To appear in: Nordic Journal of Linguistics 28
Special issue on 'Dialects and Linguistic Theory'

Coda Maximisation in Northwest Saamic

Patrik Bye

The languages of the Northwest Saamic group evince a pattern of syllabification that maximises the complexity of the coda in a bimoraic stressed syllable (Kiparsky 2004). The coda maximisation requirement interacts with four other syllabic well-formedness constraints in a fixed ranking that regulates the sonority profile, quantity and structural complexity of the rhyme. Varying the point at which the coda maximisation requirement interleaves with the constraints in this fixed ranking generates a restrictive microtypology of coda maximisation in Northwest Saamic. The last part of the paper proposes to eliminate the stipulative fixed ordering by ranking the four syllabic well-formedness constraints in a proper inclusion (stringency) hierarchy (de Lacy 2004). It is argued that syllable rhymes may be characterised as falling on a scale of degree of perceptual integrity (dpi) and that complex codas are more dispreferred when the syllable has low dpi.

Keywords Saami, quantity, syllable structure, hypercharacterisation, Coda Maximisation, Optimality Theory

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1. INTRODUCTION

One of the many challenging areas in the phonology of the Saamic languages[1] is the interaction of segmental quantity and syllable structure. This article addresses the microtypology of Coda Maximisation in a small set of very closely related languages belonging to the northern group of West Saamic languages (henceforth: Northwest Saamic), a group that includes the three major dialect areas known to scholars as North Saami, Lule Saami and Pite Saami (Sammallahti 1998).[2] Examples of Coda Maximisation from West Finnmark Saami (a variety of North Saami) are shown in (1).[3]

(1) Coda Maximisation in West Finnmark Saami

/taavta/	taavt.ta, *taav.ta	'illness (acc/gen.sg)'
/hilko/	hilk.ko, *hil.ko	'reject!'

Coda Maximisation is apparently an areal feature of the Scandinavian Peninsula, since the phenomenon is also known from Fenno-Swedish (Kiparsky 2004). Kiparsky proposes that Coda Maximisation may be understood as enhancing a (stressed) *heavy* syllable by making it even heavier, an interpretation that is also adopted here. In some dialects of Fenno-Swedish, Coda Maxmisation may take place either post-vocalically (/CVVCV/→*CVVC.CV*) or post-consonantally (/CVC_1C_2V/→$CVC_1C_2.C_2V$). In Northwest Saamic, and in Fenno-Swedish generally, Coda Maximisation may only take place immediately following a consonant.

Within the Northwest Saamic group, the environments in which Coda Maximisation applies vary. This variation is systematic and mediated by a strict implicational hierarchy. It is proposed that this implicational hierarchy has its basis in a universal scale that encodes phonetic knowledge about the degree of perceptual integration (dpi) of the syllable rhyme. The dpi reflects the degree to which a syllable is confusable with something larger, such as a disyllable. The lower the dpi of a syllable, the less likely it will be perceived as a single syllable. There are a number of different dimensions that impact the dpi. Most obvious among these is sonority, but I will argue that the quantitative and tonal profiles of syllable rhymes also play a role, making comparisons across these dimensions meaningful. In the analysis developed in the last part of the paper, the lower the dpi of the syllable rhyme the more dispreferred a complex coda will be.

The organisation of the paper is as follows. Section 2 provides the necessary descriptive background and spells out the representational assumptions. Section 3 describes the typology of Coda Maximisation and Section 4 introduces the dpi scale and spells out the typological implications. Section 5 presents the main conclusions.

2. BACKGROUND

The aim of this section is to provide the necessary descriptive background as well as explain the representational assumptions for the analysis in §3. Our point of departure is the West Finnmark dialect of North Saami, specifically the varieties spoken in Kautokeino (North Saami: Guovdageaidnu, [kuovːtakeajːtnuu]) and Eastern Enontekiö (North Saami: Nuorta Eanodat, [nuorːhta eanoðaht]) documented by Sammallahti (1977, 1984, 1998) and Magga (1984).[4]

2.1 Metrical structure

Metrical structure profoundly influences the distribution of contrasts and so we begin with a brief statement of how stress is assigned. As shown in the examples in (2), syllabic trochees are constructed from left to right across the word. Monosyllabic feet are disallowed, and so imparisyllabic inputs surface with a domain-final unfooted syllable.

(2) Stress assignment in West Finnmark Saami

(tíeh.tiih)	‘to know’
(véah.ke).hih	‘to assist’
(át.tes).(tèah.tiih)	‘to give a little’
(póar.raa).(sèep.mo).sah	‘the oldest ones’
(ráahː.kaa).(sìjː.ta).(sèa.meh)	‘to our loved ones’
(méahː.tse).(tàa.luj).(ðà.sa).meh	‘to our forest farms’

Since all examples below are disyllabic forms, neither foot structure nor the location of stress will be marked from this point on. Coda Maximisation exclusively targets the head of the syllabic trochee, e.g. *(táa<u>vt</u>.ta)*, ‘illness (acc/gen.sg)’; *(hí<u>lk</u>.ko)*, ‘reject!’.

2.2 Foot-medial quantity contrast

Foot-medial position (the ‘consonant centre’ of Sammallahti 1998) is the hotbed of phonological activity in the Northwest Saamic languages. One of the more unusual characteristics of the languages in this group is that they evince a three-way length contrast in consonants in foot-medial position, distinguishing plain and overlong geminates. An example of a minimal triplet illustrating the three-way distinction in the West Finnmark dialect of North Saami is provided in (3).

(3) Three-way length contrast (West Finnmark Saami)

singleton	kaa.ruu	'by consenting'
plain geminate	kaar.ruu	'he/she consents'
overlong geminate	kaar:.ruu	'consenting'

'Foot-medial' refers to any consonantal material that intervenes between the nucleus of the head syllable and the nucleus of the dependent syllable. The underlined portions of the following examples thus represent the foot-medial position: *(lu.liil)*, 'in the south'; *(vier.ruu)*, 'habit (nom.sg)'; *(nan:.neh)*, 'to fortify'; *(šuš:.mii)*, 'heel (nom.sg)'.

