i̥] can be found in the same position.

In German, the quality of the glottal fricative /h/ is dependent on the following vowel. It could also be described as the devoiced counterpart of the following vowel (Kaneko & Neyer 1984). Therefore, in the sequence /hi/, as in the German word *hier* ([hiɐ], 'here'), the fricative is palatalized. In addition, a contrasting fricative, the so-called *ich-Laut*, which is transcribed as [ç], can be found in German, as in the word *Hierarchie* ([hiɣaɐçi:], 'hierarchy'). The occurrence of this palatal fricative is very much restricted in its distribution.

In the present study some comparisons of the acoustic structure of specific effects within and between Japanese and German are shown. These comparisons include an investigation of the fricatives in both languages under no further specified context conditions and one that focusses on possible spectral similarities in the fricatives in Japanese /hi/, where the /i/ is

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phonetically maintained, with the German /hi/, and if Japanese /i/ is unvoiced with German [ç]. One further investigation was undertaken to find out whether some influence of positioning exists. Hence, positioning of Japanese /hi/ in a word and of German [ç] in a syllable was looked at. In addition, consonantal and vocalic context influence on the German and Japanese fricatives was tested.

Phonotactics

On a segmental level, every language has its own set of sounds and its own rules to combine them. The rules sometimes overlap but more often differ from those of other languages. This is also the case for Japanese and German, where overlapping in many aspects can be found.

A brief description of the context and the placing of the sounds on which this study focusses follows.

/hi/ in Japanese

Adopting Hattori's concept of the phonological syllable (1954), the syllable structure in Japanese allows only a very limited number of combinations of sounds. The permitted sequence of sounds in a Japanese syllable has the following structure:

$$(C)(S) \ V \ (N/Q)$$

V could be any long or short realisation of the five Japanese vowels[1], C any of the consonants[2], including affricates[3], and S, one of the Japanese semivowels[4] (Murasaki 1982). The syllable-final N refers to the moraic nasal, which only occurs after a vowel and takes its quality either from the following consonantal context or results in a nasalized vowel of the same quality as the preceding one. One more phoneme is Q, which is a quantity phoneme, extending the length of the following consonant. This is similar to consonant gemination in Italian and Finnish.

The /hi/-syllable can be found at any position in a word, preceded by any vowel and the nasal /N/, but not by the gemination phoneme /Q/. /N/ or /Q/

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[1] They are /a, i, u, e, o/ and their long equivalents respectively.

[2] They are /p, b, t, d, k, g, s, m, n, h/.

[3] There is some discussion regarding which affricates have phonemic status and which ones do not. Some agreement exists that /tʃ/ and /dʒ/ are phonemes, whereas [ts] is considered an allophone of /t/.

[4] Semivowels are /y/ and /w/. They occur under certain vocalic and consonantal context conditions only.
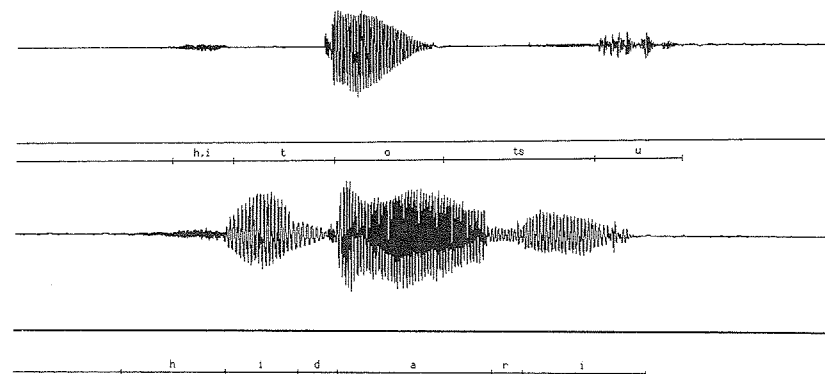
Figure 1. Wave forms of the Japanese words *hitotsu* 'one' and *hidari* 'left' showing different realisations of the initial /hi/ syllable, where the /i/ is deleted in the first example but present in the second.

may be added to the end of the syllable, and any permissible syllable may follow.

