

Palatal Fricatives in German Revisited: Durational Aspects

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ABSTRACT

In German, two fricatives of similar articulatory character can be found, which belong to different phonological categories. One of them, the palatal fricative [ç] is a member of the ich-ach-Laut paradigm, whereas the other one is a member of the class of glottal fricatives /h/, but is palatalised before /i/. Following on after an earlier investigation of spectral differences between these two sounds, the present study will focus on durational aspects which possibly distinguish one sound from the other.

INTRODUCTION

In describing the German consonants, two similar fricatives can be detected, of which both are produced at a palatal place of articulation. The palatal fricative [ç] is known as the ich-Laut and is an allophone of the phonemic class /x/, together with the ach-Laut [x, χ]. The phonemically distinct sound is a member of the class of glottal fricatives /h/, but is palatalised in /i/-context¹.

The palatal fricative [ç] underlies certain contextual conditions but may occur in both, onset and coda of a syllable. In coda position it is more restricted in its permissible context, but may appear after a front vowel and a diphthong, targeting a front vowel, or in a consonant cluster after /l,r,n/ and before /t/. The glottal fricative /h/ appears in syllable initial position only, immediately followed by a vowel. There is a strong tendency for this fricative to be voiced intervocally, and sometimes even in word or utterance initial position. However, devoiced realisations are most likely to be found at the beginning of an utterance, opening a stressed syllable.

To investigate possible differences in the production of these two sounds, a comparison of their spectral nature was undertaken previously (Tronnier, 1993). This comparison showed that for the glottal but palatalised fricative [j] the second and the third formants lie closer together than for [ç], which, when applying Jassems intensity values (1968), would result in a faster intensity increase from the second to the third formant for the case of [j]. Another parameter in describing contrasting characteristics of these two sounds is the aspect of duration. In the following, an analysis of the two sounds in that respect will be presented. Two comparisons were undertaken: one shows the duration of the two sounds in any broader context, whereas the second one examines the effect of prominence of the respective syllable on the sound duration of the sound.

MATERIAL AND DATA ANALYSIS

The speech data were obtained from four native German speakers with Standard German pronunciation. The material consists of connected read speech, containing a set of

¹ The glottal fricative /h/ which is palatalised before /i/ will henceforth be written as [j], since it can be described as the devoiced counterpart of the vowel (cf. Kancko & Neycr, 1984 or Tronnier, 1993).

sentences, including a set of words with the syllable initial sequences [çi] and [ji]. The set of sentences was read five times by each subject and recorded in a sound proof booth. Using the ESPS/Waves+ package, the target sounds were auditorily, visually and manually labelled and the duration of the labelled portion calculated. The data used for further statistical analysis does not contain any voiced realisation of the fricatives.

The data were grouped according to the investigated conditions and the mean and standard deviation for each condition per subject were calculated. For the statistical comparisons a two-factor analysis of variance (ANOVA) was used.

NO-CONTEXT CONDITION

This part of the present study shows the durational aspects of the two sounds under no additional broader context condition. As pointed out earlier, they must occur in syllable initial position and before /i/. The general tendency is focused on rather than on the absolute durational value of the sounds. The results of each individual subject will be compared to the results of the other subjects.

Table 1. The average duration (in ms) and standard deviation for each fricative and each subject.

		Subj A	Subj B	Subj C	Subj D
[ç]	n	13	19	14	21
	mean	99.6	107.9	111.5	96.0
	stdev	33.1	22.1	21.3	11.2
[j]	n	30	24	45	18
	mean	65.4	74.2	77.3	57.7
	stdev	24.3	22.5	19.3	16.2

The results show that the realisation of the palatal fricative [ç] is longer than for the realisation of the palatalised fricative [j] for each subject. The ANOVA-test shows (see Appendix Table 3) that these findings are highly significant ($p < 0.01$), whereas the variation between the subjects is, although significant not quite as strong ($0.01 < p < 0.05$). One can say furthermore that the palatalised glottal fricative [j] is between 30-40% shorter than the palatal fricative [ç].

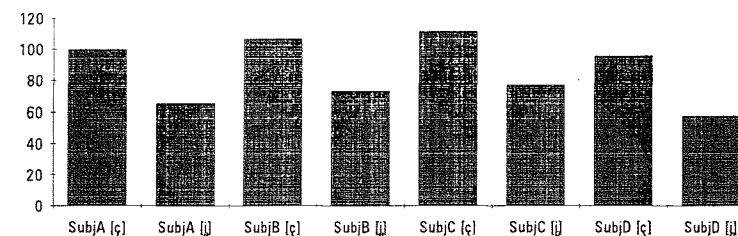


Figure 1. Average duration of [ç] and [j] per subject in [ms].

INFLUENCE OF DIFFERENT DEGREES OF PROMINENCE

In this section, the influence of varying degrees of prominence on the duration of the fricative in syllable initial position will be dealt with. The palatalised glottal fricative [j] can be found uttered with three different degrees of prominence: *stressed*, *unstressed* and *neutral*. The term *stressed* refers to a syllable with lexical stress in either a polysyllabic word or a monosyllabic word, set in focus when produced. *Unstressed* relates to a

lexically unstressed syllable in a polysyllabic word. The third degree, *neutral*, points to those realisations, which are either lexically stressed, but are in a weaker position, due to focussed neighbouring words, leading to weaker prominence, or monosyllabic words which are not in focus.