A note on the conventions used in transcribing quantity is in order at this point. Plain geminates are written double. Overlong consonants, and overlong consonants *only*, are marked in transcription with the length mark [:]. Where the overlong consonant forms part of both the coda of the head syllable and the onset of the dependent syllable, the consonant will be written double with the length mark in the middle, as in *kaar:.ruu*, 'consenting'. If the overlong consonant does not form part of the onset of the unstressed syllable, because it is part of a foot-medial cluster, the symbol for the consonant will be written singly, e.g. *pas:.te*, 'spoon (nom.sg)'.[5]

Extending moraic theory (Hayes 1989; Hock 1986; Hyman 1985; McCarthy and Prince 1986) to deal with the opposition between plain and overlong geminates, we can assume overlong geminates bear two moras as in (4).

(4) Moraic representations of geminates

a. plain geminate b. overlong geminate

No segment, vowel or consonant, may be trimoraic. No languages apparently allow trimoraic consonants, although some languages, such as Estonian (Bye 1997 and refs. therein), permit trimoraic nuclei. I assume the constraint in (5) is undominated in Northwest Saamic. I use the Greek letter ν to designate the nucleus.

(5) $*\nu_{\mu\mu\mu}$

Trimoraic nuclei are disallowed.

2.3 Segment inventory

The segment inventory of Eastern Enontekiö Saami is given in (6), adapted from Sammallahti (1998) and modifed in the light of the interpretation in Bye (2001).

(6) Segment inventory of West Finnmark Saami (Eastern Enontekiö dialect)

a. consonants

p	t	ts	tš	c	k
^{h}p	^{h}t	^{h}ts	^{h}tš		^{h}k
b	d			ɟ	g
f	θ	s	š		
m	n		(ŋ)	ɲ	
^{p}m	^{t}n			^{c}ɲ	
^{h}m	^{h}n				
v	ð			j	
				^{h}j	
	l				
	^{h}l			ʎ	
	r				
	^{h}r				

b. vowels

i		u	ii		uu
e		o	ee		oo
	a			aa	
ié		uó	ie		uo
eá		oá	ea		oa
	aá				

By way of annotation, note the following points. The voiced occlusives /b d ɟ g/ are phonologically sonorants, as are the voiced median continuants /v ð j/. Nasals may be plain or prestopped. Obstruent stops evince a contrast between [+spread glottis] or [–spread glottis]. The same is true of each of the sonorant series, with the exception of the sonorant oral stop series. Turning to the vowels, both monophthongs and diphthongs may be long or short. The diphtongs all rise in sonority. Both the diphthongs and the monophthong /aa/ may be either even or rising in intensity. The even diphthongs are generally long, while the rising-intensity diphthongs (marked with an acute accent on V_2) and /aá/ are short.[6]

The phonology of West Finnmark Saami makes a central distinction between obstruent-initial and sonorant-initial clusters. In this variety, obstruent-initial clusters resist Coda Maximisation, while sonorant-initial clusters under certain conditions require it. Obstruent-initial clusters evince a two-way length contrast between plain $C_1.C_2$ and overlong

C_1:.C_2 as shown in (7).[7] The left-hand column (plain) shows the accusative/genitive singular, the right-hand (overlong) the nominative singular.[8]

(7) Obstruent-initial clusters

plain	overlong	
iθkuu	iθ:kuu	'shadow'
saθmii	saθ:mii	'aquatic moss'
luspii	lus:pii	'outlet'
rustaa	rus:ta	'winter mist'
paaska	paas:ka	'rowing boat'
kuštaah	kuš:ta	'brush'
puškuu	puš:kuu	'something thin'
šušmii	šuš:mii	'heel'

For sonorant-initial clusters, the possibilities of quantity contrast are richer than those for obstruent-initial clusters since either C_1 or C_2 may bear constrastive overlength. A sonorant-initial cluster may be biliteral or triliteral. The possible shapes for biliteral clusters are C_1C_2.C_2 (plain), C_1:C_2 (with C_1 overlong), and C_1C_2:.C_2 (with C_2 overlong), while those for triliteral clusters are C_1C_2.C_3 (plain), C_1:.C_2C_3 (with C_1 overlong), and C_1C_2:.C_3 (with C_2 overlong).[9] Illustrative minimal pairs for biliteral sonorant-initial clusters are given in (8). Here the C_1 overlong forms represent the nominative singular, C_2 overlong the accusative/genitive singular, and the plain forms the accusative plural. Notice that both the C_2 overlong and the plain forms evince Coda Maximisation.[10]

(8) Sonorant-initial clusters (biliteral)

C_1 overlong	C_2 overlong	plain	
tšuv:tii	tšuvt:tii	tšuvttiit	'index finger'
við:jii	viðj:jii	viðjjiit	'chain'
nij:pii	nijp:pii	nijppiit	'knife'
rim:sii	rims:sii	rimssiit	'rag'
šal:tii	šalt:tii	šalttiit	'bridge'
ur:pii	urp:pii	urppiit	'bud'

Triliteral clusters are always sonorant initial.[11] Minimal pairs are given in (9). Again, the C_1 overlong forms represent the nominative singular, C_2 overlong the accusative/genitive singular, and the plain forms the accusative plural.