In intervocalic position or after /N/ any /h/-sound may be voiced through voicing assimilation. As Kawakami 1977 points out, this is not the case in careful speech and it was not found in the data for the experiment presented here.

Vowel devoicing

Vowel devoicing of Japanese high vowels in a CV syllable very often takes place under voiceless consonant conditions or in word final position. According to Han 1962, devoicing occurs preferentially on unaccented syllables, although Maekawa 1989 shows that devoicing is a feature which underlies active control from a physiological perspective and also indicates dialectal identity. There is considerable discussion as to whether the vowel is devoiced, or maybe even deleted, under such circumstances. As Beckman & Shoji 1984 point out, when looking at a waveform of this kind of syllable no spectral or temporal indicator seems to be observable to show the presence of a devoiced vowel (see also Figure 1). Ohso 1973 claims that as an allophonic variation vowels in this position are rather deleted than devoiced. For Vance 1977, deletion may occur in rapid speech in general, whereas Kawakami 1977 points out that this is the case only if preceded by

a fricative or affricate. In addition, Kawakami 1977 argues that in such cases coarticulatory effects remain present in the fricative. In their study on Japanese [ʃ] before unvoiced /i/ and /u/, Beckman & Shoji 1984 showed that listeners detect the intended vowel by making use of the colouring of the fricative.

However, in the data used for the acoustic analysis in this study, vowel deletion was almost always found when /hi/ occurred before unvoiced stops (Figure 1).

Sound quality
Kawakami 1977 claims that, in the case of vowel deletion in a /hi/-syllable, the phonetic value of the fricative /h/ is always [ç] and can never be replaced by a glottal fricative. Others say, on the other hand, that this may well appear instead of a palatal fricative like the "ich-Laut" in German in most environments (Sakuma 1929). A third claim is that before a high front vowel a palatal fricative [ç] is generally found (Amanuma et al. 1985).

/hi/ in German
The glottal fricative /h/ in German occurs in syllable initial position only, immediately followed by any German vowel. Its quality is very much influenced by the following vowel and acts, therefore, as its unvoiced counterpart. In the case of /hi/, the phonetic value would be [i̥]. /h/ is almost always voiced intervocalically and sometimes even word- or utterance-initially. However, the probability of finding a devoiced realization is highest when /hi/ is at the beginning of an utterance, opening a stressed syllable. At the end of a syllable introduced by /hi/, any permissible syllable-final structure may occur.

[ç] in German
The palatal fricative [ç] in German is known as the *ich-Laut*. Different phonological approaches classify it either as an allophone of /x/, in complementary distribution with the *ach-Laut* [x, χ], or as an independent phoneme, using also derived words as basic units for the phonological analysis (Werner 1972). (*ich-* and *ach-Laut* are written as *ch.*)

This fricative is restricted in its permissible context but may occur in initial or final positions of a syllable. In final position, the palatal fricative can be found immediately after front vowels, diphthongs targeting front vowels or after /l, r, n/. It may also be followed by /t/ in this position.

In syllable initial position [ç] may be followed by any vowel, but only a very limited number of examples where a non-front vowel follows the palatal fricative can be found. Those words are very often borrowed from Greek, such as *Echo* ([εço]) or *Eucharistie* ([ɔɪçaɣɪstʰi:]), where also a front vowel precedes. On the other hand, a morpheme boundary between the non-front nuclear vowel of the syllable and the fricative may be identified, as in *Verseuchung* 'contamination' ([fɐzɔɪçʊŋ]). In this case the quality of the fricative is also determined by the quality of the target vowel of the preceding diphthong. For *Eucharistie* this may also be true, although there is a morpheme boundary before the fricative. The unprefixed part of this word is related to the word *Charisma*, which is pronounced with word initial [ç] according to the pronunciation standard (*Duden Aussprachewörterbuch* 1990). An informal questionnaire among native speakers of Standard German on the other hand showed general agreement that it should be pronounced with the velar stop [k] initally. This is the case for most borrowings from Greek, which were pronounced with a fricative in that position originally (i.e. *Charakter*). In the case of *Eucharistie*, which is not a very common word in German, native speakers might not recognize the morpheme boundary. They might therefore make use of the same rules as for the word *Verseuchung*, which means, that the quality of the preceding diphthong target is responsible for the quality of the fricative rather than anything that follows. One should also take into consideration that diverse borrowings from Greek were taken over through different channels, e.g. through a transmitter language like Latin, in which any comparable fricative was unknown originally. The words *Eucharistie* and *Charisma*, which belong to a theologians vocabulary, might have been preserved in their original pronunciation, because of the theologians having studied Classical Greek as part of their professional education. Since the word *Charisma* and its related adjective respectively have been transposed to other settings in life, the awareness of its Greek origin has been lost, hence its pronunciation in the same way as for the word *Charakter* has been absorbed. In other Greek borrowings, the initial palatal fricative might be followed by a /t/, as in the word *chthonisch*. This is also a word of rare occurrence and rather familiar to a particular user group.

