

# The Phonology of Gradation in North Saami\*

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## 1. Introduction

This paper presents aspects of the phonology of North Saami, in particular the dialect of Guovdajohtolat, Guovdageaidnu (Kautokeino) county which is spoken by the first author. North Saami is one of ten Saami languages (a branch of Finno-Ugric spoken in Norway, Finland, Sweden and Russia) — see Sammallahti 1998 for details of the history and structure of the Saami languages. The dialect under investigation is in the Finmark Saami group of North Saami, and the western sub-group therein. North Saami has the largest speaker population of all of the Saami languages, numbering around 25,000 speakers living in Norway, Finland and Sweden. A considerable literature exists in North Saami, as well as some linguistic works on the structure of the language (though little is published in English).

A number of properties of North Saami phonology are of particular interest, notably the complex vowel length and consonantal grade alternations which accompany certain morphological contrasts such as nominative vs. accusative. The alternations involve deaspiration, spirantization, stop voicing, shortening and lengthening, deglottalization, shift in glottalization, glide fortition, and vowel epenthesis. The language also has inventory peculiarities such as long and short diphthongs and three surface degrees of consonant length. The purpose of this paper is to describe the basic facts of the language which are relevant to the strong / weak gradation system, which results in alternations such as *čiehkka* ~ *čiega* ‘corner (n.s. ~ a.s)’ *diehhpi* ~ *diehpi* ‘pom-pom (n.s. ~ a.s)’, *lŕo?ni* ~ *luoni* ‘dirt (n.s. ~ a.s)’. We do not present a theoretical analysis of these alternations here, since the basic facts themselves are quite complex, and a theoretical analysis without a suitable empirical foundation has no scientific value. This paper is therefore a necessary step towards a theoretically-informed analysis.

The main challenge to research on North Saami phonology, based on published data, is the difficulty of obtaining a large enough corpus which preserves phonetical details, which represents a single variety of the language, and which is paradigmatically controlled. These challenges motivate our firsthand paradigmatic-fieldwork approach to the language. Three main factors contribute to the poverty-of-materials problem. First, North Saami is not phonologically monolithic, so data from speakers of one area are not always valid for speakers from another area. While it is obvious that regional dialect differences have to be taken into account in all languages, it needs to be emphasized that such differences can be very significant in North Saami even when they do not prevent mutual intelligibility. Thus data from the Guovdageaidnu dialect of North Saami cannot be freely mixed with data from the Káráŕjohka dialect: indeed, according

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to Sammallahti 1998, there are dialects within Kárášjohka. There are also non-trivial generational differences within the Guovdageaidnu dialect, and we know of dialect differences for speakers of the same generation but different parts of Guovdageaidnu. This is unsurprising, since Guovdageaidnu covers over 3,700 square miles. Since our goal is to model a mental faculty rather than trace a socio-historical development, we present just one language here.

Second, the morphophonology of the language is extremely complex. Grammar books do not give the volume of data that would be necessary to pin down all of the details of the language and to justify a claim to generality. Sources on North Saami tend to give relatively few complete inflectional paradigms of nouns. For example Kåven et al. 1995 only give a complete case-inflectional paradigm for seven nouns, plus certain crucial inflected forms that hint at the alternations found in 65 nouns (this includes a high proportion of irregular nouns). The complexities of nominal morphophonology are such that the number of paradigms necessary for a complete documentation of noun patterns, controlling various relevant dependencies, numbers in the hundreds. The surface complexities of the inflectional system become much more tractable when reduced to phonological principles whereby many of these facts can ultimately be predicted by rule. However, the point of investigating the phonology of a language is precisely to determine what those principles are, based on actual data: these data are not available in published sources.

Finally, the written representation of published data often cannot be trivially or even reliably translated into phonetic data; indeed, the question of how to interpret existing written data is the most significant problem that faces the novice wishing to do research on North Saami, since spelling conventions do not directly represent pronunciations. The extensive grammar and dictionary of Konrad Nielsen (Nielsen 1926-29, 1932-62) illustrates the problem in one form. In his grammar, forms seem to diverge quite substantially from the pronunciations that we find in this dialect. For example, Nielsen gives the forms *čiekkâ* ‘corner (n.s.)’, *čuoivâg* ‘yellow-grey reindeer’ where we have *čiehkka*, *čuoivaht*. Such forms seem to represent a book-form, an idealized pan-North Saami form, or perhaps a historical reconstruction: as far as we know, it is not a pronunciation in any spoken form of North Saami. In his lexicon, Nielsen organises forms according to this idealized form, but then for each form lists the phonetic forms in the Polmak, Kárášjohka and Guovdageaidnu dialects. His phonetic forms for Guovdageaidnu are relatively close to what we encounter.

(1)	<i>Ideal</i>	<i>Nielsen Guov.</i>	<i>our phonetics</i>	<i>gloss</i>
	bar'dne	BÀR <sup>ɛ</sup> DNÌ	baareʔni	‘son (n.s.)’
	bardne	BÀRTNÌ	baarʔni	‘son (a.s.)’
	ai'ge	ÀĲ'GÌ	aaigi	‘time (n.s.)’
	aige	ÀĲ <sup>k</sup> GÌ	aaikki	‘time (a.s.)’
	bag'go	BÀG'GÒ	baaggu	‘need (n.s.)’
	baggo	BÀGKÒ	baakku	‘need (a.s.)’
	čier'ra	ȚŠIER'RÀ	čierraa	‘crybaby (n.s.)’
	čierra	ȚŠIERRÀ	čierraa	‘crybaby (a.s.)’
	duoggje	DUOG <sup>g</sup> 'KÌ	dūočči	‘handicraft (n.s.)’
	duoje	DÙQJÌ	duoji	‘handicraft (a.s.)’

Some of these differences are just differences in transcriptional system (such as the difference between <č> and <č̣>), and others such as the presence of *dn* and *tn* clusters in Nielsen’s data are due to known dialect differences, this one reflecting a change found in the speech of younger speakers from Guovdageaidnu. Data in the grammar volumes, which provide fuller inflectional details, are only presented in the historical reconstructive spelling system which does not match the phonetic properties of an existing spoken dialect that is learned by children. The lexicon, which does give actual spoken forms, does not give full inflectional paradigms for nouns, and at any rate even interpreting Nielsen’s phonetic dialect data is quite challenging.

As is the case with most languages, research on North Saami are significantly influenced by the written language and thus by the prevailing orthographic conventions. Bergsland 1961 states that his Saami grammar is based on his earlier unpublished grammar of written Saami so he presents the noun ‘corner’ as *čiekka* ~ *čiega* (n.s. ~ a.s.) which is different from the current spelling (and the phonetic value) *čiehka* ~ *čiega*. However, Bergsland notes in his explanation of the phonetic values of letters that the voiceless stops may represent aspiration. No hard and fast rule is given for when this is the case, thus the interpretation of *p*, *t*, *k* is potentially ambiguous and at best would require the application of interpretive conventions which the researcher would need to discover by comparing Bergsland’s written forms with actual pronunciations. In describing the Jukkasjärvi dialect, Collinder 1949 provides forms such as [ko<sup>h</sup>tē], which in the present dialect corresponds to [goahti] ‘tent’, and we take the two forms to be reasonably close in pronunciation, though we do not assume that the form given by Collinder was actually pronounced [goahti]. Ulseth 1981 presents phonetic data on duration from speakers of this same dialect, and while presenting data in an orthographic form, such as *dietto* ‘knowledge’ ([diehtu] in the present dialect), also presents the same datum in connection with spectrograms as [diexto] — frication is quite evident in the spectrogram. It seems apparent that while the prevailing spelling system — at that time — notated preaspirated consonants as voiceless geminates, they were in fact phonetically preaspirated, a fact now recognised in the official orthography.

Most contemporary published works on the language, such as Bartens 1989, Nickel 1994 and Kåven et al. 1995 use North Saami orthography which also does not preserve certain phonetic facts, and which has an opaque relation to phonetic transcriptions.<sup>1</sup> The examples of orthography and phonetic transcriptions below give an indication of the nature of this problem.

(2)	<i>orthography</i>	<i>phonetics</i>	<i>gloss</i>
	goahkka	gõahhka	cook (n.s.)
	goahka	goahka	cook (a.s.)
	biegga	bĭegga	wind (n.s.)
	biekka	biekka	wind (a.s.)
	biebm̄u	biemʔmu	food (n.s.)
	biep̄mu	bĭeʔmu	food (a.s.)
	bárdni	baareʔni	son (n.s.)
	bártni	baarʔni	son (a.s.)

<sup>1</sup> The dictionary supplements the orthography in some cases by marking vowel length and the distinction between long and overlong consonants, using an apostrophe to mark overlong, e.g. *vuoš'šat* ‘to cook’.

gealbu	gealabu	ability (n.s.)
gealbbu	gealppu	ability (a.s.)
golli	golli	gold (n.s.)
golli	goolli	gold (a.s.)
dolla	dolla	fire (n.s.)
dola	dola	fire (a.s.)
márfi	maarefi	sausage (n.s.)
márffi	maarffi	sausage (a.s.)
nuortu	nŭorahtu	north wind (n.s.)
gávtti	gaafti	jacket (a.s.)
jávri	jaauri	lake (n.s.)
hanŋá	hannjaa	duck species (n.s.)
mannji	mannji	daughter-in-law (n.s.)
duodji	đuočči	handicraft (n.s.)
muitu	muihtu	memory (n.s.)
muittu	müihhtu	memory (a.s.)

The orthography does not mark vowel length, which is surface contrastive, except in <á> vs. <a> which in some dialects is most markedly a front / back contrast. Kåven et al. (1995) sometimes marks length with a macron, e.g. *bīhkolas* ‘complainer’, *gēho* ‘cradle’, *ōkkodit* ‘to fish with a rod’. We consider the lack of indication of surface vowel and diphthong length to be the primary impediment to a clear understanding of the phonology of gradation.

Other properties are marked indirectly (e.g. the orthographic ‘voicing’ difference <bárdni> ~ <bártni> is phonetically a vowel ~ Ø distinction). The consonant spelled *dj* is, in this dialect, the same as *č* though in some dialects it is a phonetic palatal similar to Hungarian [c] (orthographic *ty*). The spelling provides a means of unifying a diverse set of dialects by smoothing out details of actual pronunciation that are not shared by all dialects of North Saami, limits the use of special symbols, and provides a simpler orthographic representation of the gradation system. While these are valid considerations in devising an orthographic system, it means that such written data about the language cannot be taken at face value, phonetically speaking.

Magga 1984 provides phonetic data from Guovdageaidnu speakers of an older generation, which could be very similar to the present dialect. The goal of that work is to explore phonetic issues, and the corpus of examples is not paradigmatically organised nor does it have the type of information required to analyse nominal morphophonology (especially nominative / accusative pairs over the range of relevant stem types). While that dialect is geographically closest to the present dialect, there are still non-trivial differences which prevent simply importing data from that dialect into a study of morphophonology in this Saami dialect. For example, Magga gives *atna* where we have [aʔnaa] ‘he uses’, *arʹvii* for [arevi] ‘rain’, *tahʹkuu* for [dahhku] ‘deed’, *pierkkʹkujt* for [bierkkuiht] ‘meat a.p.’, *juhka* for [juhhkaa] ‘he drinks’.

Sammallahti 1998 provides data from North Saami in phonetic transcription, giving data from the very closely related Eastern Eanodat dialect (also a Western Finmark North Saami dialect, about 50 miles away), using both orthography and a phonetic notation. Our divergences from his transcriptions are relatively minor: where we record the word ‘field (n.s.)’ as [gǽddi],

Sammallahti records it as [k̥ǎ̃ːd̥t̥i]. Some differences reflect different levels of phonetic detail in the two transcriptions such as [d̥t̥] which implies a surface decay in voicing that we also find in this dialect, or writing practices (we mark only the first elements of a short diphthong as short, with no implication as to how each of the components of diphthongs compare between short and long diphthongs). Some of the differences reflect actual dialect differences, such as voicing of [g] or the representation of ‘mother’ as /ead’ni/ with a stop rather than [ean’ni], a known generational difference. Unfortunately, relatively few forms are narrowly phonetically transcribed in Sammallahti 1998. Examples given in North Saami orthography do not necessarily represent a specific dialect. So, Sammallahti reports comitative sg. [goođiin] ‘tent’ vs. locative sg. [goađis], but we find [goođin] and [goađis], with the second syllables having the same length. Similarly, the contrast between nominative pl. [goađit] vs. accusative pl. [goođiid] is represented in this dialect as [goađiht] and [goođiht].

Sammallahti 1984 describes a number of phonological features of the Guovdageaidnu dialect, even so using data from speakers of previous generations, but relatively few forms are presented that allow a systematic investigation of the dialect. Some differences are, again, interpretive, e.g. Sammallahti gives /kaalii/ ‘waded; by wading’ and we have [gaali] — there is no contrast between long and short *i* in final position, so the transcriptions are interchangeable — but some differences are substantial such as the contracted loc. sg. of ‘dog’ /peatnis/ for which we have [beaʔnas].

In this study, we focus on gradation, which pervades the morphology of the language. The central issues which we will be concerned with are: how many degrees of length are there in the language, phonetically and phonologically; is there a phonological unity to the gradation alternations; especially, what are the underlying representations of stems? The phonological complexity of the language is considerable, so this paper limits the domain of investigation to the patterns found in noun case-number inflection in regular bisyllabic vowel-final stems, with documentation of the analogous alternations in present-tense verbs.

## 2. Phonetic Preliminaries

Insofar as children learning the language only have access to phonetic outputs and must construct an analysis of phonetic facts, it is important to make clear what the facts are. A detailed acoustic characterisation of Saami will not be undertaken, but appeal to some acoustic analysis is made, to support aspects of the primarily auditorily-based claims made here.

### 2.1. Consonant inventory

A significant question in Saami phonology is the treatment of certain clusters or phonetically complex segments, such as ‘preaspirated consonants’ or ‘affricates’. We might treat *ht* as a cluster of *h* plus *t*, and we might treat *č* as a cluster of *t* plus *š*. There are good phonological reasons to consider the affricates of Saami to be single segments — this will become clear in the sections below — and no considerations pointing to a cluster analysis, so we consider a unit affricate account to be uncontroversial. The proper treatment of preaspirated consonants is non-trivial. We presume that preaspirated consonants are single segments, a decision justified later.

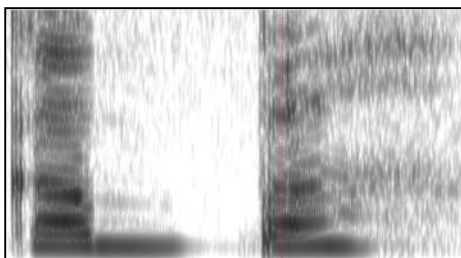
We begin with a generous list of surface segments. The following consonants exist in the variety of Saami described here. Excluded are the ‘overlong’ or ‘Q3’ long preaspirates and triple-geminate consonants, which will be considered separately. Included in the set are phonetic sequences that reasonably could be treated either as clusters or single segments such as aspirates, affricates and glottalized nasals. Most consonants have long and short versions. IPA values for consonant symbols are to be assumed in interpreting this table.