(9) Sonorant-initial clusters (triliteral)

C_1 overlong	C_2 overlong	plain	
tsum:hpii	tsumh:pii	tsumhpiit	‘hair top’
sil:hkii	silh:kii	silhkiit	‘silk’
hor:htii	horh:tii	horhtiit	‘(Norwegian breed of) dog’

2.4 *Hypercharacterisation*

2.4.1 Segmental vs. moraic hypercharacterisation

In order to accommodate bimoraic consonants within syllable structure it is necessary to countenance the possibility of trimoraic syllables. I will also argue, however, that there is a trimoraic maximum on syllable size and a bi-implicational relationship between bimoraicity of the coda and trimoraicity of the syllable in North Saami: All trimoraic syllables have bimoraic codas and all bimoraic codas belong to trimoraic syllables. This stance raises some descriptive challenges, which will be tackled in §2.4.2 below. The purpose of the present section is simply to set out what I believe are the correct moraic structures of each syllable type in the inventory. The next section will show how the interaction of well-motivated constraints derives these.

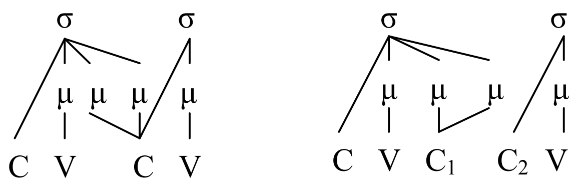
To facilitate the discussion, let us introduce a distinction between two kinds of hypercharacterisation. In moraic terms, trimoraic syllables are ‘hypercharacterised’, in that they exceed the criteria by which syllables are deemed heavy by sporting an additional mora.[12] Additional examples of moraic hypercharacterisation are shown in (10).

(10) Moraic hypercharacterisation (overlength)

Cː.C	nanː.neh	‘to fortify’
	polː.luu	‘round wooden cup’
	tsu^{h}lː.lii	‘mumbler’
C_1ː.C_2	osː.kuuh	‘to believe’
	pihː.taa	‘bit (nom.sg)’
	pumː.paa	‘chest, box (nom.sg)’
C_1ː.C_2C_3	herː.sko	‘morsel’
	rinː.htšii	‘naked (nom.sg)’
	skurː.cɲasah	‘disheartened’

The moraic structure of a CVCː syllable is shown in (11). For context, syllable structures are shown followed by a light (unstressed) syllable.

(11) Moraically hypercharacterised syllables



/CVCː.CV/ $/CVC_1ː.C_2V/$

Moraic hypercharacterisation is a violation of the constraint $*\sigma_{\mu\mu\mu}$ in (12).

(12) $*\sigma_{\mu\mu\mu}$
Trimoraic syllables are disallowed.

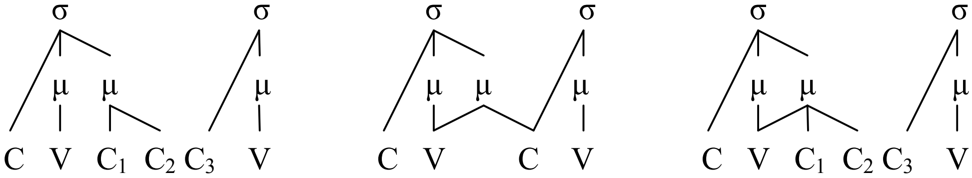
In addition to allowing hypercharacterised syllables at the level of moraic structure, North Saami also permits *segmental* hypercharacterisation. Examples of segmental hypercharacterisation are shown in (13).

(13) Segmental hypercharacterisation

CVC_1C_2	park.kaan	'I work'
CVVC	kiil.lii	'language (illative sg.)'
	koan.sta	'art (acc/gen.sg.)'
$CVVC_1C_2$	kuojr.raj	'he/she gave up'
	faarf.fuuh	'loops; nooses (nom.pl.)'
	faajh.po.ðih	'to keep waving one's hands'
	spaajl.liih	'untamed, castrated reindeer'

A syllable rhyme is segmentally hypercharacterised if it (a) is closed *and* (b) has either a complex nucleus (long vowel or diphthong) or a complex coda. In addition to allowing hypercharacterised syllables of the type CVVC and CVCC, West Finnmark Saami also allows CVVCC, which is hypercharacterised by virtue of having both a complex nucleus and a complex coda. A crucial consideration in the analysis of syllable structure and quantity is that syllables whose coda contains an overlong consonant must be characterisable as a natural class. If we assume the appropriate representation for such syllables is trimoraic, then segmentally hypercharacterised syllables *without* an overlong consonant in the coda must be bimoraic. This is only consistent with an approach which permits the sharing of moras (Broselow et al. 1995; Broselow et al. 1997; Maddieson 1993; Sprouse 1996). Given the possibility of mora sharing, the structures for the three syllable types in (13) will be as in (14).

(14) Segmentally hypercharacterised syllables



$/CVC_1C_2.C_3V/$ /CVVC.CV/ $/CVVC_1C_2.C_3V/$

The branching of the weak mora in the structures in (14) violates the constraint *COMPLEX-μ in (15).

(15) *COMPLEX-μ
Moras must not branch.

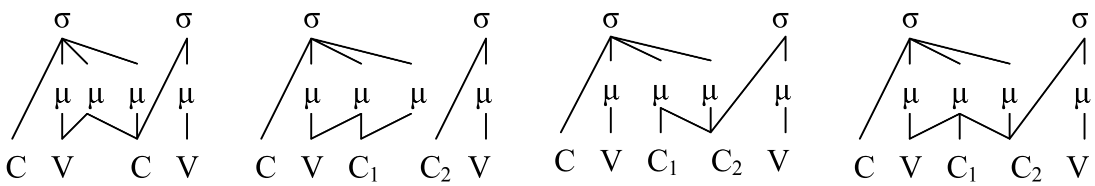
What makes West Finnmark Saami especially remarkable is that it permits the combination of moraic and segmental hypercharacterisation in the same syllable, giving CVVCː, CVCCː and CVVCCː shapes. These structures are illustrated in (16).

(16) Moraic and segmental hypercharacterisation combined

CVVCː	kaakː.htii	‘cofte (nom.sg)’
CVC_1C_2ː	limhː.puu	‘lump (acc/gen.sg)’
	almː.muus	‘public’
$CVVC_1C_2$ː	taarpː.pujt	‘necessity (acc.pl)’
	maajsː.taan	‘I taste’

Moraic structures for the syllable types in (16) are shown in (17).