In some southern German dialects, word initial [ç] is unknown, although realized as such in word-medial but syllable initial position. In Swiss-German [ç] is always substituted by the *ach-Laut*.

Rules for the distribution of [ç] can be expressed as follows[5]:

$$[ç] / V_{[+front]} \quad \underline{\quad} \quad (t) \quad \$$$
$$[ç] / V C_{[l,n,r]} \quad \underline{\quad} \quad (t) \quad \$$$
$$[ç] / \$ \quad \underline{\quad} \quad (t/+) V$$

Data Analysis

For the spectral analysis two sets of data were used.

Japanese Data

For Japanese the data of four male and four female speakers – all professional announcers speaking standard Japanese – were used. This is part of the ATR Speech Database, which was recorded in a sound-proof recording booth. Of this set of 5240 common Japanese words, 229 words per speaker containing the syllable /hi/ were selected. They had been segmented and labelled previously and the labelled /h/-portion was used for the spectral analysis.

German Data

The German data was obtained from seven native German speakers with Standard German pronunciation (three female, four male) in Japan. It consists of connected speech, a set of sentences including a set of words with [ç] (54 words) and /hi/ (24 words) in diverse contexts, read by the subjects five times and recorded in a sound proof booth. The target sounds were labelled subsequently for the analysis procedure in such a way that they also contained transient information.

Formant Analysis

The material was digitized at a sampling rate of 12 kHz. The spectral analysis is based on an LPC analysis; formants are equivalent to the poles in the complex z-domain, their frequency corresponds to the arguments of the complex poles and their bandwidth to the inverse distance between pole location and unit circle. For root-finding a modified Newton-Raphson algorithm was used (Bairstow algorithm). Following this procedure, five formants between 0 and 6 kHz and their bandwidths were calculated in steps of 5 ms from the beginning to the end of each fricative, obtaining formant values for each time frame.

[5]$ denotes a syllable boundary and + a morpheme boundary

Since the use of the term *formant* varies among researchers, the following conditions were adopted for this study: the term *formant* was used in the sense that it denotes a peak of high occurrence in the frequency domain of calculated values by the above described method. The peak showing the lowest frequency value was called the first formant (F1), the peak with the next higher frequency value the second formant (F2) and so forth.

Only formant values with bandwidth below 500 Hz were included in the statistical calculations, because formant values with a higher bandwidth will have low amplitudes and are therefore not considered reliable.

Results and Discussions

The mean and the standard deviation of each formant of the fricative were calculated for its occurrence under the conditions described in the Introduction.

An unpaired t-test was used to compare the data. In the following presentation of the results, differences and similarities are referred to at a level of significance of 5%.

General comparison between Japanese /hi/, German [ç], [çi] and /hi/[6]

First of all, the fricatives in both languages under no further context conditions were examined (Table 1). This procedure was chosen to find out whether for such fricatives some unique spectral feature can be found, similar to the locus of other consonants (Fry 1979). In addition, the relation, similarities and dissimilarities between those fricatives was looked at within German and across the two languages. The German palatal fricative under the condition syllable initial and followed by /i/, which leads to [çi] (e.g. *Hierarchie*), was also chosen for this comparison, because of its phonotactic similarity with German and Japanese /hi/. For the case of G [ç] its occurrence in any other permissible context, vocalic and consonantal, was chosen (e.g. *Arche*).