(3)	p(:)	t(:)	ts(:)	tʃ(:)	k(:)
	f(:)		s(:)	ʃ(:)	
	b(:)	d(:)	dz(:)	dʒ(:)	g(:)
	v(:)	ð(:)			
	hp	ht	hts	htʃ	hk
	m(:)	n(:)		ɲ(:)	ŋ
	?m	?n		?ɲ	
	m?m	n?n		ɲ?ɲ	
		r(:),l(:),ʎ(:?)		j(:)	h

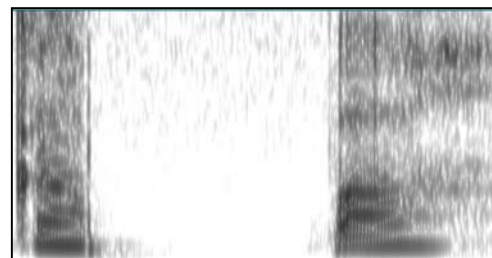
A series of voiceless sonorants might also be added, in light of [skaɾɾaa] ‘continuous rattling sound’, [daje] ‘or’, [billi] ‘front of sled’, or they could be treated as clusters of h+C — [skahhra], [dahje], [bihhli]. These segments / clusters are rare and no evidence unambiguously shows what their phonological treatment is. All of the simple sonorant consonants with phonemic status (*m, n, ɲ, l, r, j*) except *v, ɲj, lj* can enter into an h+R cluster, that is, may be voiceless. The simple consonant phonemes (the above singletons excluding [ɲ] which is not phonemic) can all be geminated, except /h/.

Voiced stops are weakly voiced, and can be devoiced, but even initially they can show clear acoustic signs of vocal fold vibration, which renders the label ‘voiced’ plausible. Phonetic voicing of orthographic <b, d, z=dz, ʒ=dʒ, g> is a dialectal feature, and some speakers employ totally voiceless unaspirated stops in initial position. Voicing is particularly strong on the initial portion of a geminate voiced consonant though it tends to die out on the second half of the geminate (see for example Sammallahti’s detailed transcription [dɔt]). Nevertheless, sometimes there is low-amplitude voicing well into the second half of a geminate stop.

(4)

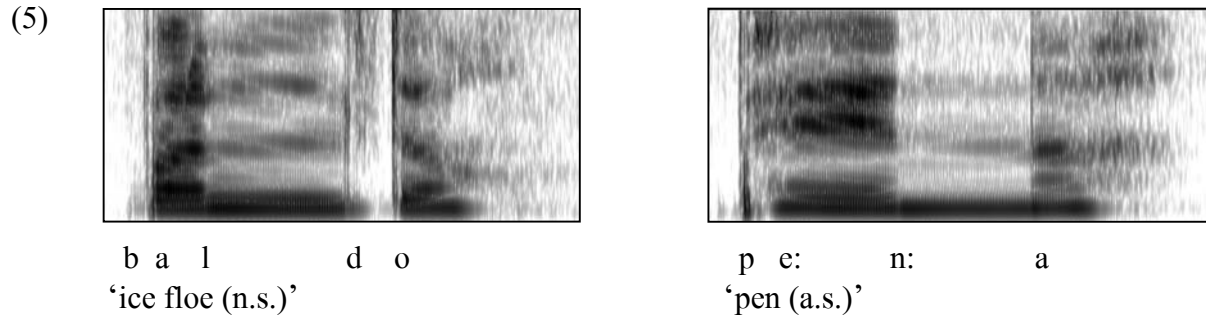


g a bb a  
‘all-white reindeer (n.s)’

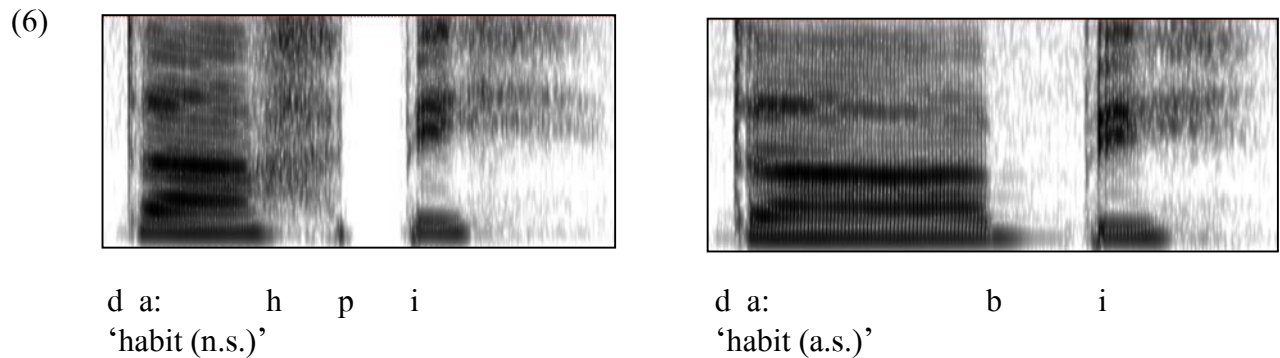


g a pp a  
‘all-white reindeer (a.s)’

The voiceless stops are aspirated, depending on context. Initially or intervocalically, there will be strong post-aspiration, thus [t<sup>h</sup>eaksta] ‘text’ vs. [deahki] ‘meat’. After /s,f/ or when preaspirated, there is a small degree of post-aspiration; geminate voiceless stops are minimally post-aspirated, and for that matter can be weakly preaspirated. Examples of initial post-aspirated and voiced stops are seen in (5).



The medial (short) preaspirated and single voiced contrast is given in (6).



This dialect lacks the voiceless interdental fricative [θ] of other dialects, and [θ] found in other dialects (spelled *t*) is pronounced as [s]. In other dialects of Saami there also exists a distinct palatal stop spelled <dj> transcribed [g<sup>y</sup>], [k<sup>y</sup>] or [t<sup>y</sup>] in some works, but in this dialect it is pronounced as [ttʃ], the same as <čč>: it is always geminated. There is phonological evidence for treating this consonant as morphophonemically different from <č>, discussed later in section 4.1. Some dialects maintain a separate phoneme [ŋ], but in this dialect, [ŋ] only appears before a velar consonants and in the loanword [šajra] ‘genre’ — nasal+[r] sequences otherwise do not exist, and the prevocalic [ŋ] found in other dialects is pronounced as [ɲ] (thus, *hannja* ‘duck’, not *hanŋa*). Finally, the pre-glottalized consonants such as [ʔm] and the medially-glottalized consonants such as [mʔm] represent the pronunciation of what is spelled <pm> and <bm> respectively. An oral stop is found in other dialects and in the speech of older generations in this dialect, but in the variety represented here there is a glottal stop, and no oral stop.

The palatal lateral [ɬ] which is written <lj> functions phonologically as a single sonorant, and participates in a long ~ short alternation [vʲeɬɬa] ‘brother (n.s.)’ ~ [vʲeɬa] ‘brother (a.s.)’ that is parallel to that of *jielli* ‘fish-drying rack (n.s.)’ ~ *jielli* ‘rack (a.s.)’. There is also a lateral plus glide cluster which functions as a bisegmental sonorant-initial cluster, as in *oljju* ‘oil (a.s.)’, which engages in a vowel-epenthesis alternation — see *oloju* ‘oil (n.s.)’ — which is parallel to

that of *moreji* ‘berry (n.s.)’ ~ *morjji* ‘berry (a.s.)’. From what we can determine, the cluster *ljj* is not phonetically different from the palatal lateral of [v̥ieʎʎa]. The spelling system represents [ʎ] of [v̥ieʎʎa] ‘brother (n.s.)’ as *viellja*, in contrast to identical *oljju* ‘oil (a.s.)’, doubling the letter for the glide rather than that for the liquid. The spelling does not represent the difference between [vieʎa] ‘brother (a.s.)’ spelled *vielja* and [oloju] ‘oil (n.s.)’ spelled *olju*. Our transcriptions resolve the ambiguity by notating the monosegmental palatal lateral as [lʲ], and notating the separable bisegmental cluster — which is, phonologically, always has a long glide — as [ljj]. This should not be construed as meaning that *viell’a* and *oljju* have phonetically different clusters. As to whether the consonants of *viell’a* (n.s.) and *viell’a* (a.s.) are themselves phonetically distinct (in terms of length), we take this matter up in section 3. There are very few examples of either variety, /ʎ/ or /lj/.

The Northern Saami orthography generally represents these consonants as follows.

(7)	[p] = <p>	[t] = <t>	[ts] = <c>	[tʃ] = <č>	[k] = <k>
	[f] = <f>	[s] = <s>	[ʃ] = <š>		
	[b] = <b>	[d] = <d>	[dz] = <z>	[dʒ] = <ž>	[g] = <g>
	[v] = <v>	[ð] = <đ>			
	[hp] = <hp>	[ht] = <ht>	[hts] = <hc>	[htʃ] = <hč>	[hk] = <hk>
	[pp] = <pp>	[tt] = <tt>	[tts] = <cc>	[ttʃ] = <čč>	[kk] = <kk>
	[ff] = <ff>	[ss] = <ss>	[ʃʃ] = <šš>		
	[bb] = <bb>	[dd] = <dd>	[ddz] = <zz>	[ddʒ] = <žž>	[gg] = <gg>
	[vv] = <vv>	[ðð] = <đđ>			
	[m] = <m>	[n] = <n>		[ɲ] = <ɲj>	[ŋ] = <ŋ>
	[mm] = <mm>	[nn] = <nn>		[ɲɲ] = <ɲɲj>	
	[ʔm] = <pm>	[ʔn] = <tn>		[ʔɲ] = <tnj,kɲ>	
	[mʔm] = <bm>	[nʔn] = <dn>		[ɲʔɲ] = <dnj,gɲ>	
		[r] = <r>, [l] = <l>		[j] = <j>	[h] = <h>
		[rr] = <rr>, [ll] = <ll>		[jj] = <jj>	
		[ʎ] = <lʲ>, [ʎʎ] = <llʲ>			

The orthographic system is context-sensitive, in that for example <bm> can also represent an epenthetic vowel before a preglotalized nasal in <fierbmi> [fieriʔmi] ‘fishing line’; likewise, <gg> represents [kk] in <áiggi> [aaikki] ‘time (a.s.)’. Preaspiration can be represented as *ht* (*goahti* ‘hut’) or *t* ([baaihtiht] = <báitit> ‘to shine’). Data are given here in an orthography which compromises between IPA symbols and standard Saami orthography as follows:

(8)	IPA	present transcription
	ts	c
	dz	z
	tʃ	č
	dʒ	ž
	ʃ	š
	ɲ	ɲj



- (12) a.     ie uo ea oa  
 b.     ui ei oi aai iu ou eu au  
 c.     iei uoi eai oai ieu uou eau oau  
 d.     ïe ůo ěa ōa ůi ěi ōi ai

There a marginal contrast between [au] and [aau] — generally, we find [aau], but we have also encountered *njauge* ‘smooth-coated dog’, *raussa* ‘baby diapers (a.s.)’. The contrast between [ai] and [aai] is more robust, for example *baihka* ‘shit’, *gaiba* ‘cap with bill’, *gaihkaat* ‘contrarian’ *skaihpi* ‘person with long nose’ vs. *čaaïmmas* ‘laughter’, *laaigađit* ‘to pry a flake off’, *aaigi* ‘time’, *daaigi* ‘dough’.

The orthography distinguishes short, back <a> from long, front <á>. The vowel <a> is generally realized as [ɑ] and <á> is realized as long front [aa], assuming the IPA standard for the low front vowel. The correspondence between the orthographic vowel difference and the phonetic vowel of this dialect is somewhat irregular, so <sivva> ‘reason’ is pronounced [sivvaa]. A surface distinction emerges in certain contexts, where the short back vowel <a> is lengthened to [ɑɑ], which while phonetically long, is qualitatively and quantitatively different from the underlyingly long central-front vowel /aa/ i.e. <á>. As discussed in section 6.5, short /a/ lengthens before a weak-grade sC cluster, thus <gaskka> [gɑɑska] ‘distance (a.s.)’ from /gaska/, to be contrasted with vs. <gáskká> [gaaskaa] ‘he gnaws’ from /gaaskaa/. As far as we have been able to determine, shortened /aa/ is identical to underlyingly short /a/, and [ɑɑ] only arises from /a/ under restricted circumstances. We write [a] for the short vowel which has a single quality, and [aa] — the basic long front low vowel — vs. marked [ɑɑ] for the distinctly back lengthened low vowel.

In some words, final short *a* is quite short and schwa-like, for example *vuoksə* ‘depth of fabric’, *bahhkə* ‘package’, *bihhkə* ‘tar’, *pennə* ‘pen’, and in others it is longer and more a-like — *bahhta* ‘buttocks’, *dolla* ‘fire’, *sohhka* ‘family’. There is, in addition, a distinct long *aa* as in *vũoksa* ‘bull’, *vivvaa* ‘son-in-law’. We hypothesize that the half-long vowels of *bahhta*, *dolla*, *sohhka* can be predicted from underlying short /a/, the vowel that we assume to be underlying in *vuoksə*, *bahhkə*, *bihhkə*, *pennə*, but this is a matter to be taken up in a separate study. Although examples of *a* in word-medial position do not figure into the present analysis, the difference between <a> and <á> is more clearly recognisable as fundamentally a phonetic vowel length difference in forms such as [bahanaalaga] ‘untamed reindeer (a.s.)’, the antepenultimate syllable being significantly longer than other syllables in the word.<sup>4</sup>

An epenthetic vowel [ə] is reported for some dialects of North Saami, for instance Bye 2002 gives *sküolləfi* ‘owl (n.s.)’ (p. 139), *fierrəp̄mii* ‘fishing net (n.s.)’ (p. 146), but we find that this epenthetic vowel is [a] which harmonizes under certain conditions to [e o], thus [sküoləfi], [fierēmi], also [oləju] ‘oil (n.s.)’, [muləju] ‘mølje’, [sküoləfaai] ‘owl (ill. sg)’. In this dialect, the vowel becomes [o] between round vowels (but not after the diphthong [uo]), and [e] before front vowels. The epenthesis alternation is discussed in more detail in section 6.3.

