

## **Topics in North Saami Phonology**

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### **1. Introduction**

This paper presents aspects of the phonological system of North Saami, in particular the dialect of Guovdageaidnu. 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. 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 volume of published literature exists in North Saami, as well as some linguistic works on the structure of the language (though little of it published in English).

One difficulty which impedes work on the phonology of North Saami is that it is hard to obtain a satisfactory corpus of phonetically accurate data representing a single variety of the language. Three main factors contribute to the poverty-of-materials problem. First, North Saami is not phonologically monolithic, and therefore data which are valid for speakers from one area are not necessarily 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 if they do not prevent mutual intelligibility. Thus data from the Guovdageaidnu dialect of North Saami cannot be freely mixed with data from the Kárášjohka dialect: indeed, according to Sammallahti 1998, there are dialects within Kárášjohka. Second, the morphophonology of the language is extremely complex. Published grammars do not provide the volume of data that would be necessary to pin down all of the details of the language. Available data sources on North Saami tend to give relatively few complete inflectional paradigms of nouns, so for example Kåven et al. 1995 gives a complete inflection paradigm of seven nouns, and certain crucial inflected forms that hint at the alternations found in 65 nouns (which includes a high proportion of irregular nouns). However, the complexities of nominal morphophonology are such that the number of paradigms necessary for a complete treatment of nouns would number in the hundreds. The underlying system of nominal inflection is not so complex once one knows the phonological principles of the language. 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 pronuncia-

tions. The extensive grammar and dictionary of Konrad Nielsen (Nielsen 1926-29, 1932-62) illustrates the problem in one form. In his grammar, one notices forms which diverge quite extremely from the pronunciations that we find in the Guovdageaidnu dialect.

(1)	<i>Nielsen</i>	<i>Guov. phonetics</i>	<i>gloss</i>
	bar'dne	baareʔni	“son (n.s)”
	bardne	baarʔni	“son (a.s.)”
	čiekkâ	čiehka	“corner (n.s.)”
	čuoivâg	čuoivaht	“yellow-grey reindeer”

However, forms like [bar'dne], [bardne], [čiekkâ] and [čuoivâg] really seem to represent a book-form, an idealised pan-North Saami form, or perhaps a historical reconstruction. In the lexicon, Nielsen organises forms according to this idealised form, but then for each form lists the phonetic forms in the Porsanger, Kárášjohka and Guovdageaidnu dialects. His phonetic forms for Guovdageaidnu are relatively close to what we encounter.

(2)	<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	ÀĪ'GÌ	aaigi	“time (n.s.)”
	aige	ÀĪG <sup>k</sup> Ì	aaikki	“time (a.s.)”
	bag'go	BÀG'GÒ	baaggu	“need (n.s.)”
	baggo	BÀGKÒ	baakku	“need (a.s.)”
	čiekkâ	ṭšĕhkq	čiehka	“corner (n.s.)”
	čier'ra	ṭšĕr'rà	čierra	“crybaby (n.s.)”
	čierra	ṭšĕrrà	čierra	“crybaby (a.s.)”
	duoggje	DUOG <sup>g</sup> ĶÌ	dũočči	“handicraft (n.s.)”
	duoje	DÙQJÌ	duoji	“handicraft (a.s.)”
	čuoivâg	ṭšùQĪVÀ <sup>h</sup> T	čuoivaht	“yellow-grey reindeer”

Some of these differences are just differences in transcriptional system (such as the difference between <č> and <ṭš>, 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. Unfortunately, data in Nielsen's grammar volumes, which provide fuller inflectional details, are presented in the historical reconstructive spelling system which does not match the phonetic properties of any real dialect learned by children. The lexicon, which does give actual language forms, does not give full inflectional paradigms for nouns, and at any rate even interpreting Nielsen's phonetic dialect data is quite challenging.

Most published works on North Saami (as on most languages) are significantly influenced by the written language and thus prevailing orthographic conventions. Bergsland 1961 states that his Saami grammar is based on his earlier unpublished grammar of written Saami and thus he presents the noun “corner” as *čiekka* ~ *čiega* (n.s. ~ a.s.) which is different from the current spelling (and the phonetic value) *čiehkka* ~ *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 requires the application of unspecified interpretive conventions. Collinder 1949 in describing the Jukkasjärvi dialect provides forms such as [ko<sup>h</sup>htē], which in the present dialect corresponds to [goahti] “tent”, and we take the two forms to be reasonably close in pronunciation. 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”, also presents the same data 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 data on the language, such as Bartens 1989, Nickel 1994 and Kåven et al. 1995 uses the current North Saami orthography which, unfortunately, also does not preserve phonetic facts. We do not provide an analysis of the relation between phonetic values and spelling here, but provide examples of the orthography and phonetic transcriptions below, to give an indication of the nature of this problem.

(3)	<i>orthography</i>	<i>phonetics</i>	<i>gloss</i>
	goahkka	göahhka	cook (n.s.)
	goahka	goahka	cook (a.s.)
	biebmu	biemʔmu	food (n.s.)
	biepmu	bieʔmu	food (a.s.)
	bárdni	baareʔni	son (n.s.)
	bártni	baarʔni	son (a.s.)
	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	maarfi	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	dŋočči	handicraft (n.s.)
muitu	muihtu	memory (n.s.)
muittu	mŋihhtu	memory (a.s.)

The orthography does not mark long vowels and diphthongs, and a number of other phonetic properties are marked indirectly (e.g. the orthographic ‘voicing’ difference <bárdni> ~ <bártni> is phonetically a vowel ~ Ø distinction in this dialect). The orthography provides a means of unifying a diverse language by smoothing out certain 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. Indeed, it may be that the orthography is phonetically appropriate for some dialects of the language. 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 data from the very closely related Eastern Eanodat dialect, using both orthography and a phonetic notation. Since the goal of that work is to explore phonetic issues, the corpus of examples is not paradigmatically organised and does not have the type of information required to analyse nominal morphophonology. And, while that dialect is historically rather close to the Guovdageaidnu dialect, there are non-trivial differences which prevent using data from that dialect in a study of Guovdageaidnu Saami morphophonology.

Sammallahti 1998 provides some data from North Saami in phonetic transcription, and especially for the data from Eastern Eanodat, our divergences from his transcriptions are relatively minor: where we record the word “field (n.s.)” as [g̊ieddi], Sammallahti records this as [k̊i̯č̊d̊t̊i̯]. Such differences primarily reflect different levels of phonetic detail in the two transcriptions. Some of the differences reflect actual dialect differences, such as the representation of “mother” as /ead’ni/ rather than [eanʔni]. Unfortunately, relatively few forms are phonetically transcribed in Sammallahti 1998. When examples are given in North Saami orthography, the data cannot be said to represent a specific dialect. Thus, Sammallahti reports comitative sg. [goođiin] vs. locative sg. [goađis], but we find [goođin] and [goađis], that is, the second syllables have the same length. Similarly, the contrast between nominative pl. [goađit] vs. accusative pl. [goođiid] is represented in the Guovdageaidnu dialect as [goađiht] and [goođiht]. Since the written form of North Saami is nontrivially different from the pronunciation of the Guovdageaidnu dialect, orthographic data cannot be used in an unmodified fashion in constructing an analysis of this synchronic system.

In this study, we focus primarily on the system of 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, to the point that it is impossible to describe all aspects in less than a monograph. In this paper we therefore limit the domain of investigation to noun inflection, and primarily consider only regular bisyllabic vowel-final stems. Furthermore, since the issues to be discussed can be presented by considering only nominative singular versus accusative singular forms, we largely limit our data to these two cases. Future developments of our research will consider other cases which brings in diphthong ~ monophthong alternations, as well as other phonological stem shapes.

## 2. Phonetic Preliminaries

We now consider the phonetic inventory. 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 here, but occasional appeal to acoustic analysis will be made, to support possibly controversial aspects of the primarily auditory claims made here.

### 2.1. Consonants

The first question that arises in listing the surface segments is how to treat such categories as ‘preaspirated consonant’ or ‘affricate’. Following IPA tradition we might treat *ht* as a cluster of *h* plus *t*, and we could treat *č* as a cluster of *t* plus *ʃ*. There are good phonological reasons to consider the affricates of Saami to be single segments, and we consider that decision to be uncontroversial. The proper treatment of preaspirated consonants on the other hand is not clear. We will also presume that the preaspirated consonants are single segments, recognising that this decision requires justification, to be given later. We begin with a relatively generous list of surface segments, on the understanding that some segments may be analysed as clusters, or may not have phonemic status.

The following consonants exist in the variety of Saami described here. Excluded are the ‘overlong’ or ‘Q3’ long preaspirates and triple-geminates consonants which will be considered separately. IPA values for consonant symbols are to be assumed in interpreting this table.

(4)	p	t	ts	tʃ	k
	f		s	ʃ	
	b	d	dz	dʒ	g
	v,β	ð			
	hp	ht	hts	htʃ	hk
	pp	tt	tts	ttʃ	kk
	ff		ss	ʃʃ	

bb	dd	ddz	ddʒ	gg
vv	ðð			
m	n		ɲ	ŋ
mm	nn		ɲɲ	
ʔm	ʔn		ʔɲ	
mʔm	nʔn		ɲʔɲ	
	r,l,ʎ		j	h
	rr,ll,ʎʎ		jj	

We begin with comments on phonetic qualities, dialect issues, transcription, and orthography. Phonetic values are provisional because they are largely based on auditory impression, and await systematic instrumental (acoustic) investigation. The voiced stops and affricates are weakly voiced and are devoiced in some instances. However, even [g] in absolute initial position can show clear acoustic signs of vocal fold vibration, which renders the label ‘voiced’ plausible. Voicing is particularly strong on the initial portion of a geminate voiced consonant but tends to die out on the second half of the geminate: in some tokens, there may be sporadic voicing at points in the second half of a geminate. The voiceless stops may be aspirated, depending on context. Initially or intervocalically, there will be strong (post)aspiration. After /s,f/ or when preaspirated there is a small degree of (post)aspiration; geminate voiceless stops are minimally aspirated.

This variety of Saami does not have a voiceless interdental fricative [θ], as exists in other dialects, and in all instances that we know of, [θ] found in other dialects appears to be pronounced here as [s]. In some varieties of Saami there also exists a distinct palatal stop spelled <dj> which is apparently phonetically [g<sup>y</sup>] or [k<sup>y</sup>], but in this variety it is pronounced as [tʃ], the same as <č>: it is always geminated. There is some phonological evidence for treating this consonant as morphophonemically different from <č>, which will be discussed later. Some dialects maintain a separate phoneme [ɲ], but in this variety, [ɲ] only appears before a velar consonants, and otherwise *ɲ* as found in other dialects is pronounced as [ɲ]. Finally, the pre-glottalised consonants such as [ʔm] and the medially-glottalised consonants such as [mʔm] represent the pronunciation of what are spelled <pm> and <bm> respectively. An oral stop is found in other dialects and in the speech or older generations in this dialect, but in the variety represented here there is a glottal stop, and no oral stop.

