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Vowel Reduction in Skolt Saami in Connected Speech

1. Introduction

In a recent pilot study on vowel reduction in Skolt Saami (McRobbie-Utasi, forthcoming) the acoustic characteristics of second syllabic word-final reduced vowels were examined. In that study it was stated that the Sevettijärvi and the Paatsjoki-Pettsamo dialects represent different stages of vowel reduction in terms of the durational and spectral realizations of the vowel in question, the former dialect being more advanced in terms of the *short unstressed vowel > reduced vowel > vowel drop* development. Because the above-mentioned study was based on recordings made by only two speakers – each representing one of the dialects – the validity of the conclusions presented there needs to be tested by examining further evidence of the acoustic characteristic of the word-final reduced vowel produced by additional speakers. The fact that the controlled experiment was carried out in a laboratory setting (see details in McRobbie-Utasi 1999, forthcoming) may have affected the degree of vowel reduction. This latter possibility was chosen as a point of departure for a follow-up study of vowel reduction that will be reported on in this paper. Accordingly, audio recordings of connected speech produced by the same Paatsjoki-Petsamo speaker were analyzed with the objective of identifying the durational and spectral properties of word-final reduced vowels. A description of these acoustic characteristics of vowel reduction will be given, followed by a comparison with the results reported in the pilot study indicated above. It will be shown that (i) the number of instances of vowel drop was significantly higher than during the course of the controlled experiment, (ii) durational changes exceeded those observed in connection with the laboratory setting, (iii) there was little change in terms of spectral characteristics in comparison with those registered during the course of the controlled experiment, and (iv) a significant number of word-final vowels were produced as voiceless vowels in connected speech -- a striking difference from observations based on the controlled experiment.

2. The acoustic properties of the reduced vowel

The material analyzed in this study is based on recordings made by the same female speaker (54 years old at the time of recording) who participated a year later in the laboratory experiment referred to above. For the purpose of the present study 180 minutes of tape recordings (conversations with family members and friends) were examined. These conversations were recorded on four occasions in the house of the speaker. Disyllabics where word-final vowel reduction could be expected numbered 489.[1] Durational and spectral analysis of the data were undertaken by using the Praat software, Version 3.8ß.

2.1 Occurrences of vowel drop

In the pilot study it was found that the speaker of the Paatsjoki-Pettsamo dialect rarely employed the vowel drop process so characteristic of the Sevettijärvi dialect.[2] Occurrences of vowel drop, however, were evident in her spontaneous conversation. Although the number of vowel drop instances may still be considered low (21%), the increase from the 6% observed in the material obtained in the controlled experiment should be considered significant.

When examining the occurrences of vowel drop in relation to the position of the relevant disyllabics in the sentence, the pattern emerging shows that when disyllabics are in sentence and/or paragraph-final positions, the vowel is most of the time retained (82%). Possible interpretations of this fact will be indicated in Section 3 below.

2.2 Durational changes

In Skolt Saami, second syllabic vowels have an average duration of 87 msec (McRobbie-Utasi 1999). With the exception of historically contracted vowels,[3] in this position the vowels are unstressed and in open syllables they may be dropped, or, as is more common in the Petsamo-Pattsjoki dialect, undergo vowel reduction.

[1] The number of disyllabics analyzed here is identical to the total of disyllabics examined in the controlled experiment (McRobbie-Utasi, forthcoming).
[2] The recently developed Skolt Saami orthography based on the Sevettijärvi dialect reflects the absence of the second syllabic vowel (Korhonen *et al*.)
[3] Historically contracted vowels have secondary stress (Korhonen 1971, 1975). The optional vowel drop or vowel reduction rule does not apply to the development of these vowels.

Durational changes associated with vowel reduction are more evident in spontaneous conversations then during the course of the controlled experiment. In McRobbie-Utasi (forthcoming) it was reported that the average duration of the reduced vowel was 62 msec (59 msec for the stem vowel /e/ and 65 msec for the two back stem vowels respectively). In the spontaneous speaking mode the average duration of the reduced vowel was 51 msec (53 msec for the stem vowel /e/ and 49 msec for the two back stem vowels respectively). The durational decrease averaged 36 msec, in relation to the 87 msec reference duration (see above) in spontaneous speech, while the durational decrease averaged 25 msec in the controlled experiment.

The manifestations of durational decrease appear to represent different degrees in relation to the position of the disyllabic in the sentence and/or the paragraph. The pattern that emerges coincides with the one referred to in connection with the instances of vowel drop. Vowels in disyllabics occupying these boundary positions undergo a lesser degree of durational decrease than those in sentence initial or medial positions. This tendency will be discussed below in Section 3.

2.3 Spectral characteristics of the reduced vowels

According to measurements reported in connection with the controlled experiment, the vowels under investigation displayed three different formant frequency patterns: (i) reduced vowels may approximate the neutral position (frequency values averaging F1 = 600Hz, F2 = 1650Hz and F3 = 2700 Hz), (ii) reduced vowels may be realized as a less centralized (more frontal), upper-mid to high position (average frequency values F1 = 350 Hz, F2 = 2765 Hz and F3 = 3375 Hz), and (iii) reduced vowels may be realized at a more back, lower-mid position (frequency values averaging F1 = 665 Hz, F2 = 1680 Hz and F3 = 2720 Hz). As mentioned above, there was little change observed in terms of spectral characteristics in comparison with those associated with vowels examined in the laboratory setting. Accordingly, the number of instances when neutral vowels were produced were relatively few (14%); disyllabics with the stem vowel /e/ when reduced were realized with formant frequency distribution similar to the values shown above, i.e., averaging F1 = 365 Hz, F2 = 2650 Hz and F3 = 3300 Hz; the realizations of the two back stem vowels averaged F1 = 660Hz, F2 = 1610 Hz and F3 = 2670 Hz.