F1:	G [ç]	= G /hi/	< G [çi]	< J /hi/[7]
F2:	G [ç]	= G [çi]	< G /hi/	< J /hi/
F3:	G [ç]	= G /hi/	< G [çi]	< J /hi/
F4:	J /hi/	< G [ç]	= G [çi]	< G /hi/
F5:	G [ç]	< G [çi]	< G /hi/	< J /hi/

[6]Hereafter, the capital letters G and J will be used to denote the affiliation of a sound or phoneme sequence to its original language (German or Japanese).

[7]= shows that both values on either side do *not* differ significantly, whereas > shows that the value on the left side is significantly higher, and for < the value on the left side is significantly lower.

Table 1. Mean (x̄), standard deviation (sd) and total number of time frames (n) for the formants (F) of the fricatives in German [ç], [çi] and /hi/ and Japanese /hi/. x̄ and sd values in kHz.

F		G [ç]	G [çi]	G /hi/	J /hi/
F1	x̄	0.71	0.78	0.72	0.89
F1	sd	0.3	0.28	0.41	0.46
F1	n	1796	151	603	3971
F2	x̄	2.2	2.21	2.34	2.37
F2	sd	0.22	0.2	0.33	0.3
F2	n	4419	355	1006	7102
F3	x̄	3.13	3.18	3.14	3.22
F3	sd	0.32	0.29	0.27	0.3
F3	n	13758	1182	1600	12483
F4	x̄	3.91	3.9	3.98	3.88
F4	sd	0.28	0.27	0.29	0.25
F4	n	13013	1271	1742	14185
F5	x̄	4.46	4.59	4.66	4.74
F5	sd	0.29	0.25	0.33	0.32
F5	n	9849	944	1277	9090

Differences and similarities vary for each formant. Therefore, under context-undifferentiated conditions, no clear one-to-one correspondence of the spectral structure between Japanese /hi/ and any German fricative of this set can be observed. In addition, there is no such correspondence within the German fricatives either (i.e. between the two palatal fricatives in different context or between the two fricatives followed by /i/). As a general tendency, one finds that the formant values of J /hi/ are higher than those of all the German fricatives in most cases, except for F4. On the other hand, G [ç] tends to have lower formant values than most of the other fricatives for F1, F2, F3 and F5 and can never be found highest. German /hi/, which very often has lower values too (F1 and F3), can also be found to have higher values than all other fricatives. G [ç] shows no difference from the fricative in G [çi] in two cases (F2 and F4). This is also the case with G [ç] and G /hi/ (F1 and F3), whereas J /hi/ is always different from any German fricative. G /hi/ and G [çi] never overlap.

Due to the general dissimilarity of the Japanese and German data, where the Japanese data show a strong tendency for almost all formants to be higher than the formants of the German data, the idea of a common locus for these fricatives must be rejected and the effects of language variation and speaker variation acknowledged. Therefore, for further comparisons, similarities in trends across the two languages will be focussed on.

Table 2. Mean (x̄), standard deviation (sd) and total number of time frames (n) for the formants (F) of the fricatives in German [ç] and /hi/ and Japanese /hi/, when [i] is phonetically realized and also when it is *not* phonetically realized. x̄ and sd values in kHz.

F		G [ç]	G /hi/	J /hi/ no [i]	J /hi/ with [i]
F1	x̄	0.71	0.72	0.98	0.83
F1	sd	0.3	0.41	0.36	0.51
F1	n	1796	603	1653	2318
F2	x̄	2.2	2.34	2.36	2.37
F2	sd	0.22	0.33	0.33	0.27
F2	n	4419	1006	3175	3927
F3	x̄	3.13	3.14	3.22	3.22
F3	sd	0.32	0.27	0.28	0.33
F3	n	13758	1600	5512	6971
F4	x̄	3.91	3.98	3.89	3.87
F4	sd	0.28	0.29	0.25	0.25
F4	n	13013	1742	6071	8114
F5	x̄	4.46	4.66	4.76	4.72
F5	sd	0.29	0.33	0.3	0.34
F5	n	9849	1277	3931	5159