The palatal lateral [ʎ,ʎʎ] is probably phonetically distinct from the sequence [lj] (and definitely distinct from [liV], as in [ʃieðeʔmi] “broadening of antlers (n.s.)”). We have very few examples of [ʎ,ʎʎ] or [lj] — in fact, only [ljj], exemplified by [v̥ieʎʎa] “brother (n.s.)”, [vieʎa] “brother (a.s.)”, [d̥uoʎʎi] “reindeer skin (n.s.)” versus [oljju] “oil (a.s.)”. Since there are very few examples of the palatal lateral in our corpus, we are not certain whether there is a contrast between single and geminate [ʎ], though in some contexts (after a short nucleus) it seems longer.

The Northern Saami orthography represents these consonants as follows.

(5)	[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,β] = <v>	[ð] = <d̥>			
	[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] = <d̥d̥>			
	[m] = <m>	[n] = <n>		[ɲ] = <nj>	[ŋ] = <ŋ>
	[mm] = <mm>	[nn] = <nn>		[ɲɲ] = <nnj>	
	[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>		[ij] = <jj>	
		[ɹ] = <lj>, [ɹɹ] = <llj>			

Data will be presented in an orthography which compromises between IPA symbols and standard Saami orthography as follows:

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

Otherwise, transcriptions, rather than orthography, will be used here.

In addition, there is a series of extra-long consonants, which can be divided into two groups. The first is the extra-long version of the voiceless preaspirated consonants.

(7)	hhp	hht	hhc	hhč	hhk
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There is a clear phonetic difference between [ht] and [hht], as reflected in the transcription, which is that the duration of the pre-aspiration in [hht] is much longer than in [ht]. In the Saami orthography, these are spelled as <htt>.

The second group contains single consonants without preaspiration. In these examples, it is not at present clear whether there is a surface durational difference between these extra-long consonants and plain long consonants. These Q3 consonants are as follows, where C'C is the notation we use to indicate (potential) Q3.

(8)	p'p	t't	c'c	č'č	k'k
	f'f		s's	š'š	
	b'b	d'd	z'z	ž'ž	g'g
	v'v	ð'ð			
	m'm	n'n		n'nj	
		r'r,l'l			

We presume that the third degree of length is a phonetic fact, pending more extensive phonetic testing. Our preliminary acoustic measurements do reveal a difference in the duration of Q2 and Q3 consonants, Q3 consonants being roughly 30% longer than Q2 consonants. The reason why it is not easy to resolve the question of Q3 consonants contrasting with Q2 is that phonetic differences do not necessarily mean there is a phonological contrast. We have not identified any minimal or near-minimal pairs which control vowel length as well as consonant quality. Vowels and diphthongs are always short before Q3 consonants, so the only context where a pure Q2 vs. Q3 consonantal contrast — if it exists — could be detected is after short vowels. So far, we have not identified any candidates for such a contrast. Combined with the fact that most initial syllables have long vowels or diphthongs anyhow, it becomes very difficult to find any words which control vowel length suitably and contrast only the selection of a Q2 vs. a Q3 consonant after a short vowel.

## 2.2. Vowels

The surface vowels of Saami are given in (9).

(9)	a e o i u <sup>1</sup>
	a: e: o: i: u:

In addition, there are a considerable number of diphthongs and triphthongs. There is a surface distinction between long and short diphthongs (“centrifugal” and “centripetal”, respectively, in the terminology of Sammallahti 1998), which we mark below with a breve on the first member of the diphthong. A non-exhaustive list would include:

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<sup>1</sup> Three other vowels can be found: front out-rounded [y], central in-rounded [ü], and front rounded [ø]. These vowels only appear in recent Norwegian loans; we have not studied the extent to which they may be replaced by other vowels as loanwords become assimilated.



- (10) ea oa uo ie oi ui ei ou eu iu  
 aai aaui eai eai uoi uoi oai oai  
 ǣ ǫ ǫ ǣ ǫ ǫ ǣ ǣ

There is no contrast between [au] and [aau], or [ai] and [aai], but we write [aai] (and also [ei, oi]) to reflect an audible fact, that the *a*-portion of [a(a)i] is palpably longer than the *o*-portion of [oi]. The short-diphthong version of [a(a)i] is thus written as [ai], again because this reflects a noticeable phonetic fact. This should not be taken to imply (or deny) a special phonological status to [a(a)i] and [a(a)u].

We have commented on the fact that short diphthongs are connected to the question of the Q2 ~ Q3 distinction, in that long vowels and diphthongs cannot appear before a Q3 consonant. One of the most salient cues to distinguishing long and short diphthongs in the initial syllable is the pitch contour on that syllable. An initial long (“centrifugal”) diphthong has a distinctly falling pitch, whereas an initial short (“centripetal”) diphthong has a level pitch. In addition, long diphthongs are around twice the length of short diphthongs. We have no evidence that the location of the pitch drop is independent of duration, and take the generally obvious difference between early versus late pitch drop to signal long versus short diphthongs, when the durational properties themselves do not seem obvious.

The orthography recognises a distinction between <a> and <á>. The vowel <á> is long, and in some dialects it is also qualitatively different from <a>, being more front. The vowels <a> and <á> are also distinct in this dialect, clearly in terms of quantity and sometimes in terms of quality. The quality of <a> in the initial syllable is approximately the same as that of initial <á>, and in that syllable the vowels are best distinguished by their significant differences in length (greater than a 2-to-1 ratio). In final syllables, the quality of <a> resembles [ə], but also appears to also be influenced by a preceding vowel, approximating [a] when the preceding vowel is [a]. There appears to be a slight durational difference between the final vowels of [čiehkə] ‘corner (n.s.)’ and [duvva] ‘dove (n.s.)’, but this is much less salient, final [a] being on the order of 1/3 greater duration than final [ə]. The vowel distinction in final position is difficult to perceive, but can be made on the basis of the subtle qualitative distinction, which we notate by transcribing final [ə] as *a* and [a] as *aa*. 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 [báhanaalaga] ‘untamed reindeer (a.s.)’, the antepenultimate syllable being significantly longer than other syllables in the word.<sup>2</sup>

An epenthetic vowel [ə] is reported for some dialects of North Saami, for instance Bye 2002 gives *sküollaffii* ‘owl (n.s.)’, *fierrəp?mii* ‘fishing net (n.s.)’, but we find that

<sup>2</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.

this epenthetic vowel is harmonised so that it is identical to one of the phonemically contrastive non-high vowels [e o a], thus [skũolefi], [fiere?mi] (there are other differences between the dialects).

The question of stress is quite complex. Regularly, the pitch-peak of a word appears on the first syllable. The final syllable also has a slightly raised pitch. It is at this point difficult to say whether medial odd-numbered syllables have raised pitch which might be taken as a direct phonetic correlate of alternating stress. There is a highly significant correlation between possible segments in a syllable and the even/odd status of the syllable which at the very least gives considerable plausibility to the postulation of an abstract alternating stress pattern.

### 2.3. Other Phonetic Notes

The consonant [v] is pronounced as a labiodental fricative or approximant prevocally, and varies between approximant [β] and [w] preconsonantly. In the latter case, it is often unclear whether the most appropriate transcription would be [w] or [u]. It will be transcribed as [u], although on occasion when the question of exact phonetic values is relevant we will revert to a narrower phonetic orthography. The status of /j/ in the coda is also uncertain: we do not have any clear evidence for a distinction between /j/ and /i/ before consonants, although such a distinction is apparently made in some dialects. It can be argued that there is a phonological distinction between a long vowel /uuC/ and a homorganic vowel plus glide sequence /uwC/, and similarly /iiC/ and /ijC/, although the surface distinction between [ii] and [ij], [uu] and [uw] is not clear: it appears that there is a phonetic neutralization.

When we have occasion to give examples with a word-final stop, we will write <t>, which is pronounced as [ht] before pause and as [h] otherwise.

### 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 pertain to whether a sound is in an even-numbered, odd-numbered, or final syllable. These patterns will be discussed later. At the moment, we focus on restrictions not related to syllable parity, since our initial focus is on consonantal alternations in disyllabic stems.

The most important restriction pertains to voicing contrasts in stops: the voicing contrast is not highly robust in the language. The voiceless stops /p t c č k/ in initial and intervocalic position appear primarily in recent loanwords, cf. *üniwersiteeha* “university”, *kapealla* “chapel”, *mekaanihkar* “mechanic”, *upuneantta* “opponent”, *matematihkar*, “mathematician”, *maratoona* “marathon”. In initial position, /p t k/ primarily occur in loanwords: *kapteai?nu* “captain”, *kaalahka* “calcium”, *taan?ka* “tank”, *kreativiteeha* “creativity”, *teaksta* “text”, *pen?na* “pen”. The affricate [č] does appear

generally in initial position (*čier'raa* “crybaby”, *čoauji* “stomach”, *čaallin* “(product of) writing”) but the voiced counterpart /ʒ/ does not appear at all. The alveolar affricate spelled <c> is voiced (or unaspirated) initially, thus differing from č. Because of this phonetic value, we transcribe the initial affricate as <z>, analogous to the spelling of the voiced affricate, thus *zumma* “kiss”, *zulehci* “protrusion”, whereas the official orthography spells the initial consonant with <c>. There is no voicing or aspiration contrast in initial voiceless alveolar affricates. The reason why there is 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) do not have affricates.

Loanwords exhibit a number of phonological anomalies which will be considered in a later section on foot structure, where we suggest a way of unifying these properties. For example, loanwords allow trisyllabic vowel-final stems (*kapealla*) which otherwise do not occur (after subtracting the effect of vocalic epenthesis which takes place in words like *mielehki* “milk”); loanwords allow long vowels and diphthongs in the stem after the initial syllable, which otherwise are not possible. We propose explaining these anomalies by expressing certain generalizations in terms of foot structure, so for example long vowels must be foot-initial and words such as *kapealla* have exceptional foot structure — *ka(pealla)*. Now, considering the problem of intervocalic voiceless consonants in loanwords, words such as *üniveršitehta* show apparently inconsistent behavior of voiceless stops in loans, since the first *t* appears as plain [t] but the second appears as preaspirated [ht]. Factoring in foot structure, the distribution of plain and preaspirated voiceless stops is predictable in terms of foot structure: preaspirated consonants appear foot-medially, as in *üniverši(teehta)*. The details of this proposal will be considered in later sections.