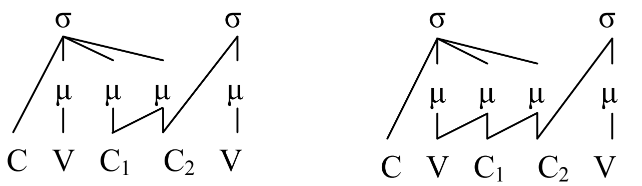
(17) Segmentally and moraically hypercharacterised syllables



/CVVCːCV/ $/CVVC_1ːC_2V/$ $/CVC_1C_2ːC_2V/$ $/CVVC_1C_2ːC_2V/$

In all cases involving combined segmental and moraic hypercharacterisation, it is the *final* consonant of the coda that is overlong: $CVC_1ːC_2$ and $CVVC_1ːC_2$ are not attested syllable types. The structures of these non-occurring syllable shapes are given in (18).

(18) Non-occurring overlong syllables in West Finnmark Saami



$*/CVC_1ːC_2.C_2V/$ $*/CVVC_1ːC_2.C_2V/$

To account for the ungrammaticality of the structures in (18), I will assume a licensing condition on bimoraic consonants, formulated in (19).

(19) SYLFIN-$C_{\mu\mu}$

If $C_{\mu\mu}$, then $C_{\mu\mu}]_\sigma$; a bimoraic consonant is licensed if and only if syllable-final.

In the case of a triliteral cluster, undominated SYLFIN-$C_{\mu\mu}$ forces the parsing of /C_1ːC_2C_3/ as C_1ː.C_2C_3, e.g. *horː.htii*, 'Norwegian breed of dog'.[13]

2.4.2 Deriving syllable quantity

Now let us address how constraint interaction generates the structures laid out in the previous section. Obviously, the constraint against trimoraic syllables in (12) must be low-ranked in West Finnmark Saami. At first blush, it looks as though this means it must be dominated by MAX-μ in (20).

(20) MAX-μ

Every mora in the input has a correspondent in the output.

Thinking this through, however, shows that this cannot be the correct ranking. This is because we want inputs like /$CV_\mu V_\mu C_\mu V_\mu$/ to map to $CV_\mu[VC]_\mu V_\mu$, in which the long vowel shares its second mora with the syllable coda. Since this mapping entails the deletion of an input mora, this must mean that $*\sigma_{\mu\mu\mu}$ *dominates* MAX-μ. Nonetheless, we know that bimoraic consonants and bimoraic vowels both surface faithfully as long. Despite the loss of an input mora, the mapping /$CV_\mu V_\mu C_\mu V_\mu$/→$CV_\mu[VC]_\mu V_\mu$ is faithful in one important respect: the number of moras associated to each mora-bearing segment in the input is preserved, showing that $*\sigma_{\mu\mu\mu}$ must be outranked by WT-IDENT in (21). See Morén (2001) for another formulation of the same basic constraint.

(21) WT-IDENT

Let α and β be segments, α ∈ input, β ∈ output, and α $\mathcal{R}$ β. If α is *n*-moraic, then β is *n*-moraic. (Evaluation: Assess one mark for each decrease or increase in *n* in the output.)

The ranking must therefore be WT-IDENT≫$*\sigma_{\mu\mu\mu}$≫MAX-μ. High-ranking WT-IDENT compels sharing of moras between segments. The possibility of sharing requires further comment. Following Zec (1995), I will assume that in heavy syllables there is a universal relation of intrinsic prominence between the moras according to which the first mora is strong and the second weak. The strong mora is never shared. We must therefore distinguish between the constraints in (22) and (23).

(22) *COMPLEX-μ_w

Weak moras must not branch.

(23) *COMPLEX-μ_s

Strong moras must not branch.

Like MAX-μ, *COMPLEX-μ_w must also be low-ranked. *COMPLEX-μ_s is undominated.

The tableaux in (24), (25) and (26) shows how this ranking works for all of the potentially problematic inputs: /$CV_\mu V_\mu C_\mu V_\mu$/ (=CVVCCV), /$CV_\mu C_\mu C_\mu V_\mu$/ (=CVCːCV), and

/$CV_\mu V_\mu C_\mu C_\mu V_\mu$/ (=CVVC:CV). Candidates violating undominated *COMPLEX-μ_s are excluded from consideration.

(24) /$CV_\mu V_\mu C_\mu V_\mu$/→$CV_\mu[VC]_\mu V_\mu$

		/$CV_\mu V_\mu C_\mu V_\mu$/	WT-IDENT	*$\sigma_{\mu\mu\mu}$	*COMPLEX-μ_W	MAX-μ
a.	☞	$CV_\mu[VC]_\mu V_\mu$			*	*
b.		$CV_\mu V_\mu C_\mu V_\mu$		*!		
c.		$CV_\mu C_\mu V_\mu$	*!			*
d.		$CV_\mu V_\mu CV_\mu$	*!			*

The input to the tableau in (24) above is a long vowel followed by a moraic consonant. Both surface faithfully with respect to their underlying moraicity. What is interesting, however, is the contest between candidates (a) and (b). The winning candidate (a) has a bimoraic syllable, while (b) has a trimoraic syllable. We know that the language permits trimoraic syllables, and so the question is why (a) wins and not (b). Both satisfy WT-IDENT but (a) bests (b) on *$\sigma_{\mu\mu\mu}$, which crucially outranks MAX-μ (and *COMPLEX-μ_W).