Realized and dropped /i/ in Japanese /hi/

As mentioned in the Introduction, Kawakami 1977 points out that if the /hi/-syllable in Japanese does not carry a voiced vowel, the fricative has to be the palatal fricative [ç]. In the following comparison, the relationship between Japanese realizations and between the possible Japanese and German counterparts – G /hi/ if the J /hi/ contains a voiced vowel, and G [ç] if it does not contain a voiced vowel – will be described (see also Table 2).

F1:	J: /hi/ < /h/	G: /hi/ = [ç]
F2:	J: /hi/ = /h/	G: /hi/ > [ç]
F3:	J: /hi/ = /h/	G: /hi/ = [ç]
F4:	J: /hi/ < /h/	G: /hi/ > [ç]
F5:	J: /hi/ < /h/	G: /hi/ = [ç]

For the Japanese data, there is a tendency for the formants of the fricative in the unvoiced syllable to be higher. This stands very much in contrast to the German data, where the palatal fricative's formants are consistently lower than those of the glottal fricative in G /hi/. Therefore, we cannot assume a one-to-one-correspondence between the German palatal fricative [ç] and the fricative in the Japanese /hi/-syllable, when the /i/-part is dropped, on the one hand and between the glottal fricative in German /hi/ and in Japanese /hi/, in the case of the occurrence of a fully voiced vowel, on the other hand.

Table 3. Mean ($\bar{x}$), standard deviation (sd) and number of data for the formants (F) of the fricative in German [ç], syllable initial and syllable final and Japanese /hi/ in different word positions. $\bar{x}$ and sd values in kHz.

F		G [ç] initial	G [ç] final	J /hi/ as word	J /hi/ word initial	J /hi/ word medial	J /hi/ word final
F1	$\bar{x}$	0.71	0.71	0.81	0.98	0.7	0.75
F1	sd	0.32	0.29	0.37	0.38	0.56	0.53
F1	n	497	1299	57	2587	553	774
F2	$\bar{x}$	2.2	2.2	2.33	2.38	2.39	2.29
F2	sd	0.21	0.23	0.16	0.29	0.33	0.36
F2	n	1267	3125	138	5222	809	933
F3	$\bar{x}$	3.14	3.13	3.23	3.24	3.15	3.17
F3	sd	0.34	0.32	0.24	0.29	0.31	0.36
F3	n	4065	9623	191	9301	1377	1614
F4	$\bar{x}$	3.89	3.92	3.85	3.97	3.86	3.87
F4	sd	0.29	0.27	0.15	0.25	0.24	0.27
F4	n	3894	9164	242	10055	1787	2101
F5	$\bar{x}$	4.63	4.64	4.77	4.74	4.72	4.71
F5	sd	0.29	0.28	0.19	0.32	0.33	0.34
F5	n	2868	6981	123	6518	1150	1299

Table 4. Mean ($\bar{x}$), standard deviation (sd) and total number of time frames (n) for the formants (F) for German [ç] before /k/ and /t/ and the fricative in Japanese /hi/, when followed by /k/ or /t/ *and* when [i] is unvoiced. $\bar{x}$ and sd values in kHz.

F		G [çk]	G [çt]	J /hik/ without [i]	J /hit/ without [i]
F1	$\bar{x}$	0.74	0.67	0.98	0.99
F1	sd	0.34	0.25	0.36	0.35
F1	n	57	303	1019	325
F2	$\bar{x}$	2.2	2.22	2.36	2.42
F2	sd	0.19	0.2	0.28	0.28
F2	n	112	706	2047	696
F3	$\bar{x}$	3.16	3.14	3.22	3.24
F3	sd	0.33	0.32	0.28	0.28
F3	n	419	1956	3552	1250
F4	$\bar{x}$	3.94	3.93	3.87	3.93
F4	sd	0.29	0.26	0.25	0.25
F4	n	417	1859	3725	1533
F5	$\bar{x}$	4.62	4.64	4.74	4.75
F5	sd	0.28	0.28	0.31	0.3
F5	n	325	1432	2439	978

Position in word and syllable
In the following, the influence of the position of the J /hi/-syllable in a word and the position of the German palatal fricative [ç] in a syllable on the spectral structure will be examined (cf. also Table 3).