Clusters of voiceless obstruents exist 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 are found in e.g. *gaakti* “jacket”, *mokta* “inspiration”, *riékti* “justice”, *baakti* “cliff”. We do not have concrete statistics on the frequency of voiceless obstruents in clusters, but they are not limited to recent loanwords, unlike initial voiceless stops. Voiced consonants do not appear in obstruent clusters, except that they are found after *ð* as in *beaðbbi* “shoulder blade (acc. sg)”, *geaðggi* “stone (acc. sg.)” — assuming that [ð] is to be treated phonologically as an obstruent in Saami.

Finally, there is a clear phonetic contrast between geminate voiced and voiceless stops, cf. *gabbaa* “all-white reindeer (nom. sg.)” vs. *gappaa* “all-white reindeer (acc. sg.)”; *baaggu* “necessity (nom. sg.)” vs. *baakku* “necessity (acc. sg.)”. However, all voiceless geminate stops are predictable in the context of the gradation system, and alternate with voiced stops.

The other distributional issue which is important to the goals of this paper is that it is rare to find nominative singular nouns that have a single voiced stop (except after

diphthongs ending in *i* or *u*, or after consonant). Nouns like *leade* “shed type”, *stoobe* “can”, and *boazu* “reindeer” are quite uncommon. However, 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 *dauda* “sickness” are representatives of a large class of words. This distribution is tightly bound up with gradation, and this point will be important when we consider gradation, to which we now turn.

### 3. The Gradation System: What Happens

Our main concern is the analysis of the gradation system. An illustration of a gradation alternation is given in (11), which is the case and number paradigm of the noun *goahti* “big tent”.

(11)		<i>singular</i>	<i>plural</i>
	nominative	goahti	goađit
	accusative	goađi	goođit
	illative	goahtai	goođije
	locative	goađis	goođin
	comitative	goođin	goođigon
	essive		goahtin

Case and number are marked by suffixation and stem-internal phonological modifications, gradation, which have some similarity to well-known alternations found in Finnish. For the moment we forgo investigation of the range of contexts where gradation occurs, and focus on the nature of the gradation alternation itself. Thus we concentrate on just nominative singular vs. accusative singular forms, concerning ourselves with the phonological nature of the gradation changes. The nominative singular, illative singular, and essive will be referred to collectively as the “strong” cases and the remainder will be referred to as the “weak” cases, referring to the phonological effect generally found in these contexts; in certain types of stems, the “weak” cases will actually exhibit a phonologically stronger variant of the stem consonant.

#### 3.1. Deaspiration

The first gradation effect we consider is deaspiration, whereby /hp ht hc hč hk/ become *b*, *đ*, *z*, *ž*, *g* — recall that <*z*> and <*ž*> represent the voiced affricates [dz] and [dʒ]. Examples of this change are found in (12).

(12)	NS	AS	
	čiehkka	čiega	“corner”
	neahpi	neabi	“nephew/neice of man”
	daahpi	daabi	“habit”
	geahči	geaži	“end”
	aahci	aazi	“hay-rack with hay”
	rieħpu	rieħu	“poor guy”
	goahti	goađi	“big tent”
	muohtu	muođu	“cheek”
	staahta	staađa	“state”

The exact description of this change as a phonological process depends on the phonological analysis of certain segments. The “essential” distinction between /ħp/ and /b/ could be that the former is a cluster and the latter is a single consonant; or the essence of the contrast could be between voiceless and voiced, or aspirated and unaspirated. Such decisions as to the basis for the segmental distinction bear on how the phonological alternation is handled. If /ħp/ et al. are treated as clusters then this process would involve cluster simplification; if /ħp/ is a single preaspirated consonant, the above phonological change involves loss of aspiration and addition of voicing. Furthermore if /b/ et al. are phonologically unaspirated stops (recall that phonetically they vary between unaspirated voiceless and voiced stops), this change would, from a phonological perspective, simply involve deaspiration. Hence, (some of) the data above could be re-analysed along the following lines.

(13)	čiek <sup>ħ</sup> a	čieħka	“corner”
	neap <sup>ħ</sup> i	neapħi	“nephew/neice of man”
	daap <sup>ħ</sup> i	daapħi	“habit”
	geač <sup>ħ</sup> i	geačħi	“end”
	aac <sup>ħ</sup> i	aacħi	“hay-rack with hay”
	rieħ <sup>ħ</sup> u	rieħħu	“poor guy”

A transcription like [čiek<sup>ħ</sup>a], seen phonologically, indicates that the medial consonant is aspirated, that is, the segment is [+spread glottis]. Considered phonetically, there would be a further conventional implication, that the feature is realised as post-aspiration, i.e. a long voicing lag, which is incorrect. Thus (13) would not be appropriate as a phonetic transcription: qua phonological transcription, it is appropriate since the timing of the implementation of the feature [+spread glottis] is not phonologically distinctive, and writing a raised [ħ] after the consonant does not entail anything phonological about timing.

In light of the highly restricted distribution of singleton voiced stops *p* etc. (post-vocalic single *p, t, k* are nonexistent outside of loanwords), there is also the option of

treating preaspiration as a contextual variant of plain voiceless (or voiceless aspirated) stops, which is to say that phonetic *daahpi* could also be analysed as phonological *daap<sup>(h)</sup>i*, with preaspiration being provided as an automatic consequence of being a voiceless (aspirated) postvocalic consonant. There are, at this point, too many initially plausible ways of accounting for these data to make a specific decision; we point out these options so that the reader will be aware that there is no immediately self-evident solution to the question of how stops in the language are represented phonologically.

Whatever analysis of this alternation is adopted, we must also face the problem that the output of gradation applied to /ht/ is [ð], not [d], which one would expect 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.

(14)	daahpi	“habit”	daalevi	“winter”
	daassi	“level”	daaugi	“bow”
	daauru	“fish soup”	dahhki	“doer”
	davvi	“north”	deačča	“tea”
	dea?nu	“large river”	diddi	“salmon sp.”
	diuras	“expensive”	doaivu	“belief”
	doai?ma	“function”	doggi	“stomach of ruminant”
	dũočči	“handicrafts”	duv’vaa	“dove”

However, [d] also exists post-vocally.

(15)	aaidi	“fence”	dieudu	“man”
	buuda	“shop”	daaidu	“ability”
	loaidu	“sleeping place”	luoudi	“wooden fishing float”
	naaudi	“predatory animal”	njeida	“daughter”

Such data are not an insurmountable problem for an assumed lenition of *d* to [ð], and it is no coincidence that these words have a vowel plus high vowel before the *d*. We have so far encountered only one noun with intervocalic *d* outside of the context of falling diphthongs, in the word *leade* “shed type”, and some tokens of the accusative singular *staada* ‘state’ (alongside *staada*). For the moment we simply note that the output of gradation applied to /ht/ is [ð]. Another very important issue which we will sidestep for the moment is what the underlying form of the alternating consonant is. We have implied that /hp/ becomes [b], but perhaps the underlying consonant is /b/ and becomes [hp] in the nominative. Again, we have no basis for deciding between these options, so we proceed to the next gradation effect.

### 3.2. Aspiration-shortening

Another gradation effect involves the shortening of the overlong ‘Q3’ preaspirated voiceless consonants. In (16) we provide examples of stems with a short diphthong and an overlong preaspirated stop. In the accusative singular, the diphthong is long and the aspiration is reduced.

(16)	gěahhčü	geahčü	“surveillance”
	mĭehhki	miehki	“sword”
	sěahhka	seahka	“bag”
	děahhka	deahka	“deck”
	děahkki	deahki	“meat”
	ďiehpi	diepi	“pompom”

There is not much evidence that short diphthongs must be recognised as an underlying category in the language, so our initial hypothesis is that all diphthongs are underlyingly long, and short diphthongs derive by rule. Thus we would assume underlying *geahhčü*, *mĭehhki*, *seahhka*, *deahhka*, *deahhki*, and *diehpi*, and shorten the syllable nucleus before a Q3 consonant. Since we have not established the directionality of gradation yet, we might also assume underlying /geahčü/, derive the Q3 consonant by rule (one applying in the nominative singular and similar contexts where the phonologically stronger grade typically shows up), and shorten long nuclei before derived Q3 consonants. It should be obvious that the two gradation changes are disjunctive. In our first group of stems we found assumed /hp/ becoming [b] in the accusative, and in this group /hpi/ becomes [hp] in the accusative: it does not then go on to become \*[b].

Some stems have short simple vowels in the nominative before a Q3 preaspirated C, and a long vowel before the Q2 consonant of the accusative.

(17)	lahhti	laahti	“floor”
	ahhči	aahči	“father”
	ahhku	aahku	“grandmother”
	lahhpa	laahpa	“horn interface”
	nahhki	naahki	“animal skin”
	mohhki	moohki	“corner (natural)”
	čohhka	čooohka	“top”
	duhhku	duuhku	“smudge”
	lihki	liihki	“skin (human)”
	bihhci	biihci	“frost”
	bihhka	biihka	“tar”
	fysihhka	fysiihka	“physics”
	faabriihka	faabriihka	“factory”

We assume underlying forms such as /laahhti/, /aahhči/, /aahhku/, /laahhpa/, /moohhki/ and /liihhki/. Given that long vowels cannot appear before Q3 consonants, we have a natural explanation for the appearance of a long vowel in the accusative, just in case the consonant is shortened.

The following nouns have what seems to be an unrelated alternation, involving vowel length and a labial fricative [ɸ].

- |      |        |        |                   |
|------|--------|--------|-------------------|
| (18) | ruɸɸtu | ruuɸtu | “bus route”       |
|      | duɸɸki | duuɸki | “handful of hair” |

Saami has no surface contrast between [ɸ] and [f] before vowels. It is somewhat unclear about such a contrast before consonants, as we will discuss in section 3.9 in connection with weakening of coda *k* to [f]. The transcription of this segment as [ɸ] reflects a narrower phonetic transcription.

These data can be accommodated into the pattern of (17) 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.

- |      |        |        |                   |
|------|--------|--------|-------------------|
| (19) | ruhhtu | ruuhtu | “bus route”       |
|      | duhhki | duuhki | “handful of hair” |

We claim that the phonetic percept [ɸ] arises explicably from details of phonetic implementation. When the vocoid *u* overlaps preaspiration, turbulent airflow through the narrow vocal tract results in a voiceless labial approximant, which could be more narrowly transcribed as [ɸ̥] or [ɸ]. This gestural overlap and its perceptual consequences are represented schematically in (20).