(25) /$CV_\mu C_\mu C_\mu V_\mu$/→$CV_\mu C_\mu C_\mu V_\mu$

		/$CV_\mu C_\mu C_\mu V_\mu$/	WT-IDENT	*$\sigma_{\mu\mu\mu}$	*COMPLEX-μ_W	MAX-μ
a.	☞	$CV_\mu C_\mu C_\mu V_\mu$		*		
b.		$CV_\mu C_\mu V_\mu$	*!			*

In the case of an input with a short vowel followed by an overlong consonant, the same ranking optimises a trimoraic syllable, as shown in the tableau in (25). Deleting one of the moras of the underlyingly bimoraic consonant in candidate (b) not only violates low-ranked MAX-μ but also high-ranked WT-IDENT.

(26) /$CV_\mu V_\mu C_\mu C_\mu V_\mu$/→$CV_\mu[VC]_\mu C_\mu V_\mu$

		/$CV_\mu V_\mu C_\mu C_\mu V_\mu$/	WT-IDENT	*$\sigma_{\mu\mu\mu}$	*COMPLEX-μ_W	MAX-μ
a.	☞	$CV_\mu[VC]_\mu C_\mu V_\mu$			*	*
b.		$CV_\mu V_\mu C_\mu C_\mu V_\mu$		*!		
c.		$CV_\mu V_\mu C_\mu V_\mu$	*!	*		
d.		$CV_\mu C_\mu V_\mu$	*!*			*
e.		$CV_\mu V_\mu CV_\mu$	*!*			*

Finally, the tableau in (26) optimises the candidate with branching in the weak mora. In the winning candidate (a), the second mora of the long vowel is shared with the first mora of the bimoraic consonant.[14]

Summing up the main points of this section, Northwest Saamic distinguishes between monomoraic and bimoraic nuclei and between monomoraic and bimoraic codas, with all combinations possible in the syllable rhyme. Syllables with bimoraic codas, however, pattern as a natural class — the natural class of trimoraic syllables. In order to reconcile the trimoraic maximum on syllable size with the combinatorial possibilities, a mora sharing analysis was developed.

3. CODA MAXIMISATION

Under certain conditions an input /VC_1C_2V/ is syllabified as *$VC_1C_2.C_2V$* with gemination of C_2, rather than *$VC_1.C_2V$*, which is the output we would otherwise expect in a language that allows codas. Under the same conditions an input /$VC_1C_2C_3V$/ is syllabified as $VC_1C_2.C_3V$. Given the mora sharing analysis described in the last section, Coda Maximisation does not increase the *number* of moras in the stressed syllable, but it does increase the number of associations between moras and consonants. The result of Coda Maximisation is thus a *complex mora*. Still, however we interpret it, Coda Maximisation goes against basic Jakobsonian principles of syllabification that onsets are maximised in preference to codas. This violation is restricted, however, to the stressed syllable of the trochaic foot. Coda Maximisation is also known from Fenno-Swedish (Kiparsky 2004). In the general Fenno-Swedish pattern, including South Ostrobothnian, Coda Maximisation behaves similarly to Northwest Saamic in that it only applies post-consonantally, e.g. /venta/→*vent.ta*, 'to wait', but /ruupa/→*ruu.pa*, 'to call'. In certain other dialects, such as Helsinki and Brändö, Coda Maximisation applies both after a consonant and after a long vowel, giving /venta/→*vent.ta*, 'to wait', and /ruupa/→*ruup.pa*, 'to call'. There are also differences in the set of consonants that undergo gemination. In Fenno-Swedish, Coda Maximisation may only geminate a voiceless consonant, but in Northwest Saamic any consonant may be geminated. Despite these differences it is highly likely that the two patterns have the same motivation. For Kiparsky, this motivation is the enhancement of a heavy syllable.[15] In what follows I will abstract away from the possibility of post-vocalic Coda Maximisation. For present purposes, I build the post-consonantal restriction into the formulation of the constraint, which is stated semi-formally in (27).

(27) CODAMAX
Let α = stressed nucleus, C_i = post-nuclear consonant tautosyllabic with α, and S = substring of consecutive consonants $<C_j, C_{j+1}, \ldots, C_n>$ such that C_j immediately succeeds C_i, then every consonant in S is tautosyllabic with α.

3.1 Forest Lule Saami

Unsurprisingly, there are dialects of Northwest Saamic that lack Coda Maximisation entirely. One such dialect is the Forest dialect of Lule Saami (Collinder 1938), shown in (28).

(28) No Coda Maximisation in Lule Saami (Forest dialect)

skaal.maa	'binding, cover (acc/gen.pl)'
kir.jee	'book (acc/gen.pl)'
faal.fuu	'swallow (acc/gen.pl)'

In this variety CODAMAX must be dominated by *COMPLEX CODA in (29).

(29) *COMPLEX CODA (*CXCODA)
Codas must be non-branching.

The tableau in (30) illustrates the effect of ranking *CXCODA above CODAMAX and shows that /$VC_1.C_2V$/ and /$VC_1C_2.C_2V$/ are neutralised to $VC_1.C_2V$ in the output. WT-IDENT(C) is low-ranked.

(30) *CxCoda ≫ CodaMax (Lule Saami; Forest dialect)

		/skaalmaa/	*CxCoda	CodaMax	Wt-Ident(C)
a.		skaalm.maa	*!		*
b.	☞	skaal.maa		*	
		/skaalmmaa/	*CxCoda	CodaMax	Wt-Ident(C)
a.		skaalm.maa	*!		
b.	☞	skaal.maa		*	*

3.2 West Finnmark Saami

For West Finnmark Saami, the reverse ranking between CodaMax and *CxCoda must obtain, since there is Coda Maximisation. This is shown in (31) for the word *aajppa*, 'quite'. Again, richness of the base is taken into account by considering both of the relevant inputs. In this dialect, /VC_1.C_2V/ and /VC_1C_2.C_2V/ are neutralised in the output to $VC_1C_2.C_2V$.

