



**Acoustics'08
Paris**
June 29-July 4, 2008

www.acoustics08-paris.org

The acoustic manifestation of consonant gradation in Northern Sami

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Consonant gradation is a feature of Sámi and is realised in Northern Sámi in changes from nominative singular to genitive plural form, e.g. ‘heavdni’ (spider) and ‘heavnni-t’ (spiders). The data examined in this paper was collected in 2007 and represents the first acoustic analysis of consonant gradation in Northern Sámi spoken in Övre Soppero. The data was collected in Övre Soppero in Northern Sweden using an elicitation technique that was designed to collect phonetically controlled material for analysis. The nouns were elicited in singular or plural form using picture prompts and the participants were asked to give the word in the carrier sentences ‘Lea okta govas’ (“There is a in the picture”) and ‘Leat guokte govas’ (“There are two in the picture”). The recordings were labelled in Wavesurfer at a phonetic level and the segments relating to consonant gradation extracted for acoustic analysis. In the paper we present our initial findings.

1 Introduction

The Sámi language belongs to the Finno-Ugric language group and is spoken in Norway, Sweden and Finland [1, 4]. The language is divided into three dialect groups: Eastern Sámi, Central Sámi and Southern Sámi. Ter Sámi, Kildin Sámi, Skolt Sámi and Inare Sámi are Eastern Sámi dialects; North Sámi, Lule Sámi and Pite (or Arjeplog) Sámi are Central Sámi dialects, and Ume Sámi and South Sámi are dialects of are Southern Sámi [1].

The North Sámi dialect is the variety of Sámi that it widely spread across the northern countries [1]. Around 16,000-18,000 people speak North Sámi, 9,000 - 10,000 of the speakers live in Norway, around 6,000 live in Sweden and around 2,000 live in Finland [1]. In Sweden, North Sámi, which is the focus of this paper, is spoken in regions north of Gällivare (Jiellváarri in Sámi).

One of the prominent features of Northern Sámi is consonant gradation. Grammatical distinctions (number, person, tense, mood and aspect in verbs and number and case in nominals) are expressed through alternation of medial (stem) consonants. The consonant gradation in North Sámi follow a range of patterns. Change from a strong grade to a weaker may, in a transcription based account, be described as application of devoicing (‘loddi’ in strong grade, ‘lotti’ in weak grade), deletion (‘vuodja’ in strong grade, ‘vuoja’ in weak grade) and lengthening of one of the stem consonants (‘duihmit’ in strong grade, ‘duihmmi’ in weak grade) [7].

The morphological conditions under which consonant gradations occur in Sámi has been studied extensively [2, 3]. However, Engstrand [2, 3] concluded in their literature review that very few studies into the phonetic realisations of the different consonant gradation realisations have been conducted. Thus, little is known about the phonetic realisation of the changes in the stem consonants under consonant gradation in the Sámi dialects.

Ulseth [8] investigated durational differences in stem consonants under consonant gradation in 10 speakers, of unknown age and gender, of the Jukkasjärvi dialect. In the four pairs of target words elicited by Ulseth [8], the nature of the consonant gradations were all different. The first target word pair involved a phonological difference in length between the strong grade and the weaker grade. The second pair involved a length difference in preaspiration. The third pair involved a change in both phonetic length and voicing, and the fourth consonant gradation change investigated involved both a change in phonological length and a process of lenition of the stem consonant, changing the plosive to a fricative. With the small number of investigated instances in each of these consonant gradation realisation groups, the data set pre-

sented by Ulseth [8] does not afford an increased understanding into the general phonetic production pattern of either one of the groups.

A more extensive study of phonetic aspects of consonant gradation in Northern Sámi was performed by Magga [4]. Magga investigated duration patterns in stem consonants in Northern Sámi, and provided a detailed account of durational variations between grades for all classes of consonant gradation in Northern Sámi. However, Magga’s investigation included recordings of only three speakers of Northern Sámi, making it difficult to assess to what extent the production patterns found is part of the dialect or part of the idiolect of the specific speaker. Further, in the investigation conducted by Magga [4], productions of consonant gradations were not specifically targeted or elicited in order to provide minimal pairs.

Thus, a systematic investigation into one kind of consonant gradation is needed, and with an increased number of speakers of the North Sámi dialect is needed. This paper provides the partial results from a pilot study aimed at investigating the realisation of consonant gradation in North Sámi. The paper focuses on grade alternations where stem consonant length is the primary candidate as a correlate to grade alternation. The data set investigated was extracted from a data base of elicited productions of minimal pairs differing only in the grade.