- |      |                 |                  |             |
|------|-----------------|------------------|-------------|
| (20) | ruhhtu = ruɸɸtu | ruhhtu = ruɸɸtu  |             |
|      | ... { u } ...   | ... { u } ...    | lips        |
|      | ... { h } ...   | ... { h } ...    | larynx      |
|      | ... [u ɸ: ] ... | ... [ u: ɸ ] ... | sounds like |

The same phonetic process is evident is attested with the sequence [i] plus preaspiration, so that a narrower transcription of the last three examples of (17) would be those in (21).

- |      |              |              |           |
|------|--------------|--------------|-----------|
| (21) | [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 [ɸ] is very similar to an existing phoneme of the language, [f], and thus the issue of confusability of segments arises. The possibility exists that there is a surface contrast between preconsonantal *f* and preconsonantal [ɸ] analysed as [uhC] but that [fC] may also be pronounced as [ɸC], as we discuss later. Insofar as [ç] is not a phoneme of the language nor is it particularly similar to [š] which is a phoneme, such a level of phonetic detail is omitted.

Another caveat is needed here. We have no evidence that there is a contrast between long and short preaspiration after a short nucleus; as we have stated, long nuclei are also not found before long preaspiration. In terms of surface distribution, long and short preaspiration are thus in complementary distribution, long preaspiration appearing just in case the preceding nucleus is short. This means that long preaspiration could be completely analysed out of existence in the language, being reduced to the status of a phonetic side-effect of a short nucleus on preaspiration. Under such an analysis, diphthong length as found in (16) becomes surface contrastive. Since diphthong length is actually not a trivial surface-predictable phenomenon, we do not, at this point, reject an alternative analysis where the alternations above are in terms of nuclear length rather than consonantal properties.

### 3.3. Degemination (Q2)

The third gradation effect is degemination, which affects intervocalic geminate fricatives and sonorants.

(22)	guolli	guoli	“fish”
	staallu	staalu	“troll”
	healla	heala	“heel of shoe”
	viessu	viesu	“house”
	maannaa	maanaa	“child”
	nuorra	nuora	“young”
	mearra	meara	“sea”
	gaaffe	gaafe	“coffee”
	fuoððu	fuoðu	“wild animal”
	roaðði	roaði	“redness”
	naðða	naða	“axe handle”

As before, we remain somewhat noncommittal as to whether underlying geminates shorten in the accusative, or singletons lengthen in the nominative.

### 3.4. Degemination (Q3)

Another shortening process is found, in the form of shortening of Q3 geminates to Q2. As noted previously, we are not certain whether Q3 geminates (which we notate as C'C) are phonetically distinct from Q2 geminates; there seems to be no clear evidence for a phonological contrast in the quantities of geminates after short vowels. The phonological evidence for this alternation is the alternation in vowel length before the geminate.

(23)	gol'li	goolli	“gold”
	rūol'la	ruolla	“rude person”
	dūol'lu	duollu	“toll”
	ĵiel'li	jielli	“fish-drying rack”
	mīel'li	mielli	“high bank of river”
	hur'ri	huurri	“newcomer”
	jor'ri	joorri	“something that goes around”
	pen'na	peenna	“pen”
	zum'ma	zuumma	“kiss”
	lum'ma	luumma	“pocket”
	bin'na	biinna	“bit of something”
	bum'ma	buumma	“barracade”
	gum'mi	guummi	“eraser”
	rūos'sa	ruossa	“cross”
	gūos'si	guossi	“guest”
	ris'si	riissi	“twig”

We assume underlying stems like /gool'li/, /peen'na/, which either undergo vowel shortening when the underlying Q3 consonant is intact because gradation has not affected the consonant, or else undergo gradation to shorten the consonant to simple Q2 which allows the underlying long vowel to surface unchanged. As with long preaspirates, it could also be assumed that the consonant itself remains phonologically invariant (simple) geminate, and the only alternation is in the length of the nucleus.

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

(24)	dūollji	duolji	“reindeer skin”
	viellja	vielja	“brother”

If in fact the palatal lateral is always geminate then these forms might be better transcribed as [dūoʎ'ʎi] ~ [duoʎʎi], [viɛʎ'ʎa] ~ [viɛʎʎa].

### 3.5. Coda Shortening

Another group of nouns might ultimately be subsumed under the preceding Q3 degemination process. In these nouns, the last stem consonants are the clusters ssC or ššC, and the preceding vowel is short. In the accusative, the fricative is shortened and the preceding vowel is long.

(25)	basste	baaste	“spoon”
	lassta	laasta	“leaf”
	gissta	giista	“reindeer gloves”
	bisstu	biistu	“durability”
	müoski	muoski	“isthmus”
	asski	aaski	“lap”
	gasska	gaaska	“distance”
	duski	duuski	“researcher”
	lüossti	luosti	“light strand of rein hair”
	lüosku	luosku	“loose snow”
	šuššmi	šuušmi	“heel”
	lusspi	luuspi	“outlet”
	osstu	oostu	“tanning liquor from willow”
	ossku	oosku	“belief”

We presume that the stem vowel is underlyingly long, and is shortened before ssC or ššC, so we assume /baasste/, /muoski/ etc. These alternations are in character the same as the shortening of long preaspiration, though there is no temptation to consider such clusters to be single consonants.

### 3.6. Devoicing

Another manifestation of gradation is devoicing, whereby a geminate voiced stops becomes voiceless in the accusative singular.

(26)	aažža	aačča	“grandfather”
	speažži	speačči	“flat-chested person”
	loažži	loačči	“abated wind”
	gabbaa	gappaa	“all-white reindeer”
	loddi	lotti	“bird”
	müoddaa	müotta	“reindeer fur dress”
	roadda	roatta	“club, bat”
	güoddaa	güotta	“mattress”
	güoddu	güottu	“stump”

g̊ieddi	g̊ietti	“meadow”
deaddu	deattu	“weight”
r̊oobbi	r̊oppi	“wart”
d̊oobbaa	d̊oppaa	“one / other”
j̊oobbaa	j̊oppaa	“one of two”
oabbaa	oappaa	“sister”
goabba	goappa	“which of two”
reabbaa	reappaa	“crab
baaggu	baakku	“necessity”
diggi	dikki	“parliament”
mugga	mukka	“jug”
doggi	dokki	“stomach of ruminant”
d̊oggi	d̊okki	“clump in hair”

These data present a considerable number of surface short diphthongs, which might strengthen the case for distinctive length in diphthongs. We note that the short diphthongs are all of the form [̊uo, ̊ie], but do not presently know if this fact is significant. A similar correlation in diphthong length and type will be seen in other contexts, such as before glottalized nasals and stop clusters. There are also stems with an alternation in diphthong length.

(27)	v̊ogga	vuokka	“fishhook”
	l̊odda	luotta	“footprint, road”
	z̊ozza	zuocca	“membrane”
	b̊iegga	biekka	“wind”

It is again striking that these stems all have the diphthongs [̊uo, ̊ie]: we have no stems with long [uo, ie] in “strong” cases, when followed by geminate voiced stops, unless the following vowel is [aa]. The question then arises what governs these two classes of alternations, and at present we are clueless. We will witness analogous length alternations in the rising diphthongs in sections below.

### 3.7. Deglottalization

In nouns which have a sequence of glottal stop before a nasal (or: preglottalized nasal) in the nominative, the glottal stop is deleted in the accusative.

(28)	laʔnja	lanja	“room”
	ruoʔma	ruoma	“tracebearer”
	joʔnja	jonja	“lingonberry”
	lieʔma	liema	“broth”

čuoʔma	čuoma	“fish skin”
duoʔma	duoma	“bird-berry”
suoʔma	suoma	“Finland”
suoʔna	suona	“sinew”
loaʔna	loana	“loan”
deaʔnu	deanu	“large river”
jieʔna	jiena	“voice”
juoʔna	juona	“plot (of novel), suspense”

There are also some stems with rising diphthongs whose short diphthong of strong cases corresponds to a long diphthong in weak cases.

(29)	gǔoʔmi	guomi	“roof of mouth”
	bǔoʔnji	buonji	“hard part of horn”
	fǔoʔni	fuoni	“bad”
	lǔoʔni	luoni	“dirt”

### 3.8. Glottal Shift

Related to deglottalization is a process whereby glottally-interrupted nasals of the nominative become pre-glottalised in the accusative.

(30)	gunʔni	guʔni	“honor”
	bǐemʔmu	bieʔmu	“food”
	eanʔni	čaʔni	“mother”
	boanʔnji	boaʔnji	“husband”
	anʔni	aʔni	“user”
	bonʔni	boʔni	“bottom”

Another way to look at this alternation is that the strong case data in (30) represents a long glottalised nasal and the weak case data represents a short glottalized nasal: the specific location of the glottal stop, in the middle of the nasal, would then be a matter of phonetic timing, not phonological representation.

### 3.9. Coda Weakening

Nouns with a k-initial obstruent cluster in the nominative undergo a lenition of that /k/ to [f] before a stop.

(31)	gaakti	gaafti	“jacket”
	faakta	faafta	“keeper”
	mokta	moofta	“inspiration”
	dikta	diifta	“poem”
	gikta	giifta	“sinker on net”
	sikta	siifta	“scenic point”
	riekti	riifti	“right, justice”
	baakti	baafti	“cliff”
	oakti	oafti	“intermittent rain or snow”
	zoakci	zoafci	“foothold”
	zŭokca	zuofca	“ice bridge”
	roakči	roafči	“dent (in car)”
	daakti	daafti	“bone”
	fraakta	fraafta	“freight”
	lŭokta	luofta	“creek”

However, before [s], /k/ lenites to [u] (or [w], depending on the interpretation of pre-consonantal [w]) — there are few examples of this in the current corpus.

(32)	teaksta	teausta	“text”
	taaksta	taausta	“appraisal”
	leaksu	leaussu	“homework”
	leaksa	leaussa	“lefse”
	raksa	raaussa	“baby diapers”
	uksaa	uussaa	“door”
	buksa	buussa	“pants”
	boksa	boussa	“can”
	dikšu	diuššu	“nurturing”

The second set of examples further illustrate a complication pertaining to lengthening of consonants in connection with gradation, to be discussed in the next section.

In light of the analysis of phonetic overlap between *u* and preaspiration in section 3.2, another way of interpreting the data in (31) is that *k* lenites to *u*, and that the following consonant is preaspirated, resulting in the phonological sequence *uh* realized phonetically as *u̥* which simply sounds like *f* (or *φ*): thus (31) could be retranscribed as (33).