Since the words containing a syllable initial palatal fricative [ç] consist of polysyllabic words only, the category *neutral* does not apply here, thereby resulting in only two degrees of prominence, *stressed* and *unstressed*.

Table 2. The average duration (in ms) and standard deviation for each fricative and each subject under different prominence conditions: stressed (*pro-*), unstressed (*pro0*) and neutral (*pro0*).

[j]	Subj A	Subj B	Subj C	Subj D	[ç]	Subj A	Subj B	Subj C	Subj D
<i>pro+</i>	n	15	11	29	13	7	9	3	6
	mean	75.6	81.3	82.9	55.2	125.9	122.8	128.3	108.7
	stdev	25.0	21.6	18.9	14.5	19.0	11.4	9.2	5.5
<i>pro-</i>	n	7	8	16	3	6	11	11	21
	mean	49.6	70.0	81.9	70.2	69.0	93.6	106.9	96.0
	stdev	14.9	28.1	19	20.9	10.1	20.1	21.6	11.2
<i>pro0</i>	n	6	3	4	2				
	mean	50	69.3	65.5	54.4				
	stdev	13.6	8.4	3.7					

The results show that for the palatal fricative [ç], the duration of the variant found in a stressed syllable is consistently longer than the unstressed counterpart. The difference is highly significant ($p < 0.01$, Table 5) and the subjects act in the same way. However, the degree of shortening of the unstressed version varies between subjects from 45% (subj A) to 12% (subj D). The results are not quite the same for [j], where there is a tendency for the stressed version to have longer duration, but this is not consistent over all subjects (e.g. subj. D). The third factor, *neutral*, shows no consistent difference between the subjects either. Although one can find it to be about 20% shorter than the fricative in unstressed position for two subjects (C and D), its length is more or less the same for the other two subjects. Apart from the special case, Subject D, the fricative in neutral position is shorter than in stressed position, as is true for the unstressed data. For Subject D, the length of the neutral fricative is more or less the same as the length of the stressed one.

In the following, a cross-sound and cross-prominence-level investigation will be described. As reported above, the palatalised fricative [j] is generally shorter than the palatal fricative [ç]. Thereafter we have seen, that the unstressed version of [ç] is shorter than the stressed one, and there is a tendency - although not quite that strong - for the [j] to behave in the same way. The question pursued here is, whether unstressed [ç] has the same duration as stressed [j]. The ANOVA in Table 6 shows that this is not the case. And as is apparent from Table 2, the duration of the unstressed [ç] is still longer than for stressed [j].

CONCLUSIONS

The investigation presented showed durational characteristics of the palatal fricative [ç] and the palatalised glottal fricative [j] in German in relation to each other. It was observed that, under no further context specification, [j] was about 30-40% shorter than [ç]. The clear influence of the degree of prominence on the duration of [ç], which showed that [ç] is longer in a stressed syllable than in an unstressed syllable, can not be transferred to that extent to [j]. For [j] and the third category with neutral stress, the

subjects do not behave in the same way, in that they produce [j] either shorter (two subjects) or with the same length as the unstressed complement (two subjects). The assumption that the duration of unstressed [ç] equals the duration of stressed [j] cannot be maintained, since [j] is shorter even under this particular prominence condition.

APPENDIX

Table 3. ANOVA of the no-context condition.

Source	SS	df	MS	F	p
Between sounds	45.8	1	45.8	101.1	< 0.01
Between subjects	4.4	3	1.5	3.27	< 0.05
Interaction	4.2	3	1.4	3.11	< 0.05
Residual	82.4	182	0.45		
Total	136.8	189			

Table 4. ANOVA for [j] in a syllable with different degree of prominence.

Source	SS	df	MS	F	p
Between prominence level	4.8	2	2.4	6.1	< 0.01
Between subjects	7.1	3	2.4	6.1	< 0.01
Interaction	3.5	6	0.6	1.52	> 0.05
Residual	40.7	105	0.4		
Total	56.2	116			

Table 5. ANOVA for [ç] in a syllable with different degree of prominence.

Source	SS	df	MS	F	p
Between prominence level	11.5	1	11.5	49.7	< 0.01
Between subjects	1.9	3	0.6	2.7	< 0.05
Interaction	5.0	3	1.7	7.52	< 0.01
Residual	15.2	66	0.2		
Total	33.7	73			

Table 6. ANOVA of the palatal fricative [ç] in unstressed position and the palatalised glottal fricative [j] in stressed position.

Source	SS	df	MS	F	p
Between sounds/prom	10.1	1	10.1	29.12	< 0.01
Between subjects	4.1	3	1.37	3.94	< 0.05
Interaction	8.8	3	2.93	8.46	< 0.01
Residual	37.8	109	0.35		
Total	60.7	116			

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