In Japanese, the /hi/ may occur in three different positions in a word: initial, medial and final. In addition, it may be a word by itself.

The palatal fricative [ç] in German may occur in any syllable of a word and at the beginning and at the end of a syllable (for further contextual restrictions see *[ç] in German* above).

F1:	J /hi/: m = f < w < i	G [ç]: i = f
F2:	J /hi/: f < w < i = m	G [ç]: i = f
F3:	J /hi/: m = f , f = w, m < w = i , f < i	G [ç]: i = f
F4:	J /hi/: f = m = w < i	G [ç]: i < f
F5:	J /hi/: f = m = w , m < i, f = m = i	G [ç]: i < f

There is some tendency for the fricative in Japanese /hi/ to differ as a function of its position in a word. Although the spectral structure of J /hi/ in final position is very similar to the one in medial position, it receives some kind of "dark colouring" through F2, where the value differs strongly from the value in medial position. Here, it equals the value of the fricative in initial J /hi/. Apart from that, most of the formant values of initial J /hi/ are considerably higher. The J /hi/-syllable as a word seems to inherit both

positional properties, final and initial, because it shows intermediate formant values for lower formants and overlaps in its values with the values of the fricative in non-independent J /hi/ in both initial and final positions.

The difference of the values of F4 in German [ç] is not as strong as the differences for the Japanese data. In addition, the lower value is found in initial position and not syllable final. This contrasts strongly with the Japanese data, where in initial position the values are usually higher.

Consonantal context
Contextual effects will be examined in this section. For such an examination, a context common to both languages was chosen. This is the case when a fricative is followed by a voiceless plosive. As mentioned earlier, the vowel of the J /hi/-syllable is almost always dropped when a voiceless plosive follows. Therefore, the sequences J /hik/ and J /hit/, containing no voiced vowel, were chosen (i.e. *hito* 'person' and *hikari* 'light'). It should be noticed, that in Japanese, there is always a syllable boundary before the voiceless plosive. For German, the sequences [çk] and [çt] were used for this comparison, where a syllable boundary, and sometimes also a morpheme boundary, can be found between the palatal fricative and the velar plosive (i.e. *Pünkt+lich+keit* 'punctuality'). This is not always the case for G [çt] (i.e. *Reich+tum* 'wealth' vs. *Recht+s+anwalt* 'lawyer').

F1:	J /hik/ = J /hit/	G [çk] = G [çt]
F2:	J /hik/ < J /hit/	G [çk] = G [çt]
F3:	J /hik/ = J /hit/	G [çk] = G [çt]
F4:	J /hik/ < J /hit/	G [çk] = G [çt]
F5:	J /hik/ = J /hit/	G [çk] = G [çt]

The Japanese and the German data show clear differences. The German data are homogeneous across contexts, whereas the Japanese data show context sensitivity for two formants. This contrast signifies the different status of the fricative for each language.

Vocalic context
To investigate possible overlapping of context effects through vowels of both languages, phonotactically similar conditions in Japanese and German were again chosen. The utterance- and word-initial /hi/-syllable in German and Japanese, the latter containing a voiced vowel in its phonetic realization, were used for this procedure. Here, the vowel of the next syllable (V2) served as the possible factor of variability. In most cases, there is at least one consonant between the /hi/-syllable and the vowel of the next syllable in both languages:

$$\# \ /hi/ \ (C_n) \ V2 \ [8]$$

Before describing the results, a brief explanation of the symbols used in Table 5b is necessary. What is transcribed as /ɐ/, refers to the centralized vowel, which is the pronunciation for the syllable final /r/ immediately after a vowel or the *er*-sequence in an unstressed syllable, as in the name *Peter*. /ɛ/ refers to the short front and open-mid vowel, which lies close to the third cardinal vowel [ɛ], as in the German word *Pech*. /ə/ stands for the centralized vowel schwa, which is more closed than /ɐ/.