The question of stress is complex. Exceptionlessly, the pitch-peak of a word is on the first

<sup>4</sup> In Kåven et. al. 1998, the word is given as <bahánalaga>, indicating long vowels in the second and third syllables — as we have mentioned, there is significant variation in the language. The dictionary lists both *gistta* and *gistá* ‘reindeer gloves’, and we have recorded both pronunciations of this and other words.

syllable, and citation-form final syllables also have a somewhat raised pitch. It is uncontroversial to say that in e.g. [goahti] ‘big tent (n.s.)’, the stem-penultimate syllable is stressed, and since the vast majority of data which we present are from disyllables, the locus of gradation is almost always obviously the stressed syllable (and following onset). Nouns such as [fabrihhka] ‘factory (n.s.)’ have the pitch peak on the first syllable, but phonologically behave as though the stress is on the penult, thus [fabri'hhka]. Certain case endings have allomorphic alternants depending on even / odd syllable count, thus [beaʔnag-itta] ‘dog il. pl.’ vs. [müitalus-aije] ‘story il. pl.’. Surface trisyllabic stems like *fabrihhka* behave like disyllabic *goahti* — [fabriihka-ije], [gooði-je] — which is explained if the allomorphy rule is stated not in terms of actual even / odd syllable count of the word, but in terms of alternating stress, where the stem-initial syllable of *fabrihhka* is exceptionally ignored for stress. It is at this point difficult to say whether medial odd-numbered syllables have an autonomous durational or pitch-related phonetic correlate of alternating stress. We will, at any rate, presume that stress is on the stem-penult.

### 2.3. Other Phonetic Notes

The glides [j, w] can appear postvocally in the coda, and the question arises whether the segment is a glide or a vowel, i.e. is it more accurate to transcribe [VjC, VwC] or [ViC, ViC]. Phonologically speaking, the segments clearly behave like consonants, as discussed in 6.1. On the surface, the glide’s phonetic value varies subtly between strong grade [VjC, VwC] with a longer vowel-like segment, and weak grade [VjC, VwC] with a shorter and more closed glide. Examples of the difference are below.

(13)	NS	AS	
	diwʔri	diwrri	‘insect’
	hewʔro	hewrro	‘damp’
	sijʔvu	sijvvu	‘travel conditions’
	buwʔru	buwrru	‘porridge’

The alternation between [wʔ] and [w], idem [jʔ] and [j], is a consequence of gradation. The surface difference between the homorganic vowel + glide sequence [uwC] and [uuC] is made clear by the minimal pair [buwrru] ‘porridge (a.s.)’ and [buurru] ‘Taurus (a.s.)’. The auditory effect of the glide/vowel difference is that in [sijvvu, buwrru], the vowel is more lax than the vowel would be elsewhere. It is uncertain whether in examples like [sijʔvu, buwʔru] there is phonetic neutralization between strong-grade /ijʔ/ and /ii/ or /uwʔ/ and /uu/: there does not appear to be a phonetic difference between the vowel+glide sequence of [bijʔhpu] ‘pipe (n.s.)’ = /bijhpu/ and the long vowel of [giihpu] ‘pain (a.s.)’, but more extensive phonetic research is required to give a definite answer to this question. We know of no minimal pairs which decide the question.

When we have occasion to give examples with a word-final stop, which is always *t*, we will write <t>, which is pronounced as [ht] before pause and as [h] otherwise, thus *leat* ‘they are’ is pronounced [leah<t>] prepausally, but [leah] in *leat go* ‘are they?’, *leat maanaat* ‘they are children’, *leat öahhpapeažžit* ‘they are teachers’.

## 2.4. Distribution

The distribution of segments in Saami is far from free, and there are significant restrictions on where certain segments can appear. A number of these restrictions pertain to whether a sound is in an even-numbered, odd-numbered, or syllable-final position. These patterns are orthogonal to the focus of this paper, which is on consonantal alternations in disyllabic stems, but is ultimately connected in terms of higher-level prosody.

The most important restriction relevant to this paper pertains to laryngeal contrasts in stops. The voicing contrast is not highly robust in the language. The voiceless stops /p t k/ in initial and intervocalic position appear primarily in recent loanwords, cf. *üniverši*[t]eehta ‘university’, [k]a[p]ealla ‘chapel’, *me*[k]aanihkar ‘mechanic’, *u*[p]uneantta ‘opponent’, *mara*[t]oona ‘marathon’, *maa*[t]ema[t]ihkar ‘mathematician’, [k]apteai?nu ‘captain’, [k]aalahka ‘calcium’, [t]aajka ‘tank’, [k]rea[t]ivi[t]eehta ‘creativity’, [t]eaksta ‘text’, [p]enn:a ‘pen’. These stops are aspirated similar to voiceless stops of English. Most common in initial position are *b*, *d*, *g*, which are often voiced. The affricates *č*, *c* freely appear in initial position (*čierraa* ‘crybaby’, *čoauji* ‘stomach’, *čaallin* ‘(product of) writing’, *cuummaa* ‘kiss (a.s.)’, *culehci* ‘protrusion’) where they appear only lightly aspirated, and the voiced affricate counterparts *ž*, *z* do not appear at all. The reason for a limited voicing contrast with plain stops but not affricates is that the initial voiceless stops come from loanwords and the source languages for loanwords (Scandinavian or Finnish) do not have affricates.

Clusters of voiceless obstruents are possible in the language. Initial sC clusters such as *stal’lu* ‘troll’, *stuoris* ‘large’, *spaabba* ‘bowl’, *skuihti* ‘opening’, and medial sC clusters as in *basste* ‘spoon’, *lassta* ‘leaf’, *gissta* ‘reindeer gloves’, *maaski* ‘journey’, *sarvvaskat* ‘fur from buck’ exist in non-loans and loans; other medial fricative plus voiceless stop clusters are found as in *beškoš* ‘swallow (bird)’, *beštor* ‘bird sp.’, *gaafiti* ‘jacket (acc. sg)’. Voiceless stop clusters, which are limited to *kt*, *kc*, *kč*, plus non-native clusters as in *kapteai?nu*, are found in e.g. *gaakti* ‘jacket’, *mokta* ‘inspiration’, *roakči* ‘dent’, *coakci* ‘foothold’. Voiced consonants do not appear in obstruent clusters.

A distributional issue which is important to this paper is that it is rare to find nominative singular nouns that have a single voiced stops (except after diphthongs ending in *i* or *u*, or after a consonant). Nouns like *leade* ‘shed type’, *stoobe* ‘can’, and *boazu* ‘reindeer’ are quite uncommon, though *b*, *g*, *z*, *ž* (not *d*) are very common in accusative singulars. After a diphthong ending with a high vowel, single voiced consonants are not unusual: *gaiba* ‘bill of cap’, *njeida* ‘daughter’, *sjeidi* ‘offering stone’, *aigi* ‘time’, *naaudi* ‘predatory animal type’, *ruibi* ‘frown’ and *daauda* ‘sickness’ are representatives of a large class of words. This distribution is tightly connected to gradation.

While this paper focuses on describing the facts of gradation rather than presenting a detailed theoretical analysis of gradation, we nevertheless need to make explicit some underlying assumptions about segmental representation relevant to the nature of gradation as a process. We treat preaspirated consonants such as *ht*, *hp* as being underlying single aspirated segments, thus phonetic *daahpi* is phonologically /daap<sup>h</sup>i/, i.e. the medial consonant is aspirated — it is [+spread glottis]. As noted above, there are also post-aspirated stops as in *mekaanihkar* ‘mechanic’, but the realization of aspiration as post-aspiration is restricted to pre-tonic position in

loanwords, where preaspirated, glottalized and long segments do not appear. The alternation *čiehkka* ~ *čiega* is thus a deaspiration alternation, rather than a cluster-simplification one. Q3 preaspirates as in [čohhka] ‘top (n.s.)’ are then long aspirates, that is /čok<sup>h</sup>:a/. Analogously, preglottalized nasals are treated as [+constricted glottis] nasals, so phonetic [boʔni] ‘bottom (n.s.)’ is phonological /boŋi/, and interrupted nasals (as in [bonʔni] ‘bottom (a.s.)’) are long versions of these. Though (single) *b*, *d*, *z*, *ž*, *g* are phonetically voiced at least in inter-sonorant context, they are not necessarily phonologically / underlyingly voiced. However, we assume that the geminate voiced stops *bb*, *dd*, *zz*, *žž*, *gg* are phonologically voiced, since they contrast minimally (and alternate morphophonologically) with unaspirated geminate voiceless stops.

### 3. Q2 and Q3

While the existence of three phonological consonant grades is not controversial in the study of Saami, it is nevertheless crosslinguistically controversial to posit three-way length contrasts, and simply presuming a ternary length contrast without further analysis may obscure more interesting details of the language (see for example the case of Estonian — Lehiste 1966, Prince 1983 — which phonologically has an ordinary two-way segment length contrast interacting with surface-contrastive foot structure to yield a three-way surface difference). Here we consider basic phonetic and distributional data relevant to whether the language has more than a binary length contrast — a theoretically significant finding, if it holds up — and, if it does, how is that difference represented?

The following examples make a *prima facie* case for vowel length contrasts in the first syllable.

(14)	<b>balu</b>	‘fright (a.s.)’	<b>staalu</b>	‘troll (a.s.)’	<b>staallu</b>	‘troll (n.s.)’
	<b>dola</b>	‘fire (a.s.)’	<b>geeso</b>	‘cradle’	<b>goolli</b>	‘gold (a.s.)’
	<b>gobi</b>	‘depression (a.s.)’	<b>stoobe</b>	‘can’		
	<b>iʔmi</b>	‘uncle’s wife (n.s.)’	<b>liiʔmi</b>	‘broth (i.s.)’		
	<b>duʔmui</b>	‘judgment (i.s.)’	<b>duuʔmi</b>	‘bird-berry (i.s.)’		
	<b>horhtit</b>	‘dog sp. (n.p.)’	<b>hoorhtit</b>	‘dog sp. (a.p.)’		
	<b>dikkit</b>	‘parliament (n.p.)’	<b>diikkit</b>	‘parliament (a.p.)’		

Diphthong length differences are also justified by examples such as the following, which shown both inter- and intraparadigmatic alternations

(15)	<b>lūodda</b>	‘road (n.s.)’	<b>luotta</b>	‘road (a.s.)’
	<b>lūoʔni</b>	‘dirt (n.s.)’	<b>ruoʔma</b>	‘tracebearer (a.s.)’
	<b>čūonjaa</b>	‘goose (n.s.)’	<b>cuonju</b>	‘ice crust (n.s.)’
	<b>gūoddu</b>	‘stump (n.s.)’	<b>fuodđu</b>	‘wild animal (n.s.)’
	<b>gūottu</b>	‘stump (a.s.)’	<b>fuodđu</b>	‘wild animal (a.s.)’

Without going so far as to conclude that long and short vowels and diphthongs have unrestrictive

distribution in underlying representations,<sup>5</sup> we conclude that vocalic length should be included in transcriptions, even if it turns out to be in part predictable. It is clear that there is no automatic open-syllable lengthening, as found in some Germanic languages.

Two durationally-distinct degrees of preaspiration are clearly present in the language, as shown by the following examples.

(16)	mǐ <b>h</b> hki	‘sword (n. s)’	mie <b>h</b> ki	‘sword (a. s)’
	lǒa <b>h</b> hpa	‘end (n.s)’	loa <b>h</b> pa	‘end (a.s)’
	müo <b>h</b> h <b>t</b> aga	‘snow (a.s.)’	gie <b>h</b> ta	‘hand (n.s.)’

Three degrees of intervocalic consonant durational difference also exist.

(17)	gǔo <b>s</b> ’si	‘guest (n.s.)’	viessu	‘house (n.s)’	viesu	‘house (a.s.)’
	rǔo <b>l</b> ’laa	‘rude person (n.s)’	ruo <b>l</b> laa	‘rude person (a.s)’	njuola	‘arrow (a.s.)’
	rǔo <b>s</b> ’sa	‘cross (n. s.)’	ruo <b>s</b> sa	‘cross (a.s.)’	ruosa	‘Sweden (a.s.)’

It is important to notice that all examples of Q3 consonants — long pre-aspirates and CC’ — are preceded by a short vocalic nucleus, and all examples of Q2 consonants — simple preaspirates and CC — are preceded by a long nucleus. Our systematic finding is that the surface distinction between Q2 and Q3 is surface-predictable in this dialect, once vocalic length is taken into consideration: a long consonant (preaspirate or geminate) is Q2 after a long vowel or diphthong, and Q3 after a short vowel or diphthong. There are no examples of long vowel or diphthong plus long preaspiration, or short vowel and short preaspiration; similarly, there are no examples of long vowel or diphthong plus long geminate, or short vowel plus short geminate. The triple *rǔo’s’sa* / *ruossa* / *ruosa* demonstrates a three-way duration-based contrast, but does not establish whether the contrast is based on the consonant or the diphthong.

Reputed minimal pairs illustrating the difference between Q2 and Q3 are hard to find. For example, <ohca> ‘blouse pouch’ and <ohccá> ‘s/he searches’, which supposedly illustrate the difference with the former being Q2 and the latter being Q3, do not have different consonant lengths in this dialect although they have different final vowels — [ohhca] ‘blouse pouch’, [ohhcaa] ‘s/he searches’. Orthographic <bállu> (*bál’lu* in Kåven et al.) ‘testicle’ versus <ballu> ‘fear’ differ in vowel quality in any account, and in vowel length as well in this dialect (‘testicle’ = [baallu], ‘fear’ = [bal’lu]). The supposed perfect minimal pair <gárru> ‘he consents’ and <gár’ru> ‘consenter’ are in fact homophonous [gaarru].

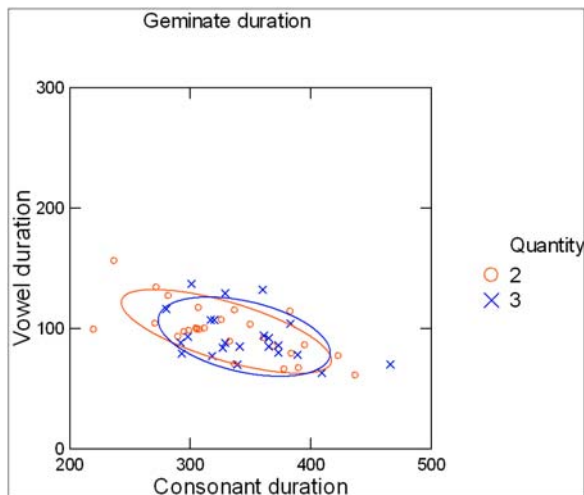
We therefore measured the duration of supposed Q2 and Q3 consonants in the context where we find no difference, namely geminates and preaspirates after short vowels. We compared words of the type C<sub>0</sub>VCV with a single short V and Q2 / Q3 consonant, the difference being determined either ‘reputationally’ (marked orthographically including via diacritics in the dictionaries of Kåven et al. or Nielsen, or thanks to personal communication with Pekka Sam-

<sup>5</sup> On the contrary, we assume that diphthong length is predictable, though a full investigation of those predictive principles is beyond the scope of this paper. We will allude to relevant generalizations as they become germane to the discussion.

mallahti), or by the morphophonemic evidence of gradation (whether the weak grade of the consonant is Q2 with preceding long vowel — presumptive Q3 — or Q1 with preceding short vowel — presumptive Q2). In the first set of words, we considered pairs such as supposed Q2 *ballu* ‘fear (n.s.)’ vs. Q3 *bollu* ‘bowl (n.s.)’, with comparable numbers of sibilants, voiced fricatives, *l*, *r* and nasals. The second set of words compares pairs such as supposed Q2 *bahhta* <bahta> ‘butt (n.s.)’ and *bahhka* <báhkka> ‘package (n.s.)’.