2 Method

2.1 Speech material

A target word list was constructed using the following four criteria,

1. The target word should be a noun which could be easily depicted in a way that afforded spontaneous production of the word without the experimenter having to provide a model production of the word
2. It should be possible to present the target word as a single item or a pair of items using picture prompts (this criterium affords elicitation of singular and plural forms)
3. It should be possible to present the target word in such a way that participants would correctly infer, without explicit instruction, as to whether the target word is a general word (e.g. “berry”) or a more specific (e.g. “blueberry”)
4. The target word should not have a frequently occurring synonym

2.2 Participants

Seven speakers of Northern Sámi, four female and three male, participated in the study. The age of the female speakers were 21, 52, 61 and 62 years old at the time of the recording. The male speakers were 35, 62, 82 years old. The speakers lived in either Övre Soppero (6 speakers) or Nedre Soppero, 10 km south of Övre Soppero (1 speaker).

2.3 Data collection

The recordings were made by a single native speaker of Sámi. One informant, the 62 year old male speaker (OM1), was recorded, in Nedre Soppero. The other speakers were recorded in Övre Soppero. The recordings were conducted in either the informant's home or in local community hall using a digital recorder. The target words were elicited by hand-drawn pictures or by photographs, depicting a single instance or a pair of the target word to be produced. The informants were instructed to produce the target word in either of the carrier sentence 'Lea okta ___ govas' ("There is a ___ in the picture") or the carrier sentence 'Leat guokte ___ govas' ("There are two ___ in the picture"). The instructions were given in Sámi.

The elicitation was made using either one of two pre-randomized slideshows using a laptop computer. This reduced the risk of prosodic boundary effects in the productions as the informants did not know which of the target words was the last in the set. The order of the pictures in each slide show was chosen so that the singular and plural elicitations of the same target word were well separated in time; this reduced the risk of reductions in production quality due to target word repetition.

Only productions where the duration of the stem consonants could be determined were included into the analysed data set. Thus, productions with no realised second vowel or an acoustically diffuse offset were removed from the data set.

2.4 Data analysis

The recordings were submitted to acoustic analysis and markup using the Wavesurfer software package [6]. Target word productions were extracted from the recordings and submitted for markup at the segmental level. The phonetic quality of the speech segment was transcribed using the SAMPA phonetic transcription system and the start and end time of each speech segment were noted. The resulting data set was submitted for statistical analysis and visualisation using the R statistical package [5].

3 Results

The duration of the stem consonants in the investigated productions are presented in Figure 1 in the form of a Box-and-whisker plot. In this plot, the central dot indicates the median of the distribution and the box indicates the first and third quartile of the distribution of the data set visualized. The outer notches indicate outer boundaries of the range in which 95% of the data set is located. The number of productions in the "Strong" grade was

97 and the number of productions in the "Weak" grade was 171.

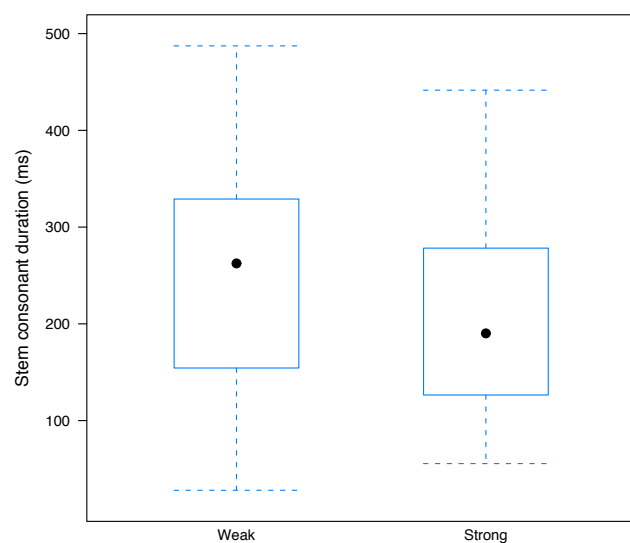


Figure 1: Box-and-whisker plot of the duration (in ms) of the stem consonants, divided by grade strength of the target word.

The duration measurements were submitted to statistical analysis of group differences. A Student's t-test of group means indicated a statistical difference between groups ($t(224) = -3.56, p < 0.001$). Thus, the differences in stem consonant durations indicated in Figure 1 were shown to be statistically significant.

4 Discussion

No systematic phonetic description of North Sámi consonant gradation has been conducted in the previous literature. Previous investigations have either provided evidence based on a diverse range of target word pairs [8] or included an extensive, but not specifically targeted, investigation of a limited number of speakers [4] of the phonetic realisations of consonant gradation in North Sámi. This paper aimed to provide further data on the durational difference between strong grade and weaker grade realisations of paired target words.

The results indicated a significant difference between strong grade and weak grade productions in terms of the duration of the stem consonants; weak grade productions were significantly longer than the strong grade productions. Thus, it can be concluded that the investigation presented here provides evidence for physical duration being a phonetic correlate to consonant gradation in North Sámi.

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