F1:	/i/ = /u/ = /e/ < /a/ < /o/
F2:	/i/ < /u/ = /a/ = /e/ < /o/
F3:	/u/ < /i/ ≤ /o/ ≤ /a/ ≤ /e/ [9]
F4:	/u/ < /i/ ≤ /a/ ≤ /o/ ≤ /e/
F5:	/u/ < /i/ ≤ /e/ ≤ /o/ ≤ /a/

For the Japanese data, there is a tendency for all formants of the fricative in the context of the following closed vowels /u/ and /i/ to be lower than for almost all other vowel contexts. The other vowels show no consistent

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[8] The symbol # denotes the beginning of a word (for Japanese) or an utterance (for German), *n* the number of permissible cluster elements in a consonant cluster
[9] The symbols ≤ and ≥ stand for the fact that the neighbouring vowels on this scale have equal influence on the fricative, but different influence on the next-neighbouring vowel.

Table 5a. Mean (x̄), standard deviation (sd) and total number of time frames (n) for the formant (F) of the fricative in Japanese /hi/, word initial and in dependency of the following vowel. x̄ and sd values in kHz.

F		J /hi/ before /a/	J /hi/ before /i/	J /hi/ before /u/	J /hi/ before /e/	J /hi/ before /o/
F1	x̄	0.98	0.94	0.94	0.94	1.05
F1	sd	0.36	0.35	0.39	0.42	0.41
F1	n	778	563	383	171	659
F2	x̄	2.38	2.34	2.37	2.38	2.42
F2	sd	0.29	0.27	0.28	0.29	0.31
F2	n	1566	1210	723	352	1323
F3	x̄	3.26	3.24	3.2	3.27	3.25
F3	sd	0.3	0.29	0.28	0.29	0.3
F3	n	2746	2050	1408	637	2329
F4	x̄	3.89	3.88	3.86	3.91	3.9
F4	sd	0.24	0.23	0.26	0.25	0.26
F4	n	3082	2092	1448	761	2516
F5	x̄	4.77	4.73	4.7	4.74	4.76
F5	sd	0.3	0.32	0.32	0.32	0.33
F5	n	1993	1313	1019	445	1656

influence in any particular order on any formant, but the values are almost always higher than in the case of the closed vowels. Anticipatory liprounding is a well-known coarticulatory effect and according to Bell-Berti & Harris 1979 liprounding activities may be observed up to 250 ms prior to the onset of the rounded vowel. It is interesting, that the only rounded vowel in Japanese, the /o/, has the opposite effect on the fricative to what one would expect: according to Fry 1979 lip-rounding causes a lower F2 value in the vowel itself, but in this study it appeared that possible anticipatory lip-rounding during the articulation of the fricative is accompanied by a higher F2 value compared to the cases where unrounded vowels are in V2-position.

F1:	/ə/ < /ɐ/ = /ɛ/
F2:	/ə/ < /ɐ/ = /ɛ/
F3:	/ə/ = /ɐ/ < /ɛ/
F4:	/ə/ = /ɐ/ < /ɛ/
F5:	/ə/ = /ɐ/ = /ɛ/

In German, the central vowel /ə/ shows influence, in that the formant value of the fricative is lower than for the other vowels in most cases. The more open central vowel /ɐ/ shows similar effects to /e/ on the fricative for the lower formants (F1, F2), but for F3 and F4 it is similar to the other central vowel /ə/.

Table 5b. Mean (x̄), standard deviation (sd) and total number of time frames(n) for the formant (F) of the fricative in German /hi/, utterance initial and in dependency of the following vowel. x̄ and sd values in kHz.