(33)	gaakti	gaauhhti	“jacket”
	mokta	moouhhta	“inspiration”
	riekti	riuhhti	“right, justice”
	baakti	baauhhti	“cliff”

zoakci	zoauhhei	“foothold”
zũokca	zuouhhca	“ice bridge”
daakti	daauhhti	“bone”
fraakta	fraauhhta	“freight”
lũokta	luouhhta	“creek”

One question arises regarding phonetic qualities, namely whether the weak form is (in a narrow phonetic transcription) [gaafti] or [gaaʔti]. At this point, we are uncertain about this issue, but it does appear that either pronunciation is possible. Another point which we only mention but do not presently try to reduce to a regularity is the alternation of vowel length seen in these data: *mokta* ~ *moofta*; *dikta* ~ *diifta*; *gikta* ~ *giifta*; *sikta* ~ *siifta* as well as an alternation on some diphthongs: *zũokca* ~ *zuofca*; *lũokta* ~ *luofta*. The length alternations in the high-vowel diphthongs (*ũo* and *ĩe* vs *uo*, *ie*) parallel those found with medial geminates (section 3.6), noting that they appear to depend on the nature of the following vowel.

We suggest overlong preaspiration in these examples because we have not noted a clear *u*-like vocalic portion to the nucleus. We do not have observed a clear surface contrast between VuhC and VfC, such as hypothetical *daauhti* vs. *daafti*, and in lieu of such a contrast, the lack of *u*-like transition in the above examples could be taken as evidence that short preaspiration covers up the *u* portion of a diphthong entirely (note that the examples discussed previously where there was a clear percept of the vowel *u* were *ruhhtu* “bus route” and *duhhki* “handful of hair” which do not have diphthongs). Data discussed in section 4 such as the phonetic alternation *gaaufpi* ~ *gaaffpi* “store” will show that the overlap of short preaspiration and *u* is only partial, and that complete overlap resulting in apparent loss of *u* only arises before long preaspiration.

### 3.10. The “Irregular” Consonant

Finally, there are a number of nouns which have a voiceless geminate alveopalatal affricate in the nominative, which becomes [j] in the accusative. These are cases corresponding to <dj> in the standard orthography.

(34)	vuočča	vuoja	“butter”
	veáčču	veaju	“one’s energy”
	biečču	bieju	“den”
	soáčči	soaji	“wing”
	deačča	deaja	“tea”
	lačču	laju	“lead”
	riečča	rieja	“noise”
	guočča	guoja	“kind of grass”
	đuočči	duoji	“handicrafts”

There is no parallel alternation between a voiceless geminate stop in the nominative and a single consonant in the accusative, for any other kind of consonant, thus nothing like *\*kk ~ g*, *\*kk ~ w*.

### 3.11. Q3 ~ Q1 alternations

A number of stems appear to have an alternation between an apparent Q3 consonant (overlong geminate or preaspirate) and a single, unaspirated (voiced) consonant

(35)	a.	jahhki	jagi	“year”
		zahhca	zaza	“isthmus between two lakes”
		gohhpi	gobi	“depression in land”
		dahhku	dagu	“doing”
		ohhca	oza	“pouch under blouse”
		ohhcu	ozu	“search, register”
		ohhki	ogi	“fetus”
	b.	viv’vaa	vivaa	“son-in-law”
		nav’va	nava	“hairs soaked off hide”
		siv’va	siva	“reason”
		dav’vi	davi	“north”
		vaš’ši	vaši	“hatred”
		las’si	lasi	“extras”
		gus’saa	gusa	“cow”
		las’sa	lasa	“threshold”
		dol’la	dola	“fire”
		sal’la	sala	“torso”
		dil’li	dili	“situation”
		bal’lu	balu	“fright”

Bearing in mind that that there appears to be no phonetic contrast between Q2 and Q3 after short vowels, a simple analysis of these data is that the medial consonant is really a Q2 simple geminate or preaspirate, whose duration is phonetically increased because the preceding nucleus is short. Thus the examples in (35) differ from those in (12) and (22) only in the length of the nucleus; phonologically these data could be analysed as *jahki ~ jagi* and *navva ~ nava*.



### 3.12. Interim Summary

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

(36)	hp → b	daahpi	daabi	“habit”
	hhp → hp	m̄ichhki	michki	“sword”
	ll → l	guolli	guoli	“fish”
	l'l → ll	pen'na	peenna	“pen”
	sst → st	asski	aaski	“lap”
	bb → pp	gabbaa	gappaa	“all-white reindeer”
	ʔm → m	joʔnja	jonja	“lingonberry”
	mʔm → ʔm	gunʔni	guʔni	“honor”
	kt → ft	gaakti	gaafti	“jacket”
	čč → j	deačča	deaja	“tea”

### 4. Post-Consonantal Lengthening

The data which we have discussed so far have excluded stems with diphthongs ending in *i, u* (including long high vowels) as well as sonorant plus consonant sequences, for the reason that such stems have a different pattern of consonant gradation. As (37) shows, stems may have a single consonant in the nominative, and in the accusative that consonant is lengthened when the immediately preceding vowel is *i* or *u*.

(37)	moivi	moivvi	“chaos”
	deaivu	deaivvu	“finding where one is going”
	veaiva	veaivva	“crank”
	doaivu	doaivvu	“belief”
	ruivi	ruivvi	“mess”
	saaiva	saaivva	“fresh water”
	duivi	duivvi	“disorder”
	siivu	siivvu	“travel conditions”
	liiva	liivva	“vest”
	g̃oulu	g̃oullu	“area”
	čoauji	čoaujji	“stomach”
	aairu	aairru	“oar”
	jaauri	jaaurri	“lake”
	m̄oula	m̄oulla	“deep snow”
	ŕeula	ŕeulla	“humidity in sauna”
	daauli	daaulli	“light spot or stain”
	leaira	leairra	“clay”

reaisu	reissu	“trip”
aaisa	aaissa	“shaft”
gaaisa	gaaisa	“peak”

This complicates the gradation pattern, insofar as the general direction of change has so far been shortening, whereas these examples involve lengthening of a consonant.

These data exemplify a general sub-regularity in gradation, that in the accusative and other weak cases, a consonant is lengthened just in case it is preceded by a consonant or high element of a diphthong. We will refer to this as the post-consonantal context. When the full range of alternations has been considered, the question of how to characterise the preceding context will be discussed further, but for the moment we will simply say that the consonant which is lengthened is preceded by a sonorant.

Parallel to the examples in (37), we also find cases where a simple preaspirated stop becomes long-preaspirated (/ht/ → [hht]) rather than becoming a short voiced consonant (/ht/ → [ð]) as happens in other contexts.

(38)	muihtu	müihhtu	“memory”
	buihku	büihhku	“knife”
	duihpi	düihhpi	“slow person”
	laaihka	laihhka	“lazy person”
	leaihka	lēaihhka	“joke”
	luoihtu	lūoihhtu	“release, calculation”
	ruihtu	rühhtu	“cooking pot”

A few stems appear to manifest gradation via deletion of a vowel, as illustrated in (39), in some cases with lengthening of the preconsonantal fricative.

(39)	gaaufpi	gaafpi	“store”
	laaufka	laafka	“backpack”
	laaufki	laafki	“step”
	doaufki	doafki	“stupid”
	ruufke	ruffke	“mine (for ore)”

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

(40)	gaauhpi	gaauhhpi	“store”
	laauhka	laauhhka	“backpack”
	laauhki	laauhhki	“step”
	doauhki	doauhhki	“stupid”
	ruuhke	ruhhke	“mine (for ore)”

One unresolved factual issue is the [f] / [ɸ] question. We noted in 3.9 that coda /k/ lenites to [f] before voiceless stops, resulting in alternations such as *gaakti* ~ *gaaf*t*i* “jacket”. The question is whether the labial fricative found in *gaaufpi* ~ *gaafpi* “store”, especially in the weak-case form, is the same fricative as found as a result of leniting /k/.

The data in (38) 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 (40) reflect that assumption. The more phonetic transcriptions in (39) simply reflect the perceptual identity of coda [f] and devoiced [ɸ].

As noted earlier, intervocalic voiced stops are uncommon in the nominative. In the post-consonantal context they are not rare, and regularly alternate with voiceless geminate stops in the accusative.

(41)	nieida	nieitta	“daughter”
	siida	si(i)tta	“reindeer camp”
	liigi	likki	“what you can spare”
	siidu	siittu	“page”
	aaigi	aaikki	“time”
	leauga	leaukka	“flag”
	daauda	daautta	“sickness”
	saauga	saaukka	“sheep”
	daaigi	daaikki	“dough”
	dieudu	dieuttu	“man”
	laaigu	laaikku	“lease”
	leaibi	leaippi	“tree sp.”

The data provide a further instance of the lengthening of the first medial consonant in the accusative singular (and other contexts where weak-grade consonants are found).

While the data discussed so far have focused on consonants after high vowels, lengthening and devoicing of stops is also found after a nasal consonant, as well as in the cluster /ld/.

(42)	leanga	leankka	“shoulder harness for reindeer”
	heenǵe	heenǵke	“cliff”
	doanǵi	doanǵki	“clumsy person”
	buumba	buumppa	“chest of furniture”

gaanda	gaantta	“boy”
gieldda	gieltta	“community”
gielddu	gielttu	“prohibition”
mūoldu	mūolttu	“mold”
aaldu	aalttu	“female reindeer”
bealdu	bealttu	“arable land”

We can now bring into consideration a related gradation alternation. A number of stems appear to have the shape  $cv(v)c\check{v}cv$  in the nominative. Trisyllabic noun stems with a final vowel are restricted, and true trisyllabic stems (such as *huteella* “hotel”) are loanwords with other special properties. Other apparent trisyllables, which are not (modern) loanwords are given below. Note that in the accusative, the medial vowel is deleted and the last consonant undergoes post-consonantal lengthening. In the examples below, the last consonant in the nominative singular form is a voiced stop which lengthens and devoices in the “weak” form.

(43)	gaalebi	gaalppi	“calf”
	mearedi	meartti	“fishnet”
	gealabu	gealppu	“ability”
	mielaga	mielkka	“sternum”
	baragu	barkku	“work”
	silaba	silppa	“silver”
	jūolegi	jūolkki	“foot”

In a small set of examples where the stop does not devoice, the derived geminate is preceded by [ð], which we surmise blocks devoicing (\*[ðk(k)] is not found in the language).

(44)	geaðegi	geaðggi	“stone”
	šieðaga	šieðgga	“goat willow”
	beaðebi	beaðbbi	“shoulder blade”
	čoaðegi	čoaðggi	“duck sp.”

To this we add nouns with underlying /ð/ followed by a preglottalized nasal. When a vowel is not inserted in weak cases, the nasal deglottalizes and the fricative becomes [n].