(31) CodaMax ≫ *CxCoda (West Finnmark Saami)

		/aajpa/	CodaMax	*CxCoda	Wt-Ident(C)
a.	☞	aajp.pa		*	*
b.		aaj.pa	*!		
		/aajppa/	CodaMax	*CxCoda	Wt-Ident(C)
a.	☞	aajp.pa		*	
b.		aaj.pa	*!		*

However, not all instances of underlying /VC_1.C_2V/ and /VC_1C_2.C_2V/ are neutralised to $VC_1C_2.C_2V$. There are additional restrictions on the application of Coda Maximisation in West Finnmark Saami. These restrictions are of two kinds: (i) quantitative, (ii) sonority-based. We have already seen that overlong consonants are subject to the licensing restriction SylFin-$C_{\mu\mu}$ given in (19) that they are final within the (stressed) syllable. This requirement conflicts with CodaMax, and since Coda Maximisation fails to apply following an overlong consonant, this provides us with an argument for ranking SylFin-$C_{\mu\mu}$ over CodaMax. A tableau is provided in (32) for *šal:tii*, 'bridge (nom.sg)'.

(32) SylFin-$C_{\mu\mu}$ ≫ CodaMax (West Finnmark Saami)

		/šal:tii/	SylFin-$C_{\mu\mu}$	CodaMax	*CxCoda	Wt-Ident(C)
a.		šal:t.tii	*!		*	*
b.	☞	šal:.tii		*		
		/šal:ttii/	SylFin-$C_{\mu\mu}$	CodaMax	*CxCoda	Wt-Ident(C)
a.		šal:t.tii	*!		*	
b.	☞	šal:.tii		*		*

The two remaining conditions under which Coda Maximisation fails to apply involve constraints on the sonority profile of the coda. Coda Maximisation is blocked just in case it would result in a reverse sonority coda, as shown in (33).

(33) Blocking of Coda Maximisation with sonority reversal (West Finnmark Saami)
šuš.mii, *šušm.mii ‘heel (acc/gen.sg)’
faθ.mii, *faθm.mii ‘lap (acc/gen.sg)’

Coda Maximisation is also blocked if the resulting complex coda would have a sonority plateau, as shown in (34). Plosives and fricatives count as equal in terms of sonority.

(34) Blocking of Coda Maximisation with sonority plateau (West Finnmark Saami)
pas.te, *past.te ‘spoon (acc/gen.sg)’

In order to account for this we can assume the partial sonority scale in (35). For sonority purposes, the voiceless sonorant /h/ patterns with the obstruents.

(35) Partial sonority scale
voiced sonorants > obstruent, voiceless sonorant /h/

Given the scale in (35), we can formulate the relevant sonority-related constraints as in (36) and (37).

(36) *SONORITY RISE (*SONRISE)
A coda cluster must not rise in sonority.

(37) SONORITY FALL(SONFALL)
A coda cluster must fall in sonority.

In West Finnmark Saami, Coda Maximisation applies exclusively following a (voiced) sonorant, and so CODAMAX must be dominated by both *SONRISE and SONFALL. For the interaction between *SONRISE and CODAMAX, consider the tableau in (38) for *leasmii*, ‘gout (acc/gen.sg)’. When the sonority of C_2 exceeds that of C_1, /$VC_1.C_2V$/ and /$VC_1C_2.C_2V$/ are neutralised in the output to $VC_1.C_2V$ without Coda Maximisation.

(38) *SONRISE≫CODAMAX (West Finnmark Saami)

		/leasmii/	*SONRISE	CODAMAX	*CXCODA	WT-IDENT(C)
a.		leasm.mii	*!		*	*
b.	☞	leas.mii		*		
		/leasmmii/	*SONRISE	CODAMAX	*CXCODA	WT-IDENT(C)
a.		leasm.mii	*!		*	
b.	☞	leas.mii		*		*

Now let’s move on to consider the role of SONFALL. In addition to militating against complex codas with rising sonority, this constraint also penalises complex codas with a sonority plateau as defined by (35) above. There are two superficially different output structures that are blocked by SONFALL. Triliteral clusters generally have a medial sibilant or /h/, which has low sonority despite its being a sonorant. The other case in which Coda Maximisation is precluded in West Finnmark Saami is when there is any obstruent-initial cluster. This is exemplified in (39).

(39) No Coda Maximisation in obstruent-initial clusters (West Finnmark Saami)

lus.pii	'outlet (acc/gen.sg)'
pas.te	'spoon (acc/gen.sg)'

Triliteral clusters evince Coda Maximisation *without* gemination in West Finnmark Saami. Underlying /$C_1C_2C_3$/ is mapped onto $C_1C_2.C_3$, never *$C_1C_2C_3.C_3$ with gemination of C_3, which would parallel the mapping of underlying /C_1C_2/ (C_1 = [+son]) to $C_1C_2.C_2$. In triliteral clusters C_2 associates with the coda of the stressed syllable, but C_3 does not. This is shown in (40).

(40) Coda Maximisation without gemination of C_3 in triliteral clusters (West Finnmark Saami)

peelh.kii	'he/she scolded'
kuurp.miin	'load (loc.pl)'
ɲoolh.piit	's.th. difficult to get hold of (acc/gen.pl)'
hors.taah	'sacking (nom.pl)'
lujs.teh	'skate (nom.pl)'
nalh.taas	'stunted'

In fact, given that C_2 is always an obstruent or the voiceless sonorant /h/, there is no triliteral cluster for which gemination of C_3 is not independently ruled out by *SONRISE or SONFALL. Given this, there is no need to assume the existence of a distinct constraint militating specifically against triply branching codas to rule out non-occurring structures like *$C_1C_2C_3.C_3$. As we shall see later, this is also borne out by the typology of Coda Maximisation.

The tableaux in (41), for *paste*, 'spoon (acc/gen.sg)', and (42), for *peelhkii*, 'he/she scolded', show how the difference between (39) and (40) falls out from the same constraint ranking. For both kinds of input, the candidates with gemination of the final consonant of the cluster violate SONFALL, and are eliminated from the contest. However, for biliteral obstruent-initial clusters (41) there is no attraction of C_2 into the stressed syllable.