F		G /hi/ before /ɐ/	G /hi/ before /e/	G /hi/ before /ə/
F1	x̄	0.72	0.73	0.64
F1	sd	0.42	0.35	0.32
F1	n	93	124	37
F2	x̄	2.37	2.33	2.12
F2	sd	0.36	0.3	0.38
F2	n	184	148	49
F3	x̄	3.12	3.18	3.09
F3	sd	0.26	0.19	0.2
F3	n	305	257	71
F4	x̄	3.96	4.03	3.91
F4	sd	0.26	0.27	0.26
F4	n	397	316	60
F5	x̄	4.71	4.69	4.65
F5	sd	0.29	0.38	0.26
F5	n	271	180	40

In Japanese, there seems to be a general open/close influence on the fricative, whereas in German this seems to be the case for lower formants only (F1, F2). For the higher formants (F3, F4), an effect seems toz become apparent, where the central vowels /ɐ/ and /ə/ cause lower formant values than /e/.

A general effect is that different formant values of the fricative under varying vocalic context can be observed. An influence of the vowel following the /hi/-syllable (V2) on its fricative can therefore be assumed in both languages. Since non-identical features trigger those effects in the two languages, one has to assume language-specific properties.

Conclusions

Three different views of the phonetic classification of the fricative in the Japanese /hi/-syllable were presented in the Introduction and in the section on the distribution of */hi/ in Japanese* and contrasted with the classification of phonetically related German fricatives. These alternative points of view vary between classifying it as a palatal fricative [ç] before a high front vowel, as a glottal fricative and as a palatal fricative in the case of an unvoiced vowel in the /hi/-syllable before an unvoiced stop. In German, on the other hand, the palatal fricative [ç] and the glottal fricative [h] belong to different phonemic classes.

This study showed five acoustic comparisons of the acoustic structure of the Japanese and German data under different contextual conditions (see Introduction).

A general finding is that there is no direct correspondence between the fricative in J /hi/ and either of the two German fricatives for any of the formants measured. A spectral difference in the case of the two variations of J /hi/ can be identified and this is also true for the two German fricatives looked at here, however, the way of distinction differs between the two languages. Any auditory impression of difference for the fricative in J /hi/ if [i] is dropped compared to the version when [i] is phonetically complete can only be caused by a different factor than the acoustic distinction between German /hi/ and [ç]. One reason for this effect might be that in Japanese a [ç] in the /hi/-syllable lies further back than the German [ç], as Hattori 1984 points out from an articulatory perspective.

Positioning is another factor that shows differences between the two languages. In Japanese, the position of the syllable in a word has strong influence on the spectral structure of the fricative. German does not show such an effect, the spectral structure varying only very little for the palatal fricative [ç] in syllable initial or syllable final position.

Context effects due to neighbouring consonants also show very different results for the two languages. For German, no clear context effect is observable, contrary to the case for Japanese. Vowel influence can be identified in both languages. The factors responsible for this influence differ for each language: liprounding and closeness vs. openness both trigger variation in Japanese, whereas the latter factor has only partial influence in German, where additional effects due to vowel centralization appear.

Acknowledgement

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The Syntax of Three Japanese Postpositions

Mikael Vinka

0. Introduction

This article presents a descriptive analysis of the Japanese postpositions *e, ni* and *de*. These postpositions can serve a large number of functions, but I will concentrate on the instances where they denote LOCATIVE (*ni* and *de*), GOAL (*ni* and *e*) and INSTRUMENT (*de*).

The following study is conducted within the frame of the Government and Binding approach to linguistic inquiry. As concerns Japanese phrase structure, I use the model presented in Takano 1991, where it is assumed that Japanese is a configurational language, rather than a non-configurational one.

In accordance with Miyagawa 1989 among others, I consider the case particles *ga* (NOM), *o* (ACC) as clitics, whereas the particles to be treated below are considered as postpositions heading PPs. (See Miyagawa 1989: chapter 1 for a discussion.)

In section 1, I will introduce the postpositions treated in this paper through traditional grammar. There are two reasons for doing so. First, it gives a reader who does not know Japanese an opportunity to familiarize himself with Japanese postpositions and secondly, most of the forthcoming discussion has its basis in the observations made by traditional grammarians.

In 2 the working hypothesis of the paper is outlined. 3 discusses the licensing of locative phrases and constitutes the core of the paper. 4 treats directionals and 5 deals with instrumentals. Much of the reasoning in 4 and 5 follows from 3.

Finally, in section 6 some concluding remarks are given.