It appears, then, that in the production of reduced vowels by this speaker durational decrease plays a more prominent role. It was stated in the previous study that sporadic occurrence of schwa-like vowels may be a consequence of the relatively small degree of durational decrease (McRobbi-Utasi, forthcoming). In the present study, while a greater degree of durational change was observed, formant frequency patterns (see above) do not appear to change in proportion to the degree of durational decrease.

2.4 Voiceless vowels

It is a well-established practice to represent word-final unstressed vowels in disyllabics as voiceless.[4] When examining the status of these vowels for their voicing, it was thus surprising to observe in the controlled experiment that they were almost without exception voiced,[5] whereas e in spontaneous speech the number of voiceless vowels was greatly increased. In fact, except in sentence and/or paragraph-final positions, it appears that the production of voiceless vowel was the norm. The percentage of voiceless vowel occurrences is 76% for this speaker. It appears, then, that the difference in the number of occurrences by the same speaker in the controlled experiment vs. her spontaneous speech reflects different realizations of the reduced vowel associated with each of the two speaking modes.

3. Discussion

Research has shown that vowel reduction may involve varying degrees of centralization and durational changes, and may result in vowel elision.[6] The present study aimed at examining the acoustic consequences of vowel reduction, confirms the assumption of previous research with regard to durational change. Concerning the degree of undershoot, while the spectral patterns in the spontaneous speaking mode differed from those in the controlled experiment, the overwhelming majority of reduced vowels (see discussion above) did not undergo the degree of centralization that would approximate the neutral position of vowel articulation. In Lindblom (1990) vowel durational values when plotted against spectral changes showed clear

[4] See for example, T.Itkonen 1958.
[5] Out of the 950 instances of vowel reduction (461 by the speaker of the Sevettijärvi dialect, and 489 by the speaker of the Paatsjoki-Pettsamo dialect) only 6% were realized in voiceless vowels.
[6] Lindblom 1963, Nord 1987, Kohler 1990.

evidence of undershoot effects.[7] In evaluating the formant frequency patterns in both speaking mode, the differences in durations from the reference value[8] clearly point to undershoot effects (see section 2.2).

		Spontaneous speech	Controlled experiment
Vowel drop		21%	6%
Durational decrease		$\bar{x}$ = 36 msec	$\bar{x}$ = 25 msec
Spectral patterns	(a)[9]	F1 = 365 Hz F2 = 2650 Hz F3 = 3300 Hz	F1 = 350 Hz F2 = 2765 Hz F3 = 3375 Hz
	(b)	F1 = 660 Hz F2 = 1610 Hz F3 = 2670 Hz	F1 = 665 Hz F2 = 1680 Hz F3 = 2720 Hz
Voiceless vowel		76%	4%

Table 1. *Summary of word-final vowel reduction in Skolt Saami (Paatsjoki-Petsamo) disyllabics in spontaneous speech and in the controlled experiment (total = 489 disyllabics)*

Kohler (1990) argues for the recognition of a "…reduction hierarchy, where the degree of reduction correlates with the lowering of the stylistic level" among other variables.[10] The increase of vowel elision, the greater degree of durational change, the relevance of undershoot, and the large percentage of voiceless vowel occurrences in the spontaneous speaking mode confirm Kohler's assumption. In the controlled experiment – representing a speaking mode at a much higher stylistic level – the number of vowel drop was low, reduced vowels had lesser durational change, the spectral characteristics were closer to the quality of the original stem vowel, and these vowels were realized at most times as voiced.

In Sections 2.1. and 2.2. it was indicated that word-final second syllabic vowels in sentence and/or paragraph final positions behave differently from those in sentence-internal positions with regard to vowel reduction. While occurrences of vowel drop are identified in sentence-internal positions, most vowels are retained sentence and/or paragraph finally. Further, differences in the degree of durational decrease in vowel reduction, in relation to the position of the disyllabic in sentences, were also pointed out above (Section 2.2). The coincidence of these diverging manifestations may be related to the

[7] Lindblom1990:429.
[8] 87 msec (McRobbie-Utasi 1999); see also section 2.2.
[9] The spectral pattern in (a) pertains to the reduced stem vowel /e/; (b) to the reduced back stem vowels.
[10] Kohler 1990:72-73.

presence of a major boundary such as the sentence and/or paragraph boundary. The role of duration in signalling boundaries has been researched extensively[11] and preliminary investigations concerning durational change at boundary position in Skolt Saami have also been reported on.[12] The implications of the present study point to recognizing the different realizations of vowel reduction in relation to boundary signalling: i.e., there appears to be a tendency not to reduce duration at boundary positions.

4. Conclusions

The four acoustic characteristics of word-final vowel reduction in disyllabics are summarized in Table 1. While the results definitely point to recognizing the differences in vowel reduction between the two speaking modes and identifying the acoustic correlates of vowel reduction, because they are based are on data from one speaker only they need to be tested by extending the scope of this research to additional speakers. Further, vowel reduction will have to be examined acoustically, and related to the results presented above in connection with multisyllabics containing a reduced vowel in Skolt Saami.

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[11] For example, Lehiste 1971, 1975, 1979.
[12] McRobbie-Utasi 1994, 1996.

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