(41) SONFALL≫CODAMAX; obstruent-initial clusters (West Finnmark Saami)

		/paste/	SONFALL	CODAMAX	*CXCODA	WT-IDENT(C)
a.		past.te	*!		*	
b.	☞	pas.te		*		
		/pastte/	SONFALL	CODAMAX	*CXCODA	WT-IDENT(C)
a.		past.te	*!		*	
b.	☞	pas.te		*		*

In triliteral obstruent-medial clusters, on the other hand, there is attraction of C_2 into the stressed syllable. The tableaux in (42) and (43) show how this results from evaluation according to the constraint hierarchy already brought to bear. In both (42) and (43), candidate (a) displays attraction of C_3 into the first syllable, (b) displays attraction of C_2, and candidate (c) evinces no Coda Maximisation at all. In both (42) and (43), the winning candidate (b) (*peelh.kii* or *kuurp.miin*), bests candidate (c) (*peel.hkii* or *kuur.pmiin*) by a single violation mark on CodaMax. In (42), candidate (a), *peelhk.kii*, is ruled out by virtue of incurring a fatal violation on highly ranked SonFall. In (43), candidate (a), *kuurpm.miin*, is eliminated by highly ranked *SonRise. (42) and (43) take account of the richness of the base by including mappings for all three of the relevant inputs.

(42) SonFall≫CodaMax; obstruent-medial triliteral clusters (West Finnmark Saami)

		/peel.hkii/	SonFall	CodaMax	*CxCoda	Wt-Ident(C)
a.		peelhk.kii	*!		*	**
b.	☞	peelh.kii		*	*	*
c.		peel.hkii		**!		
		/peelh.kii/	SonFall	CodaMax	*CxCoda	Wt-Ident(C)
a.		peelhk.kii	*!		*	*
b.	☞	peelh.kii		*	*	
c.		peel.hkii		**!		*
		/peelhk.kii/	SonFall	CodaMax	*CxCoda	Wt-Ident(C)
a.		peelhk.kii	*!		*	
b.	☞	peelh.kii		*	*	*
c.		peel.hkii		**!		**

(43) *SonRise≫CodaMax; triliteral clusters (West Finnmark Saami)

		/kuur.pmiin/	*SonRise	CodaMax	*CxCoda	Wt-Ident(C)
a.		kuurpm.miin	*!		*	**
b.	☞	kuurp.miin		*	*	*
c.		kuur.pmiin		**!		
		/kuurp.miin/	*SonRise	CodaMax	*CxCoda	Wt-Ident(C)
a.		kuurpm.miin	*!		*	*
b.	☞	kuurp.miin		*	*	
c.		kuur.pmiin		**!		*
		/kuurpm.miin/	*SonRise	CodaMax	*CxCoda	Wt-Ident(C)
a.		kuurpm.miin	*!		*	
b.	☞	kuurp.miin		*	*	*
c.		kuur.pmiin		**!		**

Summing up, we can characterise the grammar of Coda Maximisation in West Finnmark Saami by the ranking in (44).

(44) Ranking for West Finnmark Saami
SylFin-$C_{\mu\mu}$, *SonRise≫SonFall≫<u>CodaMax</u>≫*CxCoda

3.3 Jukkasjärvi Lule Saami

The Jukkasjärvi dialect of Lule Saami studied by (Collinder 1949) extends Coda Maximisation to an additional environment, furnishing evidence that CodaMax outranks SonFall in this dialect.[16] Like West Finnmark Saami, Jukkasjärvi Lule Saami also evinces a three-way length contrast in consonants, e.g. *ɲammat*, 'to suck' vs. *ɲamaj*, 'he/she sucked';

taammaa, ‘mare’ vs. *taam:maajt*, ‘*id*. (acc.pl)’. The Coda Maximisation pattern is illustrated in (45). Page references are to Collinder (1949).

(45) Coda Maximisation in Lule Saami (Jukkasjärvi dialect)

a. Coda Maximisation blocked following overlong consonant

saav:.nee	‘seam, joint’	C140
kaj:.see	‘high, steep mountain’	C141
laaj:.hkee	‘idle, lazy’	C142
haaŋ:.ka.ha	‘fence for trapping reindeer (acc/gen.sg)’	C143

b. Coda Maximisation in violation of *CXCODA

saavn.neeht	‘seams, joints’	C140
kajs.see	‘high, steep mountain (acc/gen.sg)’	C141
haaŋk.kas	‘fence for trapping reindeer (nom.sg)’	C143

c. Coda Maximisation in violation of SONFALL

lusp.peeht	‘outflow of lake (nom.pl)’	C150
naask.keer	‘awl’	C150
tææpt.teen	‘milt, spleen (in.-el.sg)’	C152
maajst.tij	‘he/she tasted’	C142
aajht.teeht	‘larder, provision-shed (nom.pl)’	C142
laamhp.puuht	‘lamp (nom.pl)’	C143

Like West Finnmark Saami, the Jukkasjärvi dialect prohibits Coda Maximisation following an overlong consonant. Unlike West Finnmark, however, Jukkasjärvi *requires* Coda Maximisation following an obstruent or voiceless sonorant /h/. This pattern may be accounted for by ranking CODAMAX above SONFALL. This is shown in (46), for *lusppeeht*, ‘outflow of lake (nom.pl)’ and (47), for *maajsttij*, ‘he/she tasted’.

(46) CODAMAX≫SONFALL; obstruent-initial clusters (Jukkasjärvi Saami)

		/luspeeht/	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	lusp.peeht		*	*	*
b.		lus.peeht	*!			
		/lusppeeht/	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	lusp.peeht		*	*	
b.		lus.peeht	*!			*

(47) CODAMAX≫SONFALL; obstruent-medial triliteral clusters (Jukkasjärvi Saami)

		/maaj.stij/	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	maajst.tii		*	*	**
b.		maajs.tii	*!		*	*
c.		maaj.stij	*!*			
		/maajs.tii/	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	maajst.tii		*	*	*
b.		maajs.tii	*!		*	
c.		maaj.stij	*!*			*
		/maajst.tii/	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	maajst.tii		*	*	
b.		maajs.tii	*!		*	*
c.		maaj.stij	*!*			**

Coda Maximisation is not, however, permitted to create violations of *SONRISE in Jukkasjärvi Lule Saami, as shown in (48).