The graph below plots the duration of the geminate consonant against the duration of the preceding vowel in 36 tokens, with the two supposed consonant quantities marked.

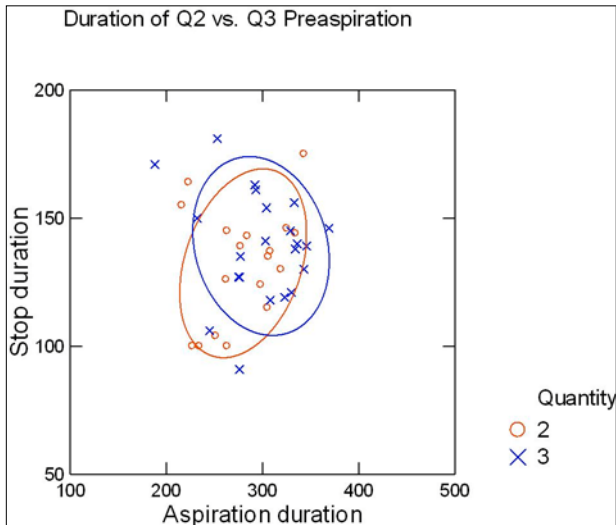
**Graph 1: Duration of geminates**



It can be seen that the durations of the two consonant types overlap, and that there is no measurable difference between Q2 and Q3 in this context. If the two consonant types were phonetically distinct, we would expect the shorter Q2 consonant durations to cluster towards the left side of the graph and the longer Q3 durations to cluster to the right, but they do not. Mean vowel duration is 99 ms; mean consonant duration of the supposed Q2 consonants is 330 ms and for supposed Q3 it is 341 ms: the difference between these numbers is not statistically significant. Interestingly, though, as can be seen from the downward trend in vowel versus consonant duration, vowel and consonant duration are inversely correlated, a statistically significant correlation ( $p < .001$ ). That is, V and C are in an isochronous, trade-off relation, suggesting an abstract phonetic goal of constant timing, a state that permeates our phonetic findings.

We find similar non-distinctness in the duration of preaspiration in graph 2, which shows the durational values for 45 tokens of aspirated stops after short vowels.

**Graph 2: Duration of geminates**



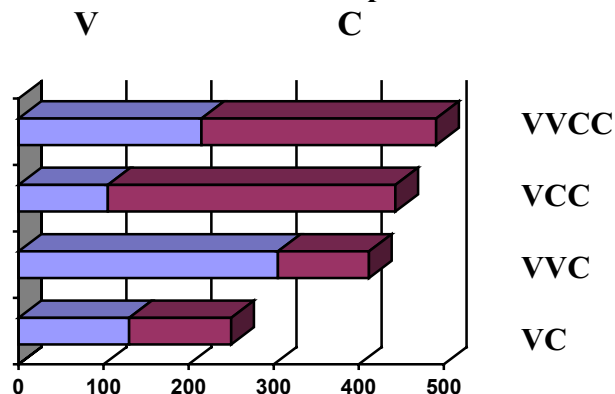
Mean vowel duration here is 72 ms. The mean durations of aspiration (Q2 = 284 ms, Q3 = 308 ms) and stop closure (Q2 = 132 ms, Q3 = 139 ms) are not significantly distinct, and it can be seen that the durations of the two supposed consonant degrees overlap substantially.

Even though the difference between Q2 and Q3 is not minimally contrastive (forming the basis of minimal pairs), there are clearly two non-contrastive, phonetically different durations of geminate and preaspirated consonant, correlated with the length of the preceding vowel. The mean durations (N=108) of vowels and consonants for all combinations of geminate and single consonants after long and short vowels are given in (18).

(18)	(V)V <sub>1</sub> duration	C duration	C quantity	example
VV <sub>1</sub> CCV	215	276	Q2	(baallu)
V <sub>1</sub> CCV	105	338	Q3	(ballu)
V <sub>1</sub> VCV	305	107	Q1	(staalu)
V <sub>1</sub> CV	130	120	Q1	(balu)

The relations between V and C duration are graphed below.

**Graph 3: Vowel / Consonant duration patterns**



The difference between simple vowel (a,e,o,i,u) and diphthong (ie, uo, ea, oa) is statistically insignificant in these durational patterns — what matters is the distinction long (ee, ea, uo) versus short (e, ěa, ůo). The duration of short vowels is not significantly determined by whether the following consonant is long or short (the difference 105 ms for VCCV versus 130 ms for VCV is not significant), thus the duration of *a* in words like *ballu* ‘fear (n.s.)’ and *lassa* ‘threshold (n.s.)’ is not statistically distinct from that in *balu* ‘fear (a.s.)’ and *lasa* ‘threshold (a.s.)’. The durational difference for single consonants after short vowels (107 ms) versus long vowels (120 ms) is not also significant, thus *s* has the same duration in words like *gusa* ‘cow (a.s.)’, *laase* ‘window (n.s.)’ and *viesu* ‘house (a.s.)’.

However, the difference in the duration of long vowels before single C (305 ms) and geminate C (215 ms) is highly significant ( $p < .001$ ). Thus *aa* in *laase* is much longer than *aa* in *gaassa* ‘cashier’ and *uo* in *vuodu* ‘bottom (a.s.)’ is much longer than it is in *vuoddu* ‘bottom (n.s.)’.<sup>6</sup> The length of a long consonant after a short vowel (338 ms) versus a long vowel (276 ms) is also significant ( $p < .001$ ), so *ss* is longer in *gũossi* ‘guest (n.s.)’ than in *guossi* ‘guest (a.s.)’.<sup>7</sup> Long vowels are maximally long in open syllables, and have a noticeably reduced duration in closed syllables. Long consonants conversely have their greatest duration after a short vowel. Sequences which have a long vowel or a long consonant have very similar total durations, and differ primarily in how the duration is distributed: to the vowel, the consonant, or more evenly split.

Aspiration differences are even clearer, as seen in (19) —N=100.

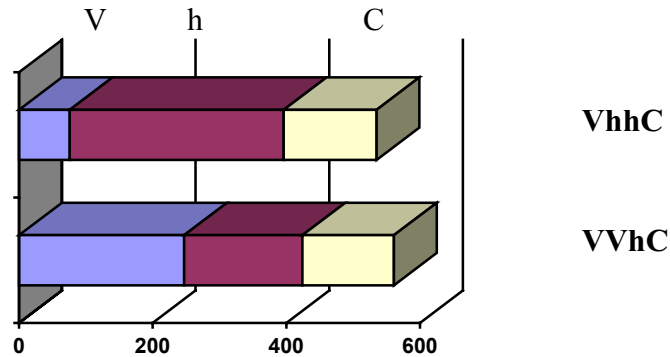
(19)		<i>V dur.</i>	<i>h dur.</i>	<i>stop dur.</i>	<i>C quantity</i>
	V	76	320	139	Q3
	VV	247	177	137	Q2

This relation is shown in Graph 4.

<sup>6</sup> Such duration-reduced long diphthongs are still longer than the phonologically short diphthongs of *gũoddu* ‘stump (n.s.)’.

<sup>7</sup> The durational ratio of surface Q2 to Q3 is .81, less distinct but similar to the ratio found by Magga 1984 for his three speakers (.69, .69 and .75).

**Graph 4: Vowel / Aspiration duration patterns**



Again, the monophthong / diphthong distinction is not significant (for V or C duration), and stop closure duration is constant across contexts. The differences in vowel and aspiration duration are both highly significant ( $p < .001$ ) for the two grades of aspiration, and the durations stand in an isochronous trade-off relation.

We conclude then that even though the distinction Q2 / Q3 is not contrastive for aspirates and geminates, being predictable from vowel length, it is nevertheless a phonetic reality. As such, we will include this phonetic fact in our transcriptions, so as to not prejudge the analysis of the phenomenon.

#### 4. The Gradation System: What Happens

Our main concern is the description of the gradation system. An illustration of a gradation alternation is given in the case and number paradigm of the noun *goahti* ‘big tent’, (20).<sup>8</sup>

(20)	<i>singular</i>	<i>plural</i>
nominative	goa <b>hti</b>	goa <b>đit</b>
accusative	goa <b>đi</b>	goo <b>đit</b>
illative	goa <b>htaai</b>	goo <b>đije</b>
locative	goa <b>đis</b>	goo <b>đin</b>
comitative	goo <b>đin</b>	goo <b>đigon</b>
essive	goa <b>htin</b>	

Case and number are marked by suffixation and the stem-internal consonantal modifications known as gradation, which are similar to the better-known alternations in Finnish (Harms 1964).

Gradation also affects verb inflection, as seen in the following present and preterite paradigms of *boahtit* ‘to come’.

<sup>8</sup> The forms given here are appropriate for the dialect — the written language has somewhat different endings, viz. *-guin* for com. pl, *-ide* for il. pl. and *-beahtti* for 2d pres.

(21)	<i>present</i>	<i>preterite</i>
1s	boa <b>ḏ</b> aan	boo <b>h</b> ten
2s	boa <b>ḏ</b> aat	boo <b>h</b> tet
3s	boa <b>h</b> taa	boo <b>ḏ</b> i
1d	boo <b>h</b> te	boo <b>ḏ</b> ime
2d	boa <b>h</b> tib <b>č</b> ahhte	boo <b>ḏ</b> ide
3d	boa <b>h</b> tiba	boo <b>ḏ</b> iga
1p	boa <b>h</b> tit	boo <b>ḏ</b> imet
2p	boa <b>h</b> tibeehteht	boo <b>ḏ</b> ideht
3p	boo <b>h</b> teht	boo <b>h</b> te

We set aside investigation into the morphosyntactic contexts where gradation occurs, and focus on the nature of the gradation alternation itself. Thus we concentrate on nominative singular vs. accusative singular forms, and for parallel verbal examples, present tense 1p versus 2s forms. The nominative singular, illative singular, and essive are referred to collectively as taking the ‘strong’ grade (similarly the 1s, 2s, 3p preterite are ‘strong’), and the remainder are referred to as taking the ‘weak’ grade, referring to the phonological effect generally found in these contexts. The general character of the gradation alternation is that the post-vocalic consonant is longer in the strong grade and shorter in the weak grade; there are a number of additional segmental complications and indeed contrary effects. Although the gradation alternations are largely predictable, some aspects are not predictable, for example, it is not possible to predict that ‘hay-rack’ alternates Q2 ~ Q1 (*aahci* ~ *aazi*) and ‘father’ alternates Q3 ~ Q2 (*ahhči* ~ *aahči*). The question of underlying representations is extremely complex and bound up in the theoretical details of the formal analysis, which we do not pursue here. We believe that the weak grade form reflects underlying prosody better, but the strong grade form tends to preserve segmental properties. At any rate, we hold that the underlying form is abstract in the usual way that phonological representations are abstract — they are not just the nominative, or just the accusative.

In our presentation of gradation effects, we give the main effects that affect stems with one intervocalic consonant first, starting with syllables having a bimoraic penult nucleus, and then consider the restricted set with a Q3 ~ Q1 alternation in section 5. In section 6, we proceed to stems with a consonant cluster. A partial schematic representation of the alternation listing some of the major manifestations of gradation is given below.

(22)	strong grade	weak grade	strong grade	weak grade
	...hp...	...b...	...hhp...	...hp...
	...ss...	...s...	...s’s...	...ss...
	...?m...	...m...	...m?m...	...?m...
	...bb...	...pp...	...Vr’s...	...jss...
	...rVs...	...rss...	...rVb...	...rpp...
	...rVhp...	...rhhp...	...ks...	...wss...

#### 4.1. Gemination (Q2)

The first gradation alternation is the Q2 ~ Q1 gemination alternation, which affects intervocalic geminate fricatives and sonorants. We assume that these stems have underlying single consonants, which are lengthened in the strong grade.

(23)	NS	AS	
	guolli	guoli	‘fish’
	staallu	staalu	‘troll’
	healla	heala	‘heel of shoe’
	viessu	viesu	‘house’
	siessaa	siesaa	‘paternal aunt’
	maannaa	maanaa	‘child’
	nuorra	nuora	‘young’
	nierra	niera	‘checkbone’
	mearra	meara	‘sea’
	gaaffe	gaafe	‘coffee’
	fuođđu	fuođu	‘wild animal’
	roađđi	roađi	‘redness’
	blaađđi	blaađi	‘sheet, leaf, newspaper’
	dievvaa	dievaa	‘mound’
	1p	2s	
	beassat	beasat	‘get away’
	eallit	calaat	‘be alive’
	goarrut	goarut	‘sew’
	jearrat	jearat	‘ask’
	leavvat	leavat	‘disperse’
	oađđit	oađaat	‘sleep’

A number of nouns have a voiceless geminate alveopalatal affricate in the strong grade, which becomes [j] in the weak grade. These are cases corresponding to <dj> in the standard orthography.

(24)	NS	AS	
	vuočča	vuoja	‘butter’
	guočča	guoja	‘wild sedge grass’
	riečča	rieja	‘noise’
	siečča	sieja	‘pus, stuff in wound, eye gunk’
	deačča	deaja	‘tea’
	gaačča	gaaja	‘loud noise, clamour’
	biečču	bieju	‘den’
	oačču	oaju	‘insurance’

veačču	veaju	‘one’s energy’
soačči	soaji	‘wing’
raačči	raaji	‘boundary between countries’
dūočči <sup>9</sup>	duoji	‘handicrafts’
sūočči	suoji	‘shelter from wind’
1p	2s	
veaččit	veajaat	be possible
vuoččat	vuojat	swim
vuoččit	vuojaat	drive

We treat these stems as having underlying single /j/, a class of stems which is lacking from the data of (23) but theoretically expected since other sonorants have been found to undergo a gemination alternation. The expected outcome of gemination in the strong grade would be *\*vuojsa*, *\*veajjit*, but intervocalic geminate *j* is nonexistent in the language. A segmental fortition rule then applies, turning /jj/ into a palatal obstruent, specifically an alveopalatal in this dialect. The appearance of a voiceless stop rather than a voiced one is unsurprising given that unmarked sonorants are voiced but unmarked obstruents are voiceless.