(45)	g̃ieðeʔmi	g̃ienmmi	“frying pan”
	l̃ieðeʔmi	l̃ienmmi	“broadening of antlers”
	leaðaʔma	leanma	“trunk partition”
	čaðeʔmi	čanmi	“freckle”

In the examples of (47), the consonant simply lengthens because it is not a voiced stop.

(46)	oloju	oljju	“oil”
	gũođoju	gũođjju	“cocoon, cover”
	gireji	girjji	“book”
	garaja	garjja	“crow”
	mũoreji	mũorjji	“berry”
	balava	balvva	“cloud”
	arevi	arvvi	“rain”
	doalevi	doalvvi	“a trot”
	doreve	doorvve	“musical horn”
	dũolava	duolvva	“filth”
	balasa	balssa	“mound”
	hirasa	hirssa	“big log”
	darefi	darffi	“turf”
	maarefi	maarffi	“sausage”

Stems of this type always have an voiced coronal continuant, *ð*, *r* or *l*, as the medial consonant; the medial short vowel is always a short non-high vowel whose quality is determined by the following vowel. We assume that this vowel is inserted under conditions to be discussed (as opposed to being present underlyingly and being deleted in the complementary context). At the moment, we will simply say “outside the gradation context, a short vowel is inserted between a consonant and a preceding voiced coronal continuant”. In the gradation contexts, a consonant is lengthened when preceded by another consonant.

If the conditioning consonant is a nasal, there is no epenthetic vowel.

(47)	hiimsi	hiimssi	“silly girl”
	liimsi	limssi	“inappropriately behaved”
	loamši	loamšši	“inappropriate, baggy clothes”
	leamši	leamšši	“short, fat woman or female reindeer”
	leamsi	leamssi	“too small for one’s clothes”

Another set of post-consonantal alternations can be seen below. In these examples, it is clear (from the phonetic devoicing of the preceding sonorant) that the last obstruent is pre-aspirated. Whether the transcription with [hht] is literally correct we cannot tell, since there is no contrast that we know of between RhC and RhhC. Since we can tell that /hC/ lengthens to [hhC] after a glide (cf. *muihtu* ~ *mũihhtu*), the same lengthening would be expected to take place in these examples — however, if it turns out that there might be

reason to treat these as simple preaspirated consonants, transcriptions like [birhcu] would also be acceptable.

(48)	nūrahtu	nuorhhtu	“north wind”
	zulehci	zulhhci	“protrusion”
	birahcu	birhhcu	“dice”
	mielehki	mīelhhki	“milk”
	đielahku	đielhhku	“spot, stain”
	direhči	dirhhči	“naked person”
	baarehti	baarhti	“bad luck”
	daalehki	daalhki	“bad weather”
	doorahka	dorhhka	“inside-out reindeer skin dress”
	goalehki	goalhki	“not windy”

Finally, examples involving a vowel before preglottalised nasal are seen below.

(49)	baareʔni	baarʔni	“son”
	fiereʔmi	fierʔmi	“fishing net”
	gūoreʔmi	gūorʔmi	“load”
	šaaraʔma	šaarʔma	“charm”
	deareʔmi	dearʔmi	“hill”
	dearaʔna	dearʔna	“raw milk”
	doaraʔna	doarʔna	“tower”

Although the nasal remains short and the glottal stop is retained in these cases, in certain related examples the glottal stop is deleted and the nasal is lengthened, just in case the glottal stop is preceded by the high vowel part of a diphthong in the nominative (hence, there is no intervening vowel).

(50)	vuoiʔna	vuoinna	“spirit”
	laauʔnji	launnji	“sod”
	maaiʔnu	maainnu	“praise”
	rieuʔnu	riennu	“straight pin”
	saaiʔma	saaimma	“fine-mesh fishnet”
	iuʔni	iunni	“color”
	vouʔna	vounna	“vogn”
	diiʔmu	diimmu	“hour”
	doaiʔma	doaimma	“function”
	duuʔni	duunni	“garbage dump”
	liiʔni	liinni	“shawl”
	kapteaiʔna	kapteainna	“captain”

In a number of nouns which have *u* followed by *r*, there is an additional segmental alternation in the quality of *u*, which surfaces as an approximant that we transcribe as <v>: its phonetic manifestation is as a labial glide at the left edge with increasing turbulence resembling the fricative [β] at the right edge.

(51)	diuri	divrri	“insect”
	muura	muuvra	“wall”
	heeuro	heevrro	“damp”
	buuru	buvrru	“porridge”
	buuri	buvrri	“shed”

This alternation only occurs in the combination /wr/, and we will simply treat this phenomenon as a phonetic contextual variant of [w], related to the phonetic partial devoicing of geminate [rr].

In the examples considered above, the consonant which is lengthened is also pre-vocalic. However, this is not a relevant conditioning factor for lengthening. The data in (52) illustrate lengthening of consonants before other consonants.

(52)	baaiski	baaiski	“herring-gull”
	beaisku	beaisku	“vermin”
	duisku	dūissku	“German”
	gaaiski	gaaisski	“bracken fern”
	guiski	gūisski	“mussel, clam”
	luiste	lūisste	“skate”
	maaiistu	maaisstu	“taste”
	raaiski	raaiski	“carnivore”
	raaisku	raaisku	“cadaver”
	roaisku	roaisku	“whip”
	čaaihni	čaihhni	“freckle”
	bauhli	baφφli	“bulge, lump”

We will now summarize the post-consonantal alternation. Regarding the preceding trigger, a preceding consonant is an important conditioning factor. The lengthening alternation takes place after *l*, *r*, *ð*, nasals, as well as certain high vowels. With a diphthong that ends in *u* or *i* (for example *aai*, *ou*, *ui*) we always find the alternation. If such diphthongs are treated as ending in a glide (i.e. are phonologically *aaj*, *ow*), the triggering class can be expressed as after a consonant. In addition, the alternation is found after surface monophthongal *uu*, *ii*, examples being repeated below.

(53)	ruuhki	ruhhki	“mine (for ore)”
	liigi	liikki	“what you can spare”
	siidu	siittu	“page”
	dii?mu	diimmu	“hour”
	duu?ni	duunni	“garbage dump”
	lii?ni	liinni	“shawl”
	muura	muuvra	“wall”
	buuru	buvrru	“porridge”
	buuri	buvri	“shed”

The alternation does not take affect a consonant which follows *s*, as the following examples show.

(54)	meastu	meastu	“jam”
	beaska	beaska	“dress”
	feasta	feasta	“festival”
	leastu	leastu	“sock”
	faasmi	faasmi	“lap”
	maaski	maaski	“journey”
	goaski	goaski	“elder maternal aunt”

The conditioning class of segments can thus be characterised as voiced non-syllabics.

Typical examples illustrating these alternations are seen below, where (a) includes examples of lengthening, (b) is lengthening and deglottalization, (c) is lengthening and devoicing, (d) is epenthesis vs. lengthening and devoicing.

(55)	a.	moivi	moivvi	“chaos”
		muihtu	müihhtu	“memory”
		beasku	beassku	“pest”
	b.	vuoi?na	vuoinna	“spirit”
	c.	leauga	leaukka	“flag”
		heen?ge	heen?kke	“cliff”
	d.	gaalebi	gaalppi	“calf”
		gea?gegi	gea?ggi	“stone”
		oloju	olju	“oil”
		n?orahtu	n?orhhtu	“north wind”
		baare?ni	baar?ni	“son”



## 5. Analysis: Underlying Distinctions

Previous sections have focused on presenting the range of alternations that characterise gradation (in disyllabic vowel-final stems). Given these data, we can now profitably consider the specifics of an analysis. The two questions most in need of an answer are: (a) what, if anything, phonologically unifies the different varieties of gradation change and (b) what is the direction of alternation? A third question, what is the conditioning context, will be set aside for the moment. For our current purposes, it could be a phonological property or it could be morphological case.

In order to characterise the nature of the change, we must know whether underlying /hp/ becomes surface [b] in weak cases or whether /b/ becomes [hp] in strong cases, thus the directionality issue must be resolved first. In classical neutralizations such as final devoicing in German and Russian, the correct underlying representations are established via the asymmetrical pattern of alternations — there is a class of stems in German whose final consonant alternates between *t* and *d* and a class with *t* having no alternations.

(56)	[bunt]	“colorful”	[buntə]	“colorful (attrib.)”
	[bunt]	“federal”	[bundə]	“federal (attrib.)”

[-son] → [-voice] / \_\_#

It is equally relevant to the analysis of German devoicing that there are no stems having *d* which lack alternations. The alternations and asymmetries are explained by positing, quite simply, that both voiced and voiceless consonants appear freely at the end of a stem, and when a voiced consonant at the end of the stem happens to be word final, it undergoes final devoicing. Had there also existed invariant nouns with a final voiced consonant, those nouns would have to be treated as lexical exceptions to final devoicing; in that case, under typical assumptions about the nature of exceptions, one would expect there to be a significant difference in the size of the two regular classes, compared to the irregular class. Such an asymmetry is in the very nature of neutralizing phonological processes.

Analogously, what one would hope for in Saami is a robust set of invariant stems that contrast with those stems which alternate, where the invariant vs. alternating property lines up neatly with some other phonological characteristic. Assuming the ideal of free distribution of phonemes in underlying representations, there should be three robust classes of stems, whose final consonant could be one of /g/, /hk/, or /hkk/. We have encountered the alternation *hk* ~ *g* and *hkk* ~ *hk*, thus the nominative shows two of the three expected consonant contrasts but lacks cases with *g*, and the accusative similarly shows two out of the three expected consonant contrasts, lacking *hkk*.

If gradation is a process of weakening in weak cases, then the nominative singular would most closely resemble the underlying form. Under that view of gradation we ex-

pect there to be underlying stems with plain preaspiration such as /čieħka/ which becomes [čieġa] in weak cases, and ones with long preaspiration such as /dĕahhka/ becoming [deahka] in weak cases. We also predict the existence of a class of invariant stems along the lines of hypothetical /meaġa/, which underlyingly have the weakest grade of consonant where further weakening in the accusative would not be possible. On the other hand if gradation strengthens consonants and the accusative represents the underlying form, there should be stems with underlying voiced consonants such as /čieġa/ which strengthen to [čieħka] in strong cases, ones with preaspiration such as /deahka/ that strengthen to [dĕahhka], and a class of invariant stems with underlying overlong preaspiration such as hypothetical /lĕahhka/, where strengthening has no effect. While alternations of the kind *čieħka* ~ *čieġa* “corner” and *dĕahhka* ~ *deahka* “deck” are common, unfortunately for both hypotheses, the expected third invariant class does not exist as a significant group.

