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Teenagers' pronunciation of Norwegian /ç/ and /ʃ/

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Abstract

This study investigates some acoustic characteristics of Norwegian /ç/ and /ʃ/ spoken by teenagers. Parameters measured were duration and relative amplitude of the fricative and three spectral properties, viz. lower and upper boundary and peak frequency. The results show that the two fricatives are mainly distinguished by their spectra. For younger speakers with a merged pronunciation the neutralization is not wholly complete.

1 Introduction

During the last few decades, the pronunciation of the Norwegian speech sounds /ç/ and /ʃ/ has drawn the attention of linguists as well as the public. These two sounds represent phonemes that can be used to distinguish between members of minimal pairs like *kjenne* (/"çɛnə/; *to know*) and *skjenne* (/"ʃɛnə/; *to scold*). Among younger speakers, however, there seems to be a growing tendency to substitute the canonical palatal with the postalveolar fricative. Thus, both *kjenne* and *skjenne* can often be heard pronounced as ["ʃɛnːə] by children and teenagers. From an experiment with three 13 year-old girls, Andrésen (1980) concluded that they were able to both differentiate between the two speech sounds in production and to a large degree distinguish them in perception. Other studies looked into the pronunciation behaviour of larger groups of subjects by means of auditory analysis (Johannessen, 1983; Nesse, 1994; Papazian, 1994). Since none of these studies made acoustical analyses of the collected speech material, the present investigation tries to shed some light on the acoustic properties of /ç/ and /ʃ/. Specifically, two questions will be addressed:

- What are the acoustic characteristics used to distinguish between canonical /ç/ and /ʃ/?
- In the case of merged pronunciation: Is there a complete neutralization of the distinction or are there still some differences between realizations of the two phonemes?

2 Method

2.1 Speech material

The speech material used for the present study was selected from the recordings made by Dalbakken (1996) for her Master thesis. In that investigation, she evaluated speech tokens containing the phonemes /ç/ and /ʃ/ produced by pupils from primary and secondary schools and classified them auditorily as [ç] or [ʃ]. The speech material consisted of four parts: an interview with the subject by the author about a film, a short history containing words with /ç/ and /ʃ/, eight minimal pairs (like *kjenne* and *skjenne*) embedded in sentence-context and the same eight pairs spoken in isolation. Since the latter two conditions were more controlled, these were selected for the present study. Due to factors like hesitations, mispronunciations, etc. in the readings, some minimal pairs had to be discarded for a number of subjects.

2.2 Subjects

In total, a group of 85 subjects was recorded by Dalbakken (1996). This group comprised 40 pupils aged 12-13 (from two different primary schools) and 45 pupils 16-17 years old (from two different secondary schools). Henceforth, their ages will be indicated as 12 and 16 years, respectively.

For the present study, nine subjects realizing both /ç/ and /ʃ/ as [ʃ] were selected (three female and three male aged 12 and one female and two male aged 16). Selection criterion was the consistency in pronunciation as indicated by the number of minimal pairs realized with merged pronunciation. To compare their pronunciation with canonical /ç/-/ʃ/, the same number of speakers who had the /ç/-/ʃ/ distinction with the same age and gender distribution was chosen.

2.3 Measurements

Using the Signalyze program (Keller 1994), the following fricative parameters were measured:

(a) duration
(b) relative r.m.s. amplitude, defined as the difference between the peak amplitude of the fricative and the peak amplitude of the following vowel
(c) three frequency characteristics of the fricative's long-term averaged spectrum, viz.
  - the frequency belonging to the maximum amplitude (*peak*)
  - the lower boundary (*left edge*) frequency measured at an amplitude of 12dB below the maximum (12 dB being chosen as the best operational value)
  - the upper boundary (*right edge*) frequency measured at an amplitude of 12dB below the maximum

(see Figure 1 for an illustration). In all cases where no unambiguous quantitative criteria were available (e.g. with broad spectral speaks), closest approximations were determined by visual inspection.

3 Results

3.1 Duration

The results from the duration measurements showed that fricative duration hardly plays any role in the /ç/-/ʃ/ distinction. For speakers distinguishing between the two phonemes, in isolated words the postalveolar is merely 15 ms longer ($t(67)= -2.759$, $p= .007$). In sentence context there are no systematic differences at all (mean difference 0 ms). For the subjects who did not distinguish between /ç/-/ʃ/, no significant differences between [ʃ] (canonical /ç/) and [ʃ] (canonical /ʃ/) were reported (mean differences of 1 ms for isolated words and -6 ms for context-embedded words).

In contrast to the absence of any consistent effects of place of articulation, sentence context has a systematic effect on fricative duration. As could be expected, durations are shorter in sentence-embedded words. According to an ANOVA with place of articulation, context, age and pronunciation (canonical vs. merged) as factors, the effect of context is significant ($F(1, 234)= 41{,}397$; $p< .001$), while there are no significant interactions of this factor with age or pronunciation.