#### 4.2. Gemination (Q3)

Another plainly length-related alternation is between long and overlong geminates. As noted previously, Q3 and Q2 geminates are phonetically distinct, even though such differences are not involved in minimal pairs in that they appear exclusively after short vowels and diphthongs, where long vowels do not appear. As the following examples illustrate, Q3 geminates and short vowels or diphthongs appear in the strong grade, and Q2 geminates and long vowels or diphthongs appear in the weak grade.

(25)	NS	AS	
	gol·li	goolli	‘gold’
	rūol·laa	ruollaa	‘rude person’
	dūol·lu	duollu	‘toll’
	ĵiel·li	jielli	‘fish-drying rack’
	bol·lu	boollu	‘wooden cup; bowl’
	hurri	hurri	‘newcomer’
	burru	buurru	‘Taurus’
	jorri	joorri	‘something that goes around’
	pen·na	peenna	‘pen’
	cum·maa	cuummaa	‘kiss’
	lum·ma	luumma	‘pocket’

<sup>9</sup> We do not treat the alternation in diphthong length here, and defer full analysis to a later work. A recurring generalization is that the high diphthongs may be short before certain kinds of medial consonant and final vowel.

bin'naa	biinnaa	'bit of something'
bum'ma	buumma	'barracade'
gum'mi	guummi	'eraser'
rũos'sa	ruossa	'cross'
gũos'si	guossi	'guest'
ris'si	riissi	'twig'
rũoš'sša	ruošša	'Russia'
1p	2s	
vũoš'sšat	vuoššat	'cook'

To the above alternations we add the following examples with the palatal lateral.

(26)	NS	AS	
	dũol'ł'i	duol'ł'i	'reindeer skin'
	v'iel'ł'a	v'iel'ł'a	'brother'

If in fact the palatal lateral is intrinsically long, these forms could be transcribed narrowly as [dũol'ł'i] ~ [duol'ł'i], [v'iel'ł'a] ~ [v'iel'ł'a]. Since there is no contrasting Q1 palatal lateral, we will assume that /ł'/ is always long.

#### 4.3. Aspiration

The third gradation alternation is between aspirated and voiced obstruent, whereby in the weak grade, /hp ht hc hč hk/ become *b, đ, z, ž, g* — recall that <z> and <ž> represent the voiced affricates [dz] and [dž], which are plain stops. Examples of this alternation are found in (27).

(27)	NS	AS	
	čiehka	čiega	'corner'
	čiehkaa	čiegaa	'hidden treasure'
	neahpi	neabi	'nephew/neice of man'
	daahpi	daabi	'habit'
	geahči	geaži	'end'
	aahci	aazi	'hay-rack with hay'
	riehpu	riebru	'poor guy'
	goahči	goađi	'big tent'
	muohtu	muođu	'check'
	staahta	staađa	'state'
	aahpi	aabi	'sea'

Verbal examples are in (28).

(28)	1p	2s	
	stoahkat	stoagat	‘play’
	viehkak	vieगत	‘run’
	baahcit	baazaat	‘remain’
	boahtit	boađaat	‘come’
	diehtit	dieđaat	‘know’

All such stems have a long vowel or diphthong in the first syllable.

Given our treatment of *hp* and other preaspirates as fundamentally reflecting an aspiration contrast, the data of (27) are phonologically re-analysed along the following lines.

(29)	NS	AS	
	čiek <sup>h</sup> a	čieka	‘corner’
	neap <sup>h</sup> i	neapi	‘nephew/neice of man’
	daap <sup>h</sup> i	daapi	‘habit’
	geač <sup>h</sup> i	geači	‘end’
	aac <sup>h</sup> i	aaci	‘hay-rack with hay’
	riep <sup>h</sup> u	riepu	‘poor guy’

That is, underlyingly aspirated consonants deaspirate in the weak grade.

We must also face the problem that the output of gradation applied to /ht/ is [ð], not [d], which would be expected by parallelism with /hp/, /hk/, /hč/ and /hc/. A natural tack to take would be to posit a rule which simply turns any *d* into [ð] after a vowel; thus /muohtu/ → *muodu* → [muoðu]. That such a rule would have to be limited to postvocalic position is indicated by the fact that [ð] does not appear word-initially, and [d] does.

(30)	daahpi	‘habit’	davvi	‘north’
	deačča	‘tea’	dea?nu	‘large river’
	diddi	‘salmon sp.’	diuras	‘expensive’
	doaivu	‘belief’	doggi	‘stomach of ruminant’
	đuočči	‘handicrafts’	duvva	‘dove’

The stop [d] does exist post-vocally as in (31): but as noted in section 2.3, it is possible to interpret the high vowels *i*, *u* before [d] as a glide, *j*, *w*.

(31)	aaidi	‘fence’	dieudu	‘man’
	buuda	‘shop’	daaidu	‘ability’
	loaidu	‘sleeping place’	luoudi	‘wooden fishing float’
	naaudi	‘predatory animal’	njeida	‘daughter’

Such data are no problem for an assumed lenition of *d* to [ð], and in section 6, we show that these postvocalic high vowels function like consonants. Another major class of examples of postvocalic [d] includes with such as *mearedi* ‘fish net (n.s.)’, where the vowel *e* is epenthetic.

There are few nouns with non-epenthetic, clearly intervocalic *d*, as in *leade* ‘shed type’, and some tokens of the accusative singular *staada* ‘state’ (alongside *staaða*). Outside of gradation, intervocalic lenition of *d* to *ð* is even attested at the phrasal level, e.g. *dus* ‘you (loc. sg.)’, *leago ðus bïeragu* ‘do you have meat?’. Thus the further adjustment of expected *d* to [ð] is expected on language-internal grounds, though given words like *leade*, non-alternating [d] must be recognised as a phoneme.

#### 4.4. Aspiration-lengthening

Another gradation alternation affects underlyingly moraic aspirated consonants, which appear as long preaspirates in the strong grade and as simple preaspirates in the weak grade. In (32) we provide examples of stems with a short diphthong and a long preaspirated stop. In the weak grade — the accusative singular or 2 sg present — the diphthong is long and the aspiration is shortened.

(32)	NS	AS	
	gěahhčũ	geahčũ	‘surveillance’
	mïehhki	miehki	‘sword’
	sěahhka	seahka	‘bag’
	děahhka	deahka	‘deck’
	děahkki	deahki	‘meat’
	dïehhpi	diehpi	‘pompom’
	cũohhki	cuohki	‘reason, excuse’
	dõahhki	doahki	‘lump (eg in soup)’
	lõahhpa	loahpa	‘conclusion, termination’
	õahhpa	oahpa	‘teaching, doctrine’
	skũohhpu	skuohpu	‘case’
	1p	2s	
	běahhtit	beahtaat	‘deceive’
	gěahhčat	geahčat	‘look’
	gũohhput	guohput	‘mold’

The changes in preaspiration described in this and the previous section are obviously disjunctive. In the stems of 4.3, /hp/ becomes [b] in the weak grade, and in this group /hhp/ becomes [hp] in the weak grade: it does not then become \*[b]. We know of no reason to recognise short diphthongs as an underlying lexical category in the language distinct from long diphthongs, even though they are part of the surface phonological system, and we assume that short diphthongs always derive by rule, thus underlying *geahhčũ*, *mïehhki*, *seahhka*, *deahhka*, *deahhki*, and *diehpi* (or analogous representations with simple aspiration and length being derived in the strong grade) and there is automatic vocalic shortening before long aspiration.

Some stems have short simple vowels in the strong grade before a long preaspirated C, and a long vowel before the plain preaspirate consonant in the weak grade.

(33)	NS	AS	
	lahhti	laahti	‘floor’
	ahhč̥i	aahč̥i	‘father’
	ahhku	aahku	‘grandmother’
	lahhpa	laahpa	‘horn interface’
	nahhki	naahki	‘animal skin’
	mohhki	moohki	‘corner (natural)’
	čohhka	čohhka	‘top’
	duhhku	duuhku	‘smudge’
	lihhki	liihki	‘skin (human)’
	bihhci	biihci	‘frost’
	bihhka	biihka	‘tar’
	fysiihka	fysiihka	‘physics’
	faabriihka	faabriihka	‘factory’
	hehhke	heehke	‘hay frame’
	1p	2s	
	dahhtut	dahtut	‘request’
	mahhtit	mahta	‘know how’

We propose underlying forms such as /laahhti/, /aahhč̥i/, /aahhku/, /laahhpa/, /moohhki/ and /liihhki/. These examples are parallel to those in (32), differing only in whether the nucleus is monosegmental or bisegmental.

The following nouns have what seems to be an unrelated alternation, involving vowel length and a surface labial fricative of the type [ɸ] or [f].

(34)	NS	AS	
	ruɸɸtu	ruuɸtu	‘bus route’
	duɸɸki	duuɸki	‘handful of hair’
	luɸɸka	luuɸka	‘men’s upper garment’
	muɸɸki	muuɸki	‘dung’

Saami has no surface contrast between [ɸ] and [f], and the transcription of this segment as [ɸ] reflects a judgment about narrow phonetic transcription, but the sound in question might be written as [f].

These data can be accommodated into the pattern of (33) by reconsidering the transcription of the data. We propose that these stems do not contain *ɸ*, at least phonologically, but rather contain [u] followed by a preaspirated consonant, thus we retranscribe the data as follows.

(35)	ruhhtu	ruuhtu	‘bus route’
	duhhki	duuhki	‘handful of hair’

We claim that the phonetic percept [ϕ] arises from phonetic implementation. When the vocoid *u* overlaps preaspiration, turbulent airflow through the narrow lip opening results in a voiceless labial approximant, which could be more narrowly transcribed as [u̥] or [ϕ]. This gestural overlap and its perceptual consequences are represented schematically in (36).

(36)	ruuhtu = ruuϕtu		ruhhtu = ruϕϕtu		
	... { u }	...	... { u }	...	lips
	... { h }	...	... { h }	...	larynx
	... [u: ϕ ]	...	... [ u ϕ: ]	...	sounds like

The same phonetic process is also evident with the sequence [i] plus preaspiration, so that a narrower transcription of relevant examples from (33) would be (37).

(37)	[liççki]	[liiçki]	‘skin’
	[fysiççka]	[fysiiçka]	‘physics’
	[faabriççka]	[faabriiçka]	‘factory’

The reason for mentioning this phenomenon, especially in the case of /u+h/, is that the surface result, [ϕ], is very similar to an existing phoneme of the language, [f], and thus the issue of confusability of segments arises. Insofar as [ç] is neither a phoneme of the language nor particularly similar to [š] which is a phoneme, such a level of phonetic detail is omitted. We will encounter this phenomenon again in section 6.4, where it is implicated in the alternation [sakta] ~ [saϕϕta] ‘juice’, a borrowing from Norwegian *saft* — this indicates a perceptual connection between [f] and low-level [ϕ] derived from gesture-overlap as in (36).

#### 4.5. Nasal glottalization

In nouns which have a sequence of glottal stop plus nasal (i.e. a preglottalized nasal) in the strong grade, glottalization is lacking in the weak grade.

(38)	NS	AS	
	baaʔni	baani	‘tooth’
	daaʔmu	daamu	‘taming, training’
	laaʔna	laana	‘heap’
	raaʔmi	raami	‘boasting, prestige’
	saaʔma	saama	‘distant whispering sound’
	loaʔna	loana	‘loan’
	deaʔnu	deanu	‘large river’
	loaʔmi	loami	‘gap, open space’
	goaʔma	goama	‘overhanging edge’
	ruoʔma	ruoma	‘tracebearer’
	lieʔma	liema	‘broth’
	duoʔma	duoma	‘bird-berry’

jieʔna	jiena	‘voice’
vuoʔna	vuona	‘fjord’
suoʔna	suona	‘vein, sinew’
1pl.	2s	
oaʔnut	oanut	‘get shorter’
rieʔmat	riemat	‘start to do’
huʔmat	humat	‘speak’
aʔnit	anaat	‘use’
jaaʔmit	jaamaat	‘die’

The occurrence of glottalized nasals in the language is restricted, and it will be noticed that in the above data, the preceding onset consonant is oral. Historically, geminate nasals partially oralized when the preceding onset was oral (Sammallahti 1998). As far as we can determine synchronically, all geminate nasals are either preceded by a nasal in the preceding syllable (*maannaa* ‘child’) or are weak grade variants of (glottal) nasals after continuant sonorants (*čaalmmi* ‘eye (a.s.)’, cf. *čaaleʔmi* ‘eye (n.s.)’) and “overlong” nasals (*bumʔma ~ buumma* ‘barracade (ns, as)’).

The class of stems with glottalized nasals also includes roots with short monophthongs, given in (39).

(39)	NS	AS	
	laʔnja	lanja	‘room’
	aʔnu	anu	‘use’
	gaʔmu	gamu	‘instinct’
	raʔni	rani	‘crumb, morsel’
	čiʔma	čima	‘bend, bowing’
	čoʔma	čoma	‘mound’
	guʔna	guna	‘ash (tree)’
	hiʔmu	himu	‘desire’
	iʔmi	imi	‘uncle’s wife’
	joʔnja	jonja	‘lingonberry’
	roʔnu	ronu	‘fem. rein which is currently calfless’

There are also stems with high-vowel initial diphthongs, having a short diphthong in the strong grade and a long diphthong in the weak grade.

(40)	NS	AS	
	gũoʔmi	guomi	‘roof of mouth’
	bũoʔnji	buonji	‘hard part of horn’
	fũoʔni	fuoni	‘bad’
	lũoʔni	luoni	‘dirt’
	dũoʔmu	duomu	‘judgment’
	lũoʔmu	luomu	‘holiday’

jũoʔmu	juomu	‘sheep's sorrel, sorrel’
vũoʔmi	vuomi	‘broad, marshy river valley’
1pl.	2s	
fũoʔnut	fuonut	‘get worse’
dĩeʔnut	dienut	‘hem clothing’
šlĩeʔnjut	šlienjut	‘gleam’

The data in (38) and (40) reflect an interesting generalization about the distribution of length in diphthongs in the language. While *ea*, *oa* are nearly always long, *ie*, *uo* are often short, and length depends on the grade, the kind of following consonant, and the vowel of the following syllable. Here we observe that the short diphthongs are followed by *i*, *u*. In other areas of the phonology, *i*, *u* and *aa* act as a class with respect to the length of the diphthongs *ie*, *uo*,<sup>10</sup> triggering short diphthongs. Our data do not include any noun stems with glottalized nasal having *aa* in the second syllable, so we do not know if such nouns also show short diphthongs in the strong grade, but we predict that they would.

#### 4.6. Interrupted Nasals

Related to deglottalization is a process whereby glottally-interrupted nasals of the strong grade become pre-glottalized in the weak grade.