The number of stems with invariant *b ġ g* is very small; similarly, the number of invariant stems with *hp* etc. is very small, as is the set of stems with invariant *hhp*. Examples of invariant stems of the first two types are given in (57).

- |      |    |               |              |
|------|----|---------------|--------------|
| (57) | a. | lođa          | “drawer”     |
|      |    | skaabe        | “cabinet”    |
|      |    | stoobe        | “can”        |
|      |    | leade         | “shed type”  |
|      | b. | liihka        | “corpse”     |
|      |    | riihpu        | “snail”      |
|      |    | kreativitehta | “creativity” |
|      |    | üniveršitehta | “university” |
|      |    | fakulteehta   | “faculty”    |

The existence of invariant stems with long preaspiration is somewhat harder to test. Possible examples are given below.

- |      |        |        |
|------|--------|--------|
| (58) | vahhku | “week” |
|      | dahhki | “doer” |

There are not many such examples. Further, such nouns might undergo a covert consonant length alternation, whose surface manifestation is obliterated due to a low-level phonetic process. Recall that vowels are always short before long preaspiration and that preaspiration has greater duration after a short vowel. It is therefore possible that there is a somewhat abstract phonological alternation, *vahhku* ~ *vahku*; *dahki* ~ *dahhki*, which is effectively “undone” by the phonetic increase in duration of coda consonants after short vowels. A clear example of an invariant stem with long preaspiration would involve a

surface short diphthong, i.e. hypothetical \**sěahhka*, since we assume that there are no underlying short diphthongs in the language, but we know of no such words. The pattern of non-alternating stems, at least those involving preaspiration and voicing alternations, thus does not reveal which consonantal grade underlies alternations like *goah̄ti* ~ *goađi*. Therefore, it remains unexplained at the moment why there are (virtually) no stems with *b* *đ* *g* in the nominative, and (virtually) no stems with *hhp* *hht* *hhk* in the accusative.

With respect to plain consonant length alternations, i.e. the alternations [s's] ~ [ss] and [ss] ~ [s], there is again a gap where one would expect a class of invariant stems. Alternations of the form [CC] ~ [C] are plentiful, and [C'C] ~ [CC] is also reasonably well attested. Invariant stems are relatively rare.

(59) *Single C*

geeso	“cradle”	geena	“gene”
raafi	“peace”	saave	“large tub”
loore	“cow toilet”	maala	“paint”
skaalaa	“scale (measurement)”		

*Geminate C*

oarri	“squirrel”	hearraa	“lord”
maalle	“design”	gaallu	“forehead”
maalle	“design”	gaassa	“cashier”
neavvu	“work tool”	daamma	“female horse”
gaassi	“milking residue, milk in the time just before or just after calving”		

*Q3 geminate*

molla	“musical key”	hannjaa	“duck sp.”
duvvaa	“dove”	nonna	“nun”
bissu	“gun”	missu	“whey”

As with preaspirated consonants, the actual existence of invariant a Q3 geminate as a phonological entity is uncertain, because these stems might have an abstract phonological alternation along the lines of *mol'la* ~ *molla* which is not phonetically realized due to the fact that the preceding vowel is short. We find no examples of invariant Q3 geminates with a diphthong, along the lines of hypothetical invariant \*[běal'la].

Analysis of the pattern of geminate stops reveals a similar gap. In light of the alternation *gabba* ~ *gappa*, one could presume that either *bb* or *pp* could be underlying. If there were a significant class of invariant stems with *pp*, or an invariant class of stems with *bb*, that fact would motivate the selection of the alternating geminates as underlyingly voiced (if the invariant class has *pp*) or voiceless (if the invariant class has *bb*). Either decision is predicated on there being a significant invariant class. In fact, there is only one type of stem, the alternating stems which have voiced geminates in strong cases

and voiceless geminates in weak cases.<sup>3</sup>We are not aware of any invariant stems at all with geminate stops.

While invariant stems with simple consonants (those in (59)) are generally more common than those with preaspirates etc, there is no significant asymmetry in the number of examples for one type vs. the other. Given the three-way contrasts  $b \sim hp \sim hhp$ , or  $s \sim ss \sim s's$ , we end up with only two out of three predicted patterns clearly attested, as well as a small handful of exceptions drawn from two of the three possible patterns.

A small measure of clarity about the nature of underlying forms seems at least initially (but deceptively) possible, upon consideration of the degemination and glottal-simplification alternations  $?m \sim m$  and  $m?m \sim ?m$ . Supposing that the nominative best represents the underlying form, we would presume a shortening process which applies to underlying /joʔnja/ vs /biemʔmu/. Were we to posit a lengthening process, we would be implicitly taking the accusative to represent the underlying form, which would be /bieʔmu/, /jonja/. The problem is guaranteeing the right lengthened output. In the case of /bieʔmu/, it would not be too hard to guarantee that the lengthened variant is [biemʔmu]: we simply need to guarantee that lengthening is accomplished by copying the nasal, and not lengthening the glottal stop — since there are no long glottal stops in the language, this poses no insurmountable problem. We can simply say that [mʔm] is a long glottalized nasal, and leave it to phonetic implementation to specify where exactly the glottal closure takes place. In terms of surface phonetic contrasts, either  $mm?$  or  $m?m$  (inter alii) would be equally adequate spellings.

The basis for predicting that the lengthened version of assumed /jonja/ is [joʔnja] is not (initially) clear, since geminate nasals do exist in Saami. The data in (60) seem to point to a distinction that is irrevocably neutralised in the accusative.

(60)	maannaa	maanaa	“child”
	nammaa	namaa	“name”
	mannji	manji	“daughter in law”
	meannu	meanu	“disposition, conduct”
	laʔnjaa	lanjaa	“room”
	ruoʔma	ruoma	“tracebearer”
	joʔnja	jonja	“tuttbær”
	baaʔni	baani	“tooth”
	lieʔma	liema	“broth”
	deaʔnu	deanu	“large river”

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<sup>3</sup>We are for the moment omitting the stems which have  $\check{c}$  in the nominative and  $j$  in the accusative — at any rate, while these stems do not satisfy the desired criterion of being invariant, the alternation found with such stems is quite different from the devoicing alternation exhibited by *gabba*, and finally these stems raise their own “lack of invariant counterpart” problem, as will be discussed.

There are two problems with taking such data as deciding the nature of underlying forms. First, even assuming a process of lengthening which applies in the nominative, the underlying representation could contain the segmental information about glottalized vs. non-glottalized nasals in the “shorter” prosodic representation, in the form of an abstract [+c.g.] short nasal realised as a plain nasal when surface short which contrasts with a [-c.g.] nasal realised as a plain nasal in all contexts. What would be special about the accusative is primarily its prosodic form, and its segmental exact form is almost entirely predictable from that, so even though the prosodic form of the accusative is unchanged, its segmental form is changed by deleting the glottal stop, which cannot be accommodated in the underlying ...VCV template.

The second fact, more damaging to construing these examples as probative, is that geminate nasals are not entirely robust as underlying segments. Note that in the above data (which include all examples in our current database with geminate nasals in the nominative), all examples with a geminate nasal also have an initial nasal; no examples with preglottalized nasal also have an initial nasal. This is unsurprising, since Sammallahti 1998 notes that earlier geminate nasals historically became (contemporary) [ʔn] except when the initial consonant is nasal. Thus the distinction between stem medial geminate nasal versus glottalized nasal turns out to be predictable from the preceding consonant.

It should be pointed out that contemporary loanwords into Saami conform to the generalization that strong-case Q2 geminate nasals do not occur in lieu of a preceding nasal. One strategy exemplified by loans such as *diiʔmu* “hour” (Norw. *time*), *kapteaiʔnu* “captain” (Norw. *kaptein*) is to borrow the nasal as preglottalized, and another is to borrow the nasal as a Q3 geminate (*bumʔma* ~ *buumma* “log, barricade”: Norw. *bom*; *gumʔmi* ~ *guummi* “eraser”: Norw. *gummi*). Loanwords do not ever appear to contain strong-case Q2 geminate nasals.

Another direction to look in seeking neutralization which could clarify the nature of underlying forms (hence the nature of gradation) would be to see whether there is a contrast between stems of the form *asski* ~ *aaski* “lap”, where the coda fricative is Q3 in the nominative, and those of some other invariant class. Such a class does exist.

(61)	meastu	meastu	“jam”
	beaska	beaska	“dress”
	feasta	feasta	“festival”
	leastu	leastu	“sock”
	faasmi	faasmi	“lap”
	maaski	maaski	“journey”
	goaski	goaski	“elder maternal aunt”

Based just on the accusative, one cannot predict whether the preconsonantal fricative of the accusative will correspond to a short fricative in the nominative or a long one: the data in (61) are to be contrasted with the examples of (25), repeated below.

(62)	basste	baaste	“spoon”
	lassta	laasta	“leaf”
	gissta	giista	“reindeer gloves”
	bisstu	biistu	“durability”
	müosski	muoski	“isthmus”
	asski	aaski	“lap”
	duski	duuski	“researcher”
	lūssti	luosti	“light strand of rein hair”
	lūosku	luosku	“loose snow”
	šuššmi	šuušmi	“heel”
	lusspi	luuspi	“outlet”
	osstu	oostu	“tanning liquor from willow”
	ossku	oosku	“belief”

Since there is no other way to predict this distinction fact, it presumably needs to be encoded in the underlying form — a distinction maintained in the nominative, and neutralised by a rule of shortening that applies in the accusative. These considerations would lead us to assume that the nominative best represents the underlying form, and that there is a process of shortening that affects weak cases. While this argument is attractive, it must be pointed out that the number of such examples is not huge, and without a more thorough study of the lexicon, we cannot be certain whether these examples are simply exceptions.

In short, the gradation alternations of section 3 turn out to be non-neutralizing: given a form in the nominative, there is a unique accusative form which is entirely predictable from the nominative, and vice versa. Any stem with [hp] in the nominative singular has [b] in the accusative, and any noun with [b] in the accusative has [hp] in the nominative.

(63)	<i>gradation as weakening</i>	<i>gradation as strengthening</i>
	hp → b	b → hp
	hhp → hp	hp → hhp
	ll → l	l → ll
	l'l → ll	ll → l'l
	bb → pp	pp → bb
	?m → m	m → ?m
	m?m → ?m	?m → m?m
	čč → j	j → čč

The directionality of gradation cannot be determined on the basis of such stems, since it is not neutralizing. We are simply faced with a gap in underlying distribution, so perhaps the nature of the gap entailed by the strengthening vs. weakening approaches may reveal something. Either there are no stems with underlying voiced obstruents (if the nominative reflects the underlying form), or there are no stems with underlying Q3 consonants (if the accusative reflects the underlying form).