3.2 Amplitude

It emerged from the data that in canonical pronunciation the relative r.m.s. amplitude of /ʃ/ is generally somewhat higher than for /ç/. For the isolated word condition, a mean difference of 2.4 dB was found ($t(67)= 6.123$, $p< .001$), whereas the difference for the sentence condition amounted to 1.6 dB ($t(67)= 4.446$, $p< .001$).

In the light of the already small amplitude differences found for distinct pronunciation it is not surprising that the effects for speakers with merged pronunciation were even smaller. The mean differences were 0.5 dB for isolated words and 1.0 dB for context-embedded words (only in the latter case statistically significant; $t(55)= 2.567$; $p= .013$).

3.3 Spectral frequencies

This section presents the results from the frequency measurements for the sentence context condition (the results for the isolated words being very similar). As appears from Table 1, for the speakers with canonical pronunciation the spectral properties of /ç/-/ʃ/ differ systematically. With the exception of the upper boundary (*right edge*) for the 16 years old, the left edge as well as the peak and the right edge values are significantly lower for /ʃ/ than for /ç/ (cf. Figure 1).

As can further be seen from the table, the fricative spectra for the speakers with merged pronunciation show the same tendency, though to a lesser degree. Only the 250 Hz difference between [ʃ] (canonical /ç/) and [ʃ] (canonical /ʃ/) measured for the 12 year-old, however, reached statistical significance.

Table 1. Position of spectral peak and left and right edges (at –12dB below amplitude peak). Differences between /ʃ/ and /ç/ (mean and standard deviation) in Hz for context-embedded words spoken by subjects having distinct or merged pronunciation. Levels of significance (t-tests for correlated samples): * p≤ .05; ** p≤ .01; *** p≤ .001.

		sentence context								
pron.	age	left edge	sign.	n	peak	sign.	n	right edge	sign.	n
distinct	12	-557 (817)	***	46	-673 (1927)	*	46	-2194 (2149)	***	46
	16	-1114 (1036)	***	24	-1652 (2539)	**	24	29 (1824)	n.s.	24
merged	12	-250 (452)	***	43	-343 (1830)	n.s.	43	-11 (2172)	n.s.	43
	16	-121 (518)	n.s.	13	-174 (1747)	n.s.	13	-836 (2589)	n.s.	13

4 Conclusions

Previous investigations of the realization of the /ç/ - /ʃ/ distinction in Norwegian have only been based on results obtained by auditory analysis. The goal of the present study was to supplement these impressionistic observations with acoustic measurements.

For the speakers of both age categories (12 and 16) it could be shown that fricative duration is not used as a parameter to distinguish between the two phonemes. Also, the relative r.m.s. amplitude turned out to be of minor importance for the distinction. But, from the parameters investigated, the fricatives' spectral properties appeared to play a major role. The lower and peak frequencies of the spectra were found to be consistently lower for /ʃ/ compared with /ç/. The results for the upper boundary were somewhat less consistent, this boundary being significantly lower only for the 12 year-old speakers. This might be due to the influence of noise in the recordings, which were made in classrooms with varying degrees of reverberation and background noise.

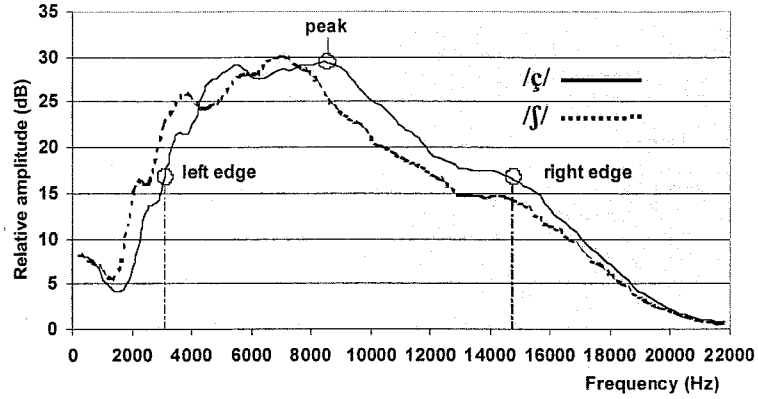

Figure 1. Long-term averaged fricative spectra of /ç/ and /ʃ/ spoken by speakers aged 12 having canonical pronunciation (3 males and 3 females; sentence condition; n= 46). Indicated are left and right edge and peak frequencies as measured in individual spectra.

In congruence with impressionistic observations, with the speakers having merged pronunciation the /ç/-/ʃ/ distinction was to a large degree neutralized. At the same time, however, the neutralization was not complete: This category of speakers had a general tendency to produce their [ʃ] (canonical /ʃ/) with lower frequency values than their [ʃ] (canonical /ç/). The fact that this tendency was less marked for the 16 year-old subjects seems to indicate that the merging for speakers of this age category is well-established. On the other hand, it should be kept in mind that neutralization is far less frequent for these speakers.

Acknowledgement

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