(41)	NS	AS	
	gunʔni	guʔni	‘honor’
	biemʔmu	bĩeʔmu	‘food’
	eanʔni	ěaʔni	‘mother’
	boanʔnji	boaʔnji	‘husband’
	bonʔni	boʔni	‘bottom’
	finʔnu	fiʔnu	‘project, enterprise’
	sumʔmi	suʔmi	‘sum’
	1pl.	2s	
	bĩemʔmat	bieʔmat	‘feed’
	camʔmit	caaʔmat	‘hit, thrash’
	cimʔmut	ciʔmut	‘hold on’
	dũonʔnjat	duoʔnjat	‘patch a hole’

Interrupted nasals are not very frequent in the language, so it is difficult to extract clear generalizations regarding the diphthong-length generalizations in these data.

<sup>10</sup> Diphthongs cannot generally precede the underlying vowels *e*, *o*.

#### 4.7. Voicing

One manifestation of gradation involves a voicing alternation in stops (some of which are affricates), where the strong grade has voiced geminate stops and the weak grade has voiceless geminate stops. The data of (42) illustrates this pattern after long vowels and (non-high) diphthongs.

(42)	NS	AS	
	speažži	speačči	‘flat-chested person’
	loažži	loačči	‘abated wind’
	baazzi	baacci	‘obelisk, monument’
	jeaggi	jeakki	‘marsh’
	deaddu	deattu	‘weight’
	faaddaa	faattaa	‘fire-starter (tinder)’
	reabbaa	reappaa	‘crab’
	roadda	roatta	‘club, bat’
	daabbaa	daappaa	‘upper forearm marrow bone’
	aagga	aakka	‘objection, pretext’
	goabbaa	goappaa	‘which of two’
	aažža	aačča	‘grandfather’
	1pl.	2s	
	aabbut	aapput	‘boil over’
	čaabbut	čaapput	‘become prettier’
	gaaddit	gaattat	‘believe’
	oažžut	oaččut	‘get, can’
	soabbut	soapput	‘walk with a stick’
	speažžut	speaččut	‘slap’

The same alternation exists after short monophthongs.

(43)	NS	AS	
	loddi	lotti	‘bird’
	diggi	dikki	‘parliament’
	biddu	bittu	‘woman’s winter legging’
	biddi	bitti	‘sappy wood’
	cigga	cikka	‘dog name’
	gabba	gappa	‘all-white reindeer’
	boddu	bottu	‘chapter’
	bodda	botta	‘time’
	roggi	rokki	‘depression, hollow’
	mugga	mukka	‘jug’

1pl.	2s	
addit	attat	‘give’
baggat	bakkat	‘swell’
coggat	cokkat	‘put stuff’
riggut	rikkut	‘become rich’
roggat	rokkat	‘dig’
suddat	suttat	‘melt’
viggat	vikkat	‘try’

With high diphthongs, the length of the diphthong correlates with the following vowel and the grade of the consonant. When the following vowel is *u*, *i*, *aa*, the diphthong of the first syllable is uniformly short in strong and weak grades.

(44)	NS	AS	
	gǐeddi	gǐetti	‘meadow’
	dūoggi	dūokki	‘clump in hair’
	gūoddaa	gūottaa	‘mattress’
	mūoddaa	mūottaa	‘reindeer fur dress’
	rūobbi	rūoppi	‘wart’
	gūoddu	gūottu	‘stump’
	dūobbaa	dūoppaa	‘one / other’
	jūobbaa	jūoppaa	‘one of two’
	dūoddi	dūotti	‘st. which helps protect or economize’
	gūoggi	gūokki	‘very bent one’

We find the same pattern in verbs, noting that verbs with the underlying theme vowel *aa* are always non-gradating. In verbs whose second stem vowel is /i/, the length of the vowel in the first syllable is determined by the underlying quality of the second vowel, which in the examples below changes to [a] in the 1st and 2nd person singular.

(45)	1pl.	2s	
	čūoggut	čūokkut	‘prick, make a hole’
	čūožžut	čūoččut	‘stand’
	dūoddut	dūottut	‘dare’
	dūoggut	dūokkut	‘be lumpy’
	gūoddit	gūottat	‘carry’
	gūoggut	gūokkut	‘bend’
	jūoddit	jūottat	‘be restless’
	rūobbut	rūopput	‘get a rash’

When the second syllable contains underlying *a*, the diphthong alternates between short in the strong grade and long in the weak grade.

(46)	NS	AS	
	bĭegga	biekka	‘wind’
	vŭogga	vuokka	‘fishhook’
	cŭozza	cuocca	‘membrane’
	lŭodda	luotta	‘footprint, road’
	1pl.	2s	
	bĭeggat	biekkat	‘blow (wind)’
	cĭeggat	ciekkat	‘sink in’
	gĭeggat	giekkat	‘grow new branches’

## 5. Q3 ~ Q1 alternations

In the preceding section, alternations with geminates and aspirates have involved longer consonants in the strong grade and forms that are one length-degree shorter in the weak grade — Q3 ~ Q2 or Q2 ~ Q1 — and in all cases, the stressed nucleus is generally long (which shortens if the consonant is Q3), save for the fact that high diphthongs are predictably short in certain contexts. A number of stems have an alternation between a Q3 consonant (overlong geminate or preaspirate) and a Q1 single, unaspirated (voiced) consonant. Nouns with preaspiration are seen in (47).

(47)	NS	AS	
	gohhpi	gobi	‘depression in land’
	jahhki	jagi	‘year’
	lihmpi	libi	‘ridge’
	lohmpi	lobi	‘permission’
	skuhhĉi	skuži	‘something crooked’
	suhhĉi	suži	‘frost’
	vihhki	vigi	‘injury’
	bohhtu	bođu	‘isolated cluster of trees’
	gohhcu	gozu	‘wakeness’
	rihhtu	riđu	‘strong storm’
	bahhta	bađa	‘butt’
	johhka	joga	‘river’
	ohhca	oza	‘pouch under blouse’
	rihhpa	riba	‘splinter, bit of straw’
	ruhhta	ruđa	‘money’
	skihhpa	skiba	‘sickness’
	sohhka	soga	‘family’
	stuhhĉa	stuža	‘splash’

Examples of Q3 geminate consonants after short vowel are given in (48).

(48)	NS	AS	
	dav'vi	davi	‘north’
	vaš'si	vaši	‘hatred’
	las'si	lasi	‘extras’
	dil'li	dili	‘situation’
	as'si	asi	‘back of a skin’
	bih'li	bihli	‘front of a sled’
	bal'lu	balu	‘fright’
	gul'lu	gulu	‘hearing’
	riš'su	rišu	‘shower’
	viv'vaa	vivaa	‘son-in-law’
	nav'va	nava	‘hairs soaked off hide’
	gus'sa	gusa	‘cow’
	las'sa	lasa	‘threshold’
	dol'la	dola	‘fire’
	jas'sa	jasa	‘patch of late spring snow’
	čađ'đa	čađa	‘carbon; charcoal’
	nađ'đa	nađa	‘axe handle’
	giđ'đa	giđa	‘spring’
	suf'faa	sufaa	‘sofa’
	skah'ra	skahra	‘continous rattling sound’
	skuh'ra	skuhra	‘snoring, rumbling’
	cih'ra	cihra	‘squeaking of mice’

Note that all such stems have a short monophthong: there are no alternations of the type *\*jahhki* ~ *jaagi*, *\*sōahhpi* ~ *soabi*.

Examples of /j/ which hardens to [čč] when geminate are in (49).

(49)	ičča	ija	‘night’
	lačču	laju	‘lead’
	ločči	loji	‘subdued, tame’
	sučča	suja	‘reason’

We do not find a noticeable difference in duration in the strong-grade stop here, though we have not subjected such examples to careful instrumental investigation. The traditional Q3 consonant corresponding to orthographic <dj> is phonetically [žž], thus /j/ does not in fact become traditional Q3 after a short vowel.

Bearing in mind that that there is no surface contrast between Q2 and Q3 after short vowels, a simple analysis of this pattern is that the medial consonant is a Q2 geminate or preaspirate, and its duration is phonetically increased because the preceding nucleus is short. Thus the examples in (47) differ from those in (27) and (23) only in the length of the nucleus; phonologically these data can be analysed as *jahki* ~ *jagi* and *navva* ~ *nava*.

## 5.1. Interim Summary

The portion of the gradation alternations which we have considered so far are summarized below.

(50)	ll ~ l	guolli	guoli	‘fish’
	ll: ~ ll	penˈna	peenna	‘pen’
	hp ~ b	daahpi	daabi	‘habit’
	hhp ~ hp	m̃iehhki	miehki	‘sword’
	?m ~ m	joʔnja	jonja	‘lingonberry’
	mʔm ~ ?m	gunʔni	guʔni	‘honor’
	bb ~ pp	gabba	gappa	‘all-white reindeer’

## 6. Consonant Clusters

Stems with a medial consonant cluster exhibit a noticeably different pattern of alternations in connection with strong vs. weak grades. Whereas stems with a single intervocalic consonant tend to have a shorter version of the (onset) consonant in the weak grade, those with a medial cluster tend to have a longer onset consonant in the weak grade. At the same time, there is usually an increase in duration in the postvocalic coda consonant in the strong grade, though this is a phonetically subtle and non-contrastive lengthening. There is, in addition, a vowel epenthesis alternation associated with the strong grade, along with certain segmental modifications.

Another property which sets C-cluster stems apart from ...VCV stems is that there are fewer contrasts. Vowel length does not contrast, and there are fewer consonant types (only always-aspirated, preglottalized, or single plain stops, no underlying geminate consonants).

### 6.1. Coda glides

The majority of stems with medial clusters have a sonorant plus C cluster. A number of such stems have phonological glides /j/ or /w/ plus a consonant, which we begin with. There is a difference, discussed in section 2.3, in the quality of the glides in the strong and weak grades where the strong grade glide is longer and more vowel-like and the weak grade glide is shorter and more consonant-like. This justifies different phonetic transcriptions, even though in most examples one could attribute the difference to the number of consonants following. As (51) shows, such stems have a longer glide plus a singleton consonant in the strong grade, whereas in the weak grade, the final consonant is lengthened and the glide is not lengthened.

(51)	NS	AS	
	mojˈvi	mojvvi	‘chaos’
	deajˈvu	deajvvu	‘finding where one is going’
	vejˈva	vejvva	‘crank’
	doajˈvu	doajvvu	‘belief’
	rujˈvi	rujvvi	‘mess’

saaj'va	saajvva	'fresh water'
duj'vi	dujvvi	'disorder'
sij'vu	sijvvu	'travel conditions'
lij'va	lijvva	'vest'
gūow'lu	gūowllu	'area'
čoaw'ji	čoawjji	'stomach'
aaj'ru	aajrru	'oar'
jaaw'ri	jaawrri	'lake'
mūow'la	muowlla	'deep snow'
liew'la	liewlla	'humidity in sauna'
daaw'li	daawlli	'light spot or stain'
leaj'ra	leajrra	'clay'
reaj'su	reajssu	'trip'
aaj'saa	aajssaa	'sled trace'
gaaj'saa	gaajssaa	'peak'
čaj'hni	čajhhni	'freckle, woodpecker'
how'ro	howrro	'restless one'
dij'la	dijlla	'brick; diamond (cards)'
beaj'vi	beajvvi	'day'
doaw'hli	doawhhli	'blister'
baw'hli	bawhhli	'bulge, lump'
diw'ri	diwrri	'insect'
hew'ro	hewrro	'damp'
muw'ra	muwrra	'wall'
buw'ri	buwrri	'shed'
buw'ru	buwrru	'porridge'
1pl.	2s	
vaaj'lut	vaajllut	'lack'
doaj'vut	doajvvut	'believe'
laaw'lut	laawllut	'sing'

Intervocalic voiced stops are uncommon in the strong grade. In the post-consonantal context they are not rare, and regularly alternate with voiceless geminate stops in the weak grade. The appearance of single voices stops is not exceptional if the vocoid in question is a phonological glide.

(52)	NS	AS	
	aaj'gi	aajkki	'time'
	biw'gi	biwkki	'barley'
	čuw'di	čuwtti	'forefinger, index finger'
	gūow'di	gūowtti	'dragon'
	leaj'bi	leajppi	'tree sp.'

nij'bi	nijppi	'knife (that has a sheath)'
rūow'di	rūowtti	'iron, dung-beetle'
saj'di	sajtti	'saithe (pollock)'
dīew'du	dīewttu	'man'
laaj'gu	laajkku	'lease'
sij'du	sijttu	'page'
njaw'ge	njawkke	'smooth-coated dog'
šaaw'ge	šaawkke	'energetic one'
guw'ge	guwkke	'pale brownish yellow dog'
čūow'ga	čuowkka	'light'
leaw'ga	leawkka	'flag'
niej'da	niejtta	'daughter'
rūoj'da	ruojtta	'shank, stump'
saaw'za	saawcca	'sheep'
sij'da	sijtta	'reindeer camp'
šie'da	siejtta	'person who can't stand being touched'
1pl.	2s	
dow'dat	dowttat	'feel, know'
čuow'gat	čuowkkat	'shine'
hoj'gat	hojkkat	'push'

We derive this alternation from underlying stems of the type /biwki, niejta/ with a plain stop which undergoes intervocalic voicing when single (in the strong grade) but not when geminate (in the weak grade). Note again that high diphthongs are invariably short before *i*, *u* in the second syllable, and alternate between strong-grade short and weak-grade long before *a*.

Some stems have an underlying aspirated stop, which is seen directly in the strong grade, and in the weak grade, the stop becomes long-preaspirated.

(53)	NS	AS	
	muj'htu	mujhhtu	'memory'
	buj'hku	bujhhku	'knife'
	duj'hpi	dujhhpi	'slow person'
	laaj'hkaa	lajhhkaa	'lazy person'
	leaj'hka	leajhhka	'joke'
	luoj'htu	lūojhhtu	'release, calculation'
	ruj'htu	rūjhhtu	'cooking pot'
	šaj'hke	šajhhke	'black dog with long-carrying bark'
	saj'hti	sajhhti	'javelin (sports)'
	bij'hpu	bihhpu	'pipe'
	cij'hku	cihhku	'female dog or beast of prey'

1pl.	2s	
luoj <sup>h</sup> hkat	luoj <sup>h</sup> hkat	lend
muj <sup>h</sup> htit	muj <sup>h</sup> httat	to remember

Other similar stems appear to manifest gradation via deletion of the glide *w*, as illustrated in (54), in some cases with lengthening of the preconsonantal fricative.

(54)	NS	AS	
	gaawfpi	gaafpi	‘store’
	laawfka	laafka	‘backpack’
	laawfki	laafki	‘step’
	doawfki	doafki	‘stupid’
	ruufke	ruffke	‘mine (for ore)’

Here, the strong grade has diphthongs ending in [u] or the long vowel [uu], followed by a cluster *f*+voiceless consonant, and the weak grade seems to delete the (second) *u*. In light of the discussion of *u+h* sequences in section 4.4, these data can be reinterpreted as involving no labial fricative at all, given the following alternative transcriptions.