The latter conclusion would be desirable from some theoretical perspectives. A standard assumption about phonological properties has been that they are binary in nature, so positing a three-way contrast in length is an anomaly, especially since other putative cases of underlying three-way length contrasts have been shown to be incorrectly analysed (most notably Estonian, also Kamba). This might then be taken as support for a strengthening approach.

The gradation pattern of stems such as *aaigi* “time”, *gealabu* “ability” etc. exhibiting the post-consonantal lengthening discussed in section 4 is rather different. The alternations are simple: considering the relation of accusatives with respect to nominatives, the last consonant is lengthened and (generally) devoiced if it is a stop. Again, consonant distribution is noticeably asymmetrical. Whereas in the case of simple postvocalic consonants single consonants are extremely uncommon and overlong consonants are not rare, in this class of stems there are many cases of single voiced stops (*aaigi* “time”), short preaspiration (*buihku* “knife”) and singleton consonants (*airu* “oar”), but geminates, long preaspirates, and interrupted-glottalized nasals do not occur in nominatives of post-consonantal type stems: there are no stems like hypothetical nominative singular *\*sainnu*, *\*beaihhti*. There is only one “grade” of consonant in this class, and as with the regular postvocalic set of nouns, there is no neutralization, so the nominative can be fully predicted from the accusative or vice versa.

A possible line of evidence for selecting a particular underlying form involves glottalized nasals. Given alternations such as *vuoi?na* ~ *vuoinna* “spirit”, we would look for a stem containing a simple nasal in the strong case and a geminate in the weak case — analogous to the alternation *airu* ~ *airru* “oar”, simply substituting a nasal. But it turns out that while single oral consonants are common in this class of stems, there are no stems with single nasals, i.e. hypothetical *\*ainu* does not exist. Had there been stems of the form *\*ainu* ~ *\*ainnu*, which contrast with existing *vuoi?na* ~ *vuoinna*, we would have the desired evidence needed to show that there is an unrecoverable neutralization in one column (the accusative): but such evidence doesn’t exist. In terms of existing contrasts, underlying /vuoina/, /vuoinna/, /vuoi?na/ or even /vuoin?na/ are equally possible representations, since there is only one “type” of stem in this medial-cluster group and thus very little issue regarding preservation of information. The underlying forms /vuoina/ and /vuoin?na/ are less plausible because of their abstractness (neither corresponds to a surface variant of the word), but it is well-known that underlying forms of morphemes cannot rigorously be required to be the same as some surface allomorph.

These data do point to an interesting complication in the analysis of glottalized nasals. We noted in connection with alternations of the type *meannu* ~ *meanu* “disposition” versus *ruoʔma* ~ *ruoma* “tracebearer” that geminate nasals are found in the nominative only when the initial consonant of the stem is a nasal. This can be accounted for in a number of ways. If we assume that the underlying consonant is a preglottalized nasal, there could be a rule changing a preglottalized nasal into a geminate nasal when a nasal precedes in the syllable (hence /*meaʔnu*/ becomes [meannu]); if the nasal is underlyingly a geminate, it could undergo a process of “consonantal breaking” that applies to geminate nasals only in lieu of a preceding nasal (whereby presumed /*ruomma*/ becomes [ruoʔma]). Alternations such as *vuoiʔna* ~ *vuoinna* — as well as equally analogous *maaiʔnu* ~ *maainnu* “praise” — obviously bear on this issue. Forms like *vuoinna* (accusative) show that we cannot simply leave it at saying that a simple rule changes a geminate nasal into a glottalized nasal when no nasal precedes, and ones like *maaiʔnu* (nominative) show that there also cannot be a simple rule turning glottalized nasals into geminates after nasals.

The evident difference in distribution of geminate and glottalized nasals in the post-vocalic vs. post-consonantal contexts can be partially addressed. One simple observation is that, even if we take the post-consonantal alternation to involve lengthening in weak cases, long nasals which are derived from short nasals do not undergo glottalization. This directly addresses the question of how a form such as (accusative) [vuoinna] could exist if there is a process “breaking” long nasals. Nevertheless, it remains unclear how to directly relate presumed /*vuoiʔna*/ to [vuoinna], given only a process of lengthening in weak cases. The lengthened version of /*nʔ*/ should in fact be [nʔn], and not [nn] — somehow, additional machinery is needed to derive an intermediate form *vuoina*, to simplify the nasal.

On the basis of alternations of the type *lieʔma* ~ *liema* “broth” discussed in section 3.7 plus alternations like *gunʔni* ~ *guʔni* “honor” seen in 3.8, the consonants *n* ~ *ʔn* ~ *nʔn* are established as falling paradigmatically into the classes Q1 ~ Q2 ~ Q3, analogous to *b* ~ *hp* ~ *hnp* or *s* ~ *ss* ~ *sʔs*. That being the case, there seems to be a bit of an anomaly that a Q2 geminate consonant doesn’t appear in the strong case but a Q2 preglottalized consonant does. What this indicates is simply that the restrictions on consonant distributions in the post-consonantal context stems is not just a matter of quantity in this overarching sense. Geminate consonants per se are lacking in the strong cases of such stems: but preaspirated consonants, which are just as much Q2 consonants in terms of gradation as preglottalized nasals are do freely appear in such stems (c.f. for example *muihti* “memory”) — they are the non-geminate Q2 consonants.

We are again faced with the problem that the direction of consonantal change cannot be determined based on an asymmetrical pattern of neutralisation. It might then be proposed that /*mũihhtu*/ becomes [muihtu] by a shortening process that applies in the nominative, or that /*muihtu*/ becomes [mũihhtu] by lengthening. Now consider data involving the coda-weakening process discussed in 3.9, exemplified by alternations such as



*daakti* ~ *daafti* “bone” or *leaksu* ~ *leaussu* “homework”. Working under the implicit assumption that there is a lengthening process applying in the accusative, we have explained these alternations as follows. In the case of /leaksu/, lenition yields *leausu* which directly undergoes lengthening. In the case of /daakti/, lenition yields *daauti*, with a voiceless stop after the stressed vowel. The stop is preaspirated to *daauhiti*, and the aspiration is lengthened giving *daauhhti* which we noted is also pronounced *daafti*.

Under the competing hypothesis that there is a shortening process applying in the nominative (and no lengthening process in the accusative), we must assume the underlying forms of these stems to be /leakssu/ and /daakhhti/. In the accusative, coda-weakening would directly result in the surface form; the nominative would undergo a separate shortening rule that shortens any consonant immediately after an obstruent stop. It is true that surface [khht], [kss] are not attested in the language so the presumed shortening rule would be empirically tenable. However, this approach also requires postulating underlying representations exhibiting properties not found in surface forms (long consonants after stops). Given a choice between otherwise comparable hypotheses one of which establishes an actually occurring surface form (the nominative) as the underlying form, versus a hypothesis which requires underlying forms that never surface as such plus an additional rule to repair the nominative, the preferable hypothesis is the one which posits an underlying form which is closer to an actual surface form. This logic leads us to accept underlying /leaksu/ and /daakti/. That decision further entails accepting the hypothesis of post-consonantal lengthening in weak forms, which of course gives independent motivation to the process required by the hypothesis that, in general, the underlying forms of the *moivi*-class of stems contains a single consonant and not a geminate.

While this seems to pose a strong argument for the lengthening hypothesis, there is an argument which supports the view that the nominative of *moivi*-class nouns contains an underlying geminate, and that is the fact that singleton postvocalic *d* is extremely rare in the language, except in *moivi*-class nouns where one finds numerous nouns such as *aaidi* “fence”, *dieudu* “man”. By comparison, geminate *d* is not rare. This distribution can be explained under the hypothesis that *aaidi* and *dieudu* are underlyingly /aaididi/ and /dieuddu/ (thus are more closely parallel to *gabbaa* “all-white reindeer”, *loddi* “bird” and *roadda* “club”), and shorten in the nominative. We lose that explanation if we assume that there is lengthening in the accusative rather than shortening in the nominative.

One aspect of underlying representations relevant to post-consonantal gradation is clear, which is that there is a rule of vowel epenthesis and not vowel deletion. Setting aside the question of the underlying length of the last stem consonant in *geaðđegi* ~ *geaðggi* “stone” we presume that the stem is underlyingly bisyllabic, not trisyllabic. First, the nature of the medial vowel in such trisyllabic stems is predictable: it is a short non-high version of the stem-final vowel (see our previous mention of the issue of *o* before *o* versus *a* before *u*). If the stem were truly trisyllabic, one would expect freer distribution of vowels in the medial syllable, rather than a totally determined relation. Second, the surrounding consonantal context for putative trisyllabic vowel-final nouns is highly re-

stricted: the preceding consonant must be a voiced oral coronal continuant (*r*, *l*, *ð*). Were we to posit that these stems are underlyingly trisyllabic, that would introduce a significant gap in underlying representations — the lack of any disyllabic vowel final stems containing VC<sub>r</sub>VCV where C<sub>r</sub> stands for *r*, *l*, *ð*, and introduces a major complementary gap in underlying forms, namely the lack of any trisyllabic vowel-final stems where the consonant is anything other than *r*, *l*, *ð* and where the vowel is not fully predictable from the nature of the subsequent vowel.

To clinch the argument, we note that the surface nature of the epenthetic vowel is not even unique within a given stem: it depends on the nature of the following vowel as well as the preceding vowel. In the nominative, one vowel may be inserted because of the nature of the following stem vowel, but in the illative a different vowel may appear, due to a change in the nature of the following vowel. Stems ending in *i* have the illative singular ending *-ai*, resulting in a different epenthetic vowel. Thus the (underlined) epenthetic vowel varies in quality as a function of what vowel follows.

(64)	NS	IS	
	fie <u>r</u> eʔmi	fieraʔmai	“fishing net”
	gaare <u>j</u> i	gaarajai	“narrow”
	lie <u>ð</u> eʔmi	lieðaʔmai	“broadening of antlers”

Furthermore, the epenthetic vowel may also harmonize with a preceding *o*, so the epenthetic vowel is *o* after *o* as in *oloju* “oil”. Additionally, stems with the underlying diphthong /*oa*/ are subject to a complex monophthongization process that applies in the illative singular but not the nominative singular. The result then is again that the nature of the epenthetic varies within the paradigm: it is *a* if the preceding vowel is not *o* (which is the case when monophthongization does not take place), and is *o* when the previous vowel monophthongizes to *o*.

(65)	NS	IS	
	goaradu	gorodui	“something that warms you; usurer”
	goaragu	gorogui	“last name”

Therefore the epenthetic vowel cannot be a fixed property of the underlying form.

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