(55)	NS	AS	
	gaaw <sup>h</sup> hpi	gaawhhpi	‘store’
	laaw <sup>h</sup> hka	laawhhka	‘backpack’
	laaw <sup>h</sup> hki	laawhhki	‘step’
	doaw <sup>h</sup> hki	doawhhki	‘stupid’
	ruw <sup>h</sup> hke	ruwhhke	‘mine (for ore)’

The data in (53) provide a straightforward motivation for the assumption that plain preaspiration becomes overlong after a diphthong ending with a high vowel, and the surface phonological transcriptions in (55) reflect that assumption. The more phonetic transcriptions in (54) simply reflect the perceptual similarity of coda [f] and devoiced [ɸ].

## 6.2. Nasals and liquids

Consonants other than glides can appear in sonorant+C clusters, and analogous alternations are found with nasal consonant plus continuant. The surface phonological alternation below involves lengthening of the final consonant in the weak grade, where the cluster is non-homorganic. As with preconsonantal glides, we notate the fact that the post-tonic consonant is somewhat longer, even though that length could be predicted by reference to the following single versus geminate consonant.

(56)	NS	AS	
	him'si	himssi	'silly girl'
	lim'si	limssi	'inappropriately behaved'
	loam'sši	loamšši	'inappropriate, baggy clothes'
	leam'sši	leamšši	'short, fat woman or female reindeer'
	leam'si	leamssi	'too small for one's clothes'
	šaj'ra	šajrra	'genre'

With stops, there is the additional effect of voicing the single stop between voiced segments in the strong grade.

(57)	NS	AS	
	leaŋ'ga	leaŋkka	'shoulder harness for reindeer'
	heŋ'ge	heŋkke	'cliff'
	roŋ'ge	roŋkke	'big bell w/ loud sound'
	leŋ'ge	leŋkke	'harness part'
	raam'bi	raamppi	'cripple, lame'
	faaŋ'ga	faaŋkka	'prisoner'
	doaŋ'gi	doaŋkki	'clumsy person'
	bum'baa	bumppaa	'chest of furniture'
	gaan'da	gaantta	'boy'
	1pl.	2s	
	heaŋ'gat	heaŋkkat	'hang'

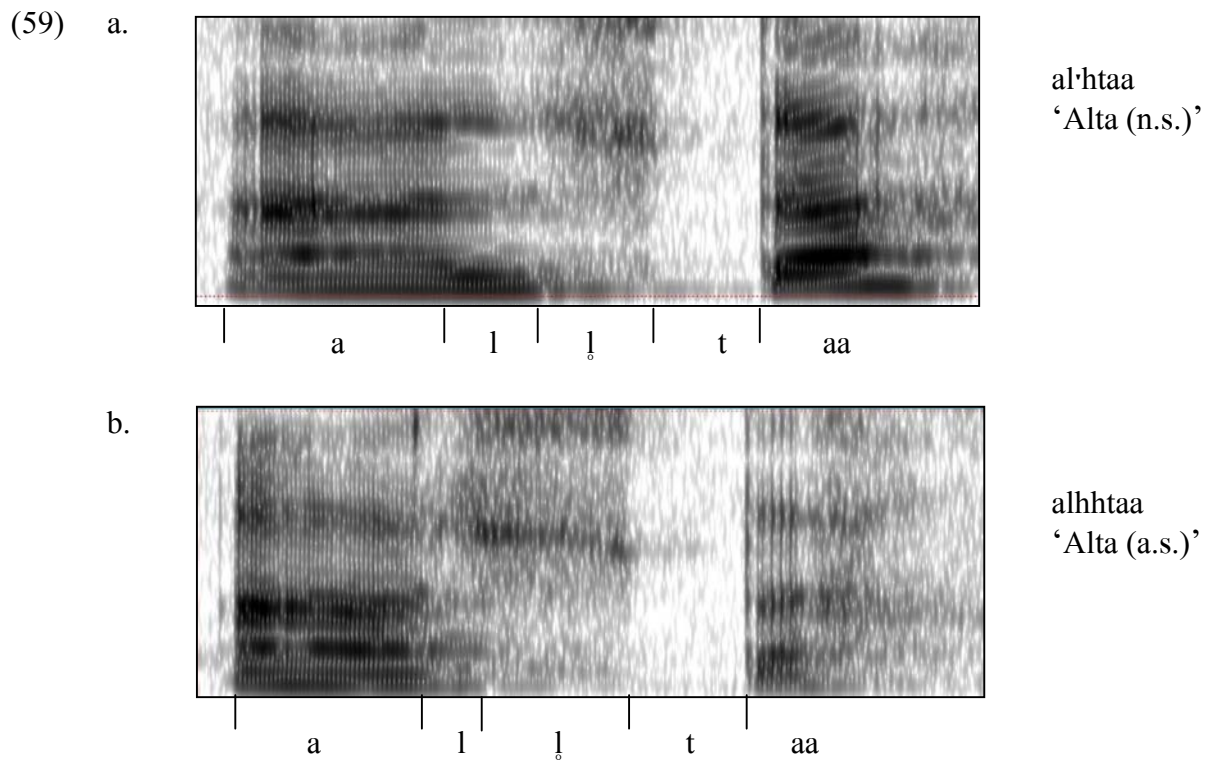
Clusters of /l/ plus alveolar stop behave the same as nasal plus consonant clusters

(58)	NS	AS	
	gïel'da	gïel'tta	'community'
	gïel'du	gïel'ttu	'prohibition'
	müol'du	müol'ttu	'topsoil'
	aal'du	aal'ttu	'female reindeer'
	beal'du	beal'ttu	'arable land'
	1pl.	2s	
	düol'dat	duol'ttat	'be boiling'
	čol'gat	čol'kkat	'spit'

These examples are in all relevant ways analogous to nouns like /nieida/.

The final consonant can also be aspirated, in which case the effect is realized as lengthening of the aspiration of the aspirate. The extension of aspiration overlaps the preceding sonorant, and the acoustic consequences are small but real. Compare the spectrograms in (59). In

(59a), *al'htaa* ‘Alta (n.s.)’, the voiced period of the lateral *l* is 90 ms, and the voiceless period is 105 ms. In (59b), the voiced period to *l* lasts only 35 ms and the voiceless period lasts 181 ms.



Examples of such nouns are given in (60).

(60)	NS	AS	
	gum'hpe	gumhhpe	‘wolf’
	šluŋ'hke	šlunhhke	‘flap-eared dog’
	aal'htaa	aalhhtaa	‘Alta’
	baaŋ'hku	baaŋhhku	‘bank’
	saal'hti	saalhhti	‘salt’

### 6.3. Epenthesis

A number of stems appear to have the shape CV(V)CVCV in the strong grade. Trisyllabic noun stems with a final vowel are restricted, and true trisyllabic stems (such as *huteella* ‘hotel’) are loanwords with other special properties. Unexceptional apparent trisyllables are given below. Stems of this type always have a coronal approximant, *ð*, *r* or *l*, as the medial consonant. In the weak grade, the medial vowel is lacking and the final consonant is lengthened. In the examples of (61)-(63), the second consonant simply lengthens in the weak grade as expected. The default epenthetic vowel, *a*, is seen in (61).

(61)	NS	AS	
	aaraja	aarjja	‘effort’
	njüoraju	njüorjju	‘seal (mammal)’
	garajaa <sup>11</sup>	garjjaa	‘crow’
	balava	balvva	‘cloud’
	düolava	duolvva	‘filth’
	gilavu	gilvvu	‘competition’
	alava	alvva	‘energy’
	büolava	buolvva	‘generation’
	balasa	balssa	‘mound’
	hirasa	hirssa	‘big log’
	burasa	burssa	‘wallet’
	düorašu	düorššu	‘mallard’
	1pl.	2s	
	čüoravut	čüorvvut	‘yell’
	doarajut	doarjjut	‘side with’

Before the front vowels *i*, *e*, the epenthetic vowel is *e*.

(62)	NS	AS	
	girese	girsse	‘permafrost’
	darefi	darffi	‘turf’
	maarefi	maarffi	‘sausage’
	jarefe	jarffe	‘dog name’
	barefe	barffe	‘long-haired dog’
	lurefe	lurffe	‘shaggy dog’
	gireji	girjji	‘book’
	müoreji	müorjji	‘berry’
	arevi	arvvi	‘rain’
	doalevi	doalvvi	‘a trot’
	doreve	dorvve	‘musical horn’

Between round vowels, the vowel is *o* (except that *o* of the diphthong *uo* cannot be the context for rounding, see *njüoraju* ‘seal’).

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<sup>11</sup> The epenthetic vowel varies in phonetic length between short as in *aaraja* and half-long in *njüoraju*, *garaja*, correlated with the length of the preceding vowels or diphthong. This is no doubt connected with the phonetic partial lengthening responsible for the surface final *a* / *ə* difference noted in section 2.2.

(63)	NS	AS	
	oloju	olju	‘oil’
	guđoju	guđju	‘cocoon, cover’

When the last consonant of the stem is a stop, in the strong grade it becomes voiced,<sup>12</sup> and lengthens (remaining voiceless) in the weak grade. Epenthetic *a* is found in (64).

(64)	NS	AS	
	gealabu	gealppu	‘ability’
	m̄ielaga	mielkka	‘sternum’
	baragu	barkku	‘work’
	silaba	silppa	‘silver’
	virago	virikko	‘dog name’
	ḡuoraga	guorkka	‘crane (bird)’
	ḡuolaga	guolkka	‘fur’
	boraga	borkka	‘snowstorm’
	čolaga	čolkka	‘spit’
	b̄ieragu	b̄ierkku	‘meat’
	s̄ieđaga	s̄ieđkka	‘goat willow’
	loađagu	loađkku	‘short-eared owl’
	1pl.	2s	
	baragat	barkkat	‘work’
	čielagat	čielkkat	‘clarify’
	čolagat	čolkkat	‘spit’

The front epenthetic vowel *e* is seen in (65).

(65)	NS	AS	
	gaalebi	gaalppi	‘calf’
	mearedi	meartti	‘fishnet’
	j̄uolegi	j̄uolkki	‘foot’
	bealegi	bealkki	‘thumb’
	hearegi	hearkki	‘reindeer bull’
	vealegi	vealkki	‘debt’
	v̄uorebi	v̄uorppi	‘fate, destiny’
	aarebi	aarppi	‘inheritance, bequest, heritage’
	geađegi	geađkki	‘stone’
	beađebi	beađppi	‘shoulder blade’
	čoađegi	čoađkki	‘duck sp.’
	daađevi	daađvvi	‘spleen’

<sup>12</sup> Note that derived *d* does not lenite to a fricative, as it ordinarily does after a vowel.

jorebe	jorppe	‘dog with not much tail’
čurege	čurkke	‘grey dog’
njaarebe	njaarppe	‘short-haired animal’
1pl.	2s	
aalegit	aalkkat	‘start’
vüolegit	vuolkkat	‘burn’

Another class of epenthesis examples, analogous to those in (64)-(65), has a coronal approximant followed by a preaspirated consonant. The question arises whether there is phonetic lengthening of the preaspiration in the weak grade. This cannot be definitively answered without a detailed phonetic study; we assume that there is lengthening partially because there is weak-grade lengthening in similar cases of resonant plus preaspirate such as [muj·htu] ~ [mujhhtu] ‘memory (n.s., a.s.)’ and [aal·htaa] ~ [aalhhtaa] ‘Alta (n.s., a.s.)’.

(66)	NS	AS	
	nůorahtu	nůorhhtu	‘north wind’
	culehci	culhhci	‘protrusion’
	birahcu	birhhu	‘dice’
	mielehki	mielehki	‘milk’
	đielahku	đielhhu	‘spot, stain’
	direhči	dirhhuči	‘naked person’
	baarehti	baarhhti	‘bad luck’
	daalehki	daalhki	‘bad weather’
	dorahka	dorhhu	‘inside-out reindeer skin dress’
	goalehki	goalhki	‘not windy’
	dilahko	dilhko	‘black dog w/ white spots’
	mirahku	mirhhu	‘poison’
	baarehti	baarhhti	‘accident; problem’
	bielehka	bielehka	‘batten’
	balahkaa	balhkaa	‘salary’
	čurehti	čurhhti	‘butt’
	burehke	burhhu	‘can, tin’
	earahta	earhhta	‘pea’
	füolehki	füolhki	‘relative’

Finally, examples involving a vowel before preglottalized nasal are seen below. In the first group, we simply find an epenthetic vowel after *r*, and no vowel in the weak grade.

(67)	NS	AS	
	baareʔni	baarʔni	‘son’
	fiereʔmi	fierʔmi	‘fishing net’
	gũoreʔmi	gũorʔmi	‘load’
	šaaraʔma	šaarʔma	‘charm’
	deareʔmi	dearʔmi	‘hill’
	dearaʔna	dearʔna	‘raw milk’
	doaraʔna	doarʔna	‘tower’
	čoraʔma	čorʔma	‘fist’
	bieraʔna	bierʔna	‘bear’
	biereʔni	bierʔni	‘bear cub’
	sũoraʔma	suorʔma	‘finger’
	horaʔmaa	horʔmaa	‘fireweed’
	1pl.	2s	
	goaraʔnjut	goarʔnjut	‘climb’

However, when the preceding consonant is a continuant, the glottalized nasal deglottalizes and lengthens in the weak grade. Nouns with /l/ preceding a glottalized nasal are seen in (68).

(68)	NS	AS	
	aalaʔnja	alnnja	‘gum (in the mouth)’
	njaleʔmi	njalmmi	‘mouth’
	aleʔmi	almmi	‘sky; heaven’
	čũolaʔma	čuolmma	‘problem; knot’

To these examples we add nouns with underlying /ð/ followed by a preglottalized nasal. When a vowel is not inserted in the weak grade, the nasal deglottalizes and lengthens, and /ð/ becomes [n]. There are no cases of underlying /nm/, so this does not result in neutralization.

(69)	NS	AS	
	gĩeðeʔmi	gĩenmmi	‘frying pan; bucket?’
	lĩeðeʔmi	lĩenmmi	‘broadening of antlers’
	leaðaʔma	leanmma	‘trunk partition’
	čaðeʔmi	čanmmi	‘freckle’

Deglottalization and lengthening of nasals occurs after underlying glides, as well, where there is no epenthesis.

(70)	NS	AS	
	vuojʔnaa	vuojnnaa	‘spirit’
	laawʔnji	laawnnji	‘sod’
	maajʔnu	maajnnu	‘praise’

řewʔnu	řewnnu	‘straight pin’
saajʔma	saajmma	‘fine-mesh fishnet’
iwʔni	iwnni	‘color’
vowʔna	vownna	‘baby buggy’
dijʔmu	dijmmu	‘hour’
doajʔma	doajmma	‘function’
duwʔni	duwnni	‘garbage dump’
lijʔni	lijnni	‘shawl’
kapteajʔna	kapteajna	‘captain’
lijʔni	lijnni	‘cloth’
geajʔnu	geajnnu	‘way’
ajʔmu	ajmmu	‘world; air’
1pl.	2s	
čajʔmat	čajmmat	‘laugh’
oajʔnut	oainnut	‘see’

#### 6.4. Labial Fortition

Nouns with a *k* plus coronal stop cluster in the strong grade have apparent lenition of that *k* to [f] before a stop in the weak grade. Note that there are no other stop+C clusters in the language, apart from rare ones in the pre-topic syllables of borrowed words such as *kapteaiʔnu* ‘captain’.

(71)	NS	AS	
	gaakti	gaafti	‘jacket’
	faakta	faafta	‘keeper’
	mokta	moofta	‘inspiration’
	dikta	diifta	‘poem’
	gikta	giifta	‘sinker on net’
	sikta	siifta	‘line of sight’
	řiekti	řiefti	‘right, justice’
	baakti	baafti	‘cliff’
	oakti	oafti	‘intermittent rain or snow’
	coakci	coafci	‘foothold’
	cũokca	cuofca	‘ice bridge’
	roakči	roafči	‘dent (in car)’
	daakti	daafti	‘bone’
	fraakta	fraafta	‘freight’
	ľũokta	ľuofta	‘creek’
	vũokta	vuofta	‘head-hair’
	veakta	veafta	‘scale’
	mĩekta	miefta	‘bog grass sp.’
	rũoktu	rũoftu	‘location, home’

buktu	buuftu	‘performance’
čukčča	čuufčča	‘wood grouse’
laakca	laafca	‘cream’
1pl.	2s	
buktit	buvtat	‘bring’
čiekčtat	čievčtat	‘kick’

In light of the analysis of phonetic overlap between *u* and preaspiration in section 4.4, another way of interpreting the data in (71) is that *k* alternates with *u* or *w*, and that the following consonant is preaspirated, with predicted long preaspiration in the weak grade. The overlapping of *u* and *h* results in *ɥ* which simply sounds like *f* (or *φ*).

Support for an analysis deriving [f] from overlap between *u* and preaspiration is that when the following consonant is a fricative, *k* alternates with *u* in the weak grade and the fricative lengthens, as expected.

(72)	NS	AS	
	aaksi	aaussi	‘part of reindeer skull attached to antlers’
	laksi	laussi	‘moisture on trees’
	lïeksi	lïeussi	‘fish oil lamp’
	oaksi	oaussi	‘branch, twig’
	veaksi	veaussi	‘fish-fin’
	rũoksi	rũoussi	‘udder’
	dikšu	diuššu	‘nurturing’
	diksu	diussu	‘haddock’
	juksu	juussu	‘haddock’
	leaksu	leaussu	‘homework’
	vũoksaa	vũoussaa	‘bull’
	boksaa	boussaa	‘can’
	uksaa	uussaa	‘door’
	leaksa	leaussa	‘lefse’
	buksa	buussa	‘pants’
	čeaksa	čeaussa	‘omasum; cookie’
	raksa	raussa	‘baby diapers’
	šaakša	šaaušša	‘capelin’
	sũoksa	suoussa	‘maggot’
	vuoksa	vuoussa	‘depth of fabric’

### 6.5. Coda Shortening

The last significant group of stems with medial clusters is comprised of the nouns with fricative+C clusters. the fricative being *s* or *š*. One set of such examples in (73) presents a short vowel

or diphthong and long fricative in the strong grade, and a long vowel or fricative and short fricative in the weak grade. That is, such nouns are analogous to *səahhka* ~ *seahka* ‘sack (ns ~ as)’.<sup>13</sup>

(73)	NS	AS	
	asski	aaski	‘lap’
	dusski	duuski	‘researcher’
	lūssti	luosti	‘light strand of rein hair’
	lusspi	luuspi	‘outlet’
	mūsski	muoski	‘isthmus’
	niessti	niesti	‘provisions’
	nisski	niiski	‘nape’
	ruššpi	ruušpi	‘carrot’
	šuššmi	šuušmi	‘heel’
	basste	baaste	‘spoon’
	bisstu	biistu	‘durability’
	buššku	buušku	‘something thin’
	gisstu	giistu	‘coffin’
	lūssku	luosku	‘loose snow’
	ossku	oosku	‘belief’
	osstu	oostu	‘tanning liquor from willow’
	gušštaa	guuštaa	‘brush’
	bissma	biisma	‘bishop’
	gasska	gaaska	‘distance’
	giešška	gieška	‘reindeer earmark sp.’
	gissta	giista	‘reindeer gloves’
	jieska	jieska	‘growth’
	lassta	laasta	‘leaf’
	rūssta	ruosta	‘rust’
	russta	ruusta	‘winter mist’
	vūosstaa	vuostaa	‘cheese’
	1pl.	2s	
	čieskat	čieskat	‘break’
	noskat	nooskat	‘stop up’
	sūoskat	suoskat	‘chew’

Fricative clusters are analytically ambiguous in Saami: the fricative could be in the onset because sC is a possible onset (*spaabaa* ‘ball’, *skaabe* ‘cabinet’, *smare?mi* ‘backbone’, *šlaarava* ‘gossip’); or, the fricative could be in the coda. We conclude based on theoretical principles (the as-

<sup>13</sup> Recall that the long low vowel is usually a central-front vowel in the area of IPA [a, æ], and while the underlying short low vowel is back, in the area of [ɑ], a *lengthened* short low vowel appears on the surface as [ɑɑ]. This is the only context, in this paper, where there is a same-length distinction between front and back low vowels.

sumed representation of long consonants as moraic and the requirement that moras be in the coda) that when the fricative is long, it is in the coda. The correct treatment of short fricatives is at present unclear to us: they could be non-moraic and in the coda, or in the onset.

There are also non-alternating fricative+C clusters, which have a long vowel or diphthong in both grades.

(74)	NS	AS	
	faasmi	faasmi	‘lap’
	maaski	maaski	‘journey’
	naasti	naasti	‘star’
	leasmi	leasmi	‘rheumatism’
	geaski	geaski	‘wolverine’
	goaski	goaski	‘elder maternal aunt’
	meastu	meastu	‘jam’
	leastu	leastu	‘sock’
	vaastu	vaastu	‘responsibility’
	beaska	beaska	‘dress’
	feasta	feasta	‘festival’
	boasta	boasta	‘mail’
	leaska	leaska	‘widow(er)’
	heasta	heasta	‘horse’
	1pl.	2s	
	beastit	beastat	‘let loose’
	eastat	eastat	‘be hindered’
	oastit	oastit	‘buy’

All stems with invariant long nucleus and short fricative have the diphthongs *ea*, *oa* or the vowel /*aa*/, while those with alternating vowel and fricative have the high diphthongs *uo*, *ie*, the vowel /*a*/, or a non-low monophthong — thus the pattern is predictable from the nature of the nuclear segments. The correlation between vowel and length extends to the output of monophthongization. In the illative singular, diphthongs simplify (losing the second element) except before surface *aai*.

(75)	NS	IS	
	loa?na	loo?ni	‘loan’
	ruo?ma	ruu?mi	‘tracebearer’
	healla	heelli	‘heel of shoe’
	viessu	viissui	‘house’
	fuoððu	fuuððui	‘wild animal’
	vuočča	vuučči	‘butter’
	oačču	oočču	‘insurance’
	beahtu	beehtui	‘monster’

joahca	joohci	‘wind in trees’
čiehka	čiihki	‘corner’
gěahhčü	gehhčui	‘surveillance’
lõahhpa	lohppi	‘termination’
sküohhpu	skuhhpui	‘case’

When the following syllable has the diphthong *aai* — as happens if the stems ends in /i/ or /aa/ — there is no monophthongization.

(76)	NS	IS	
	geahči	geahčaa	‘end’
	děahkki	děahkkaa	‘meat’
	siessaa	siessaai	‘elder maternal aunt’
	dievvaa	dievvaai	‘mound’
	čierraa	čierraai	‘crybaby’
	vüoksaa	vüoksaai	‘bull’
	guolli	guollaai	‘fish’
	roađđi	roađđaa	‘redness’
	loa?mi	loa?maai	‘gap’

Observe in (77) that in the illative singular, when there is monophthongization, and only when there is monophthongization, stems with the underlying diphthongs /ea, oa/ surface with short monophthongs and long fricatives.

(77)	NS	AS	IS	
	gěšška	gieška	gišški	‘hide-stretching stick’
	jěsska	jieska	jisski	‘growth’
	lűosku	luosku	lusskui	‘loose snow’
	meastu	meastu	messtui	‘jam’
	beaska	beaska	besski	‘dress’
	boasta	boasta	bossti	‘mail’
	vűosstaa	vuostaa	vűosstaai	‘cheese’
	goaski	goaski	goaskaai	‘elder maternal aunt’
	geaski	geaski	geaskaai	‘wolverine’

The distribution of length is somewhat different in the context VRsC (all examples in our data involve glides as the sonorant). The fricative is short in the strong grade, and generally long in the weak grade.

(78)	NS	AS	
	beaisku	beaissku	‘vermin’
	duisku	dūissku	‘German (pejorative)’
	gaaiski	gaaisski	‘bracken fern’
	guiski	gūisski	‘mussel, clam’
	luiste	lūisste	‘ice skate’
	maaistu	maaisstu	‘taste’
	raaiski	raaisski	‘carnivore’
	raaisku	raaissku	‘cadaver’
	roaisku	roaissku	‘whip’

If the vowel of the second syllable is *a*, the fricative will be short in the weak grade.

(79)	NS	AS	
	teaksta	teausta	‘text’
	taaksta	taausta	‘appraisal’
	duiska	duiska	‘German’

## 7. Summary

The preceding sections have laid out the basic facts surrounding grade alternations in a dialect of North Saami. A recurrent observation has been that post-tonic consonants in the strong grade are generally long — either simply long or extra-long — and there are numerous segmental alternations associated with length alternations. This includes laryngeal alternations such as aspiration and voicing in stops and glottalization in nasals, as well as manner alternations between glides and obstruents. We have seen numerous tradeoffs in segmental length. For example, the lengthening of consonants in the strong grade is often counterbalanced by vowel shortening, thus *dēahhka* ~ *deahka* ‘deck’, *rūos’sa* ~ *ruossa* ‘cross’, *dūo?mu* ~ *duomu* ‘judgment’, *biegga* ~ *biekka* ‘wind’, *vūosstaa* ~ *vuostaa* ‘cheese’ *sikta* ~ *siifta* ‘line of sight’.

While we have not set forth a formal analysis of these facts, we do have definite hypotheses regarding how to explain these facts. Similar to Svenonius 2006, we would treat gradation as arising from the realization of a prosodic affix, a mora, which is inserted in certain morphosyntactic contexts such as nominative singular, and that syllabification of this mora is primarily responsible for length alternations. Segmental alternations are primarily governed by the requirement that distinctive laryngeal features must be licensed by a mora. However, certain questions must be resolved before a defensible formal analysis is advisable. Primarily, the question of vocalic length requires deeper investigation. On the one hand, vowel and diphthong length are important in understanding gradation and thus length cannot be ignored as has been past practice, but on the other hand vocalic length does seem to be highly predictable in the language. We have seen, for instance, that with certain types of consonant centers, high diphthongs are always short before certain vowels, and alternate in length depending on consonant grade before /a/.

Needless to say, the question of how to represent three apparent degrees of surface length on consonants is of considerable theoretical interest. Because the difference between long and

over-long is surface predictable given the length of the preceding vowel, overlength could simply be dispensed with and derived phonetically from the preceding vowel. But that would presuppose an analysis where the alternation *rüos'sa* ~ *ruossa* 'cross' is basically a diphthong-length alternation, even though the length of the diphthong is predictable from consonantal length.

The immediate fruit of this paper is therefore the presentation of a relatively theory-neutral paradigmatically controlled set of surface forms of one dialect of North Saami. A formal account of these data must be answerable to these facts — and many other facts, no doubt. In our view, the facts must first be known and presented as completely as is possible, so that an analysis can be built on them.

### References

- Bartens, H.H. 1989. *Lehrbuch der saamischen (lappischen) Sprache*. Hamburg: Buske.
- Bergsland, K. 1961. *Samisk grammatikk*. Oslo: Kirke- og undervisningsdepartementet.
- Bye, Patrick. 2002. *Virtual phonology: rule sandwiching and multiple opacity in North Saami*.  
Doctoral dissertation, Universitet i Tromsø.
- Collinder, B. 1938. *Lautlehre des waldlappischen Dialektes von Gällivare*. Suomalais-ugrilaisen seuran toimituksia 74. Helsinki: Suomalais-ugrilain seura.
- Collinder, B. 1949. *The Lappish dialect of Jukkasjärvi: a morphological survey*. Uppsala: Almqvist & Wiksells.
- Kåven, B. et al. 1995. *Sámi-Dáru Sátnegirji*. Kárášjohka: Davvi Girji
- Lehiste, Ilse. 1966. *Consonant Quantity and Phonological Units in Estonian*. Indiana University Uralic and Altaic Series 65: Bloomington.
- Magga, T. 1984. *Duration in the quantity of bisyllabics in the Guovdageaidnu dialect of North Lappish*. Acta Universitatis Ouluensis, Series B Humaniora 11. Oulu: University of Oulu
- Nickel, K. 1994. *Samisk grammatikk*. Kárášjohka: Davvi Girji
- Nielsen, K. 1926-29. *Lærebok i lappisk (samisk)*. Instituttet for sammenlignende kulturforskning. Universitetsforlaget: Oslo. (3 volumes)
- Nielsen, K. 1932-62. *Lappisk (samisk) ordbok*. Instituttet for sammenlignende kulturforskning. Universitetsforlaget: Oslo. (5 volumes)
- Prince, Alan. 1983. A metrical stress theory for Estonian quantity. *Linguistic Inquiry* 11: 511-62.
- Sammallahti, P. 1984. The phonology of the Guovdageaidnu dialect of North Saami: Some notes. Bernt Brendemoen, Even Hovdhaugen, Ole Henrik Magga (eds.), *Riepmočála. Essays in Honour of Knut Bergsland*, 136-151. Oslo: Novus Forlag
- Sammallahti, P. 1998. *The Saami languages*. Kárášjohka: Davvi Girji.
- Svenonius, P. 2006. Paradigm generation and Northern Sámi stems. MS, University of Tromsø.
- Ulseth, B. 1981. Samisk ljudlära. Rapport nr. 3, Varighetforskjeller som grunnlag for stadiesveksling i en samisk dialect. Umeå: Umeå University.
- Harms, Robert. 1964. *Finnish structural sketch*. Indiana University Uralic and Altaic series, Vol. 42. Bloomington: Indiana University