(48) Coda Maximisation blocked by *SONRISE (Lule Saami; Jukkasjärvi dialect)

sajh.nee, *saajhn.nee	'woodpecker, acc/gen.sg'	C143
sus.meeht, *susm.meeht	'heel, nom.pl'	C149
piep.muu, *piepm.muu	'food, acc/gen.sg'	C151
vaat.meen, *vaatm.meen	'arms stretched forward'	C153

There is an interesting apparent exception to this. Following /b/, a liquid /l r/ may in fact undergo Coda Maximisation, as shown in (49).

(49) Coda Maximisation in apparent violation of *SONRISE (Lule Saami; Jukkasjärvi dialect)

kaabl.leeht	'top bar of tent door (nom.pl)'	C151
ææbr.ruujs	'*Oxyria digyna* (in-.el.pl)'	C151
kaabl.leeht	'top bar of tent door (nom.pl)'	C151

Apparently only /b/ patterns in this way. The patterning is consistent with the idea that /b/ is phonologically a sonorant in this variety and that the coda-maximised clusters in (49) violates SONFALL but not *SONRISE. Additional support comes from the fact that alongside forms with the sonorant stop *ubllluuht* we find optionally spirantised forms such as *uvlluuht*, 'humble-bee [sic] (nom.pl)'; cf. *ub:luu* '*id.* (nom.sg)'. If /b/ is indeed sonorant, the data in (49) cannot be considered as counterexemplifying the claim that *SONRISE dominates CODAMAX in the Jukkasjärvi dialect of Lule Saami. A tableau is given in (50) for *kaabl.leeht*, 'top bar of tent door (nom.pl)' with satisfaction of *SONRISE explicitly marked.

(50) Coda Maximisation following sonorant stop (Jukkasjärvi Saami)

		/kaableeht/	*SONRISE	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	kaabl.leeht	✓		*	*	
b.		kaab.leeht		*!			
		/kaablleeht/	*SONRISE	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	kaabl.leeht	✓		*	*	
b.		kaab.leeht		*!			*

The final ranking for the Jukkasjärvi dialect of Lule Saami is given in (51).

(51) Ranking for Lule Saami (Jukkasjärvi dialect)
SYLFIN-$C_{\mu\mu}$, *SONRISE ≫ CODAMAX ≫ SONFALL ≫ *CXCODA

3.4 Polmak Saami

A different pattern of Coda Maximisation is found in the Polmak (Buolbmát) dialect of North Saami (Nielsen 1902). As shown in (52), Polmak Saami requires Coda Maximisation at the expense of SONFALL. Page references are to Nielsen (1902).

(52) Coda Maximisation in clusters (North Saami; Polmak dialect)
a. Coda Maximisation blocked after overlong consonant

mæθː.ki	'journey (nom.sg)'	N104
gasː.ka	'middle, interval (nom.sg)'	N109
bumː.bæ	'chest, box (nom.sg)'	N95
jielː.ti	'boil (nom.sg)'	N96

b. Coda Maximisation in violation of *CXCODA

læjp.pi	'bread (acc/gen.sg)'	N85
bump.pæ	'chest, box (acc/gen.sg)'	N95
$mæj^hl.^hli$	'sap (acc/gen.sg)'	N106
faarf.fu	'slip-knot, loop (acc/gen.sg)'	N11

c. Coda Maximisation in violation of SONFALL

mææθk.ki	'journey (acc/gen.sg)'	N104
gævhp.pi	'trade (acc/gen.sg)'	N89
rujht.tu	'iron saucepan (acc/gen.sg)'	N88
ævhk.ki	'utility (acc/gen.sg)'	N88
aarhp.pu	'flax thread (acc/gen.sg)'	N96
buærht.ti	'birch basket (acc/gen.sg)'	N96
mierhk.kæ	'mist (acc/gen.sg)'	N96

Coda Maximisation in Polmak Saami also takes place at the expense of violating *SONRISE, as shown in (53).

(53) Coda Maximisation in violation of *SONRISE (North Saami; Polmak dialect)

liesm.mii	'gout (acc/gen.sg)'	N119
guosm.muj	'it became singed'	N119
šušm.mi	'heel (acc/gen.sg)'	N120

The tableau in (54) for *liesmmi*, 'gout (acc/gen.sg)', shows the result of ranking CODAMAX above *SONRISE.

(54) CODAMAX≫*SONRISE (Polmak Saami)

		/liesmi/	CODAMAX	*SONRISE	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	liesm.mi		*	*	*	
b.		lies.mi	*!				
		/liesmmi/	CODAMAX	*SONRISE	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	liesm.mi		*	*	*	
b.		lies.mi	*!				*

In an interesting perturbation of this rising sonority coda pattern, clusters of sibilant+plosive do *not* undergo Coda Maximisation as expected. This is shown by the following examples in (55).

(55) Coda Maximisation blocked in S+plosive (North Saami; Polmak dialect)

dus.ki	'anxiety (acc/gen.sg)'	N99
his.tu	'bet, wager (acc/gen.sg)'	N99
duos.tuum	'catch mid-air (1sg.pres)'	N99
dææš.ki	'filth (acc/gen.sg)'	N99

It is perhaps significant that Coda Maximization is permitted when C_2 is a labial, as in *liesm.mi*, but blocked when C_2 is a lingual, as in *his.tu*, 'bet, wager (acc/gen.sg; N99)', and *dææš.ki*, 'filth (acc/gen.sg; N99)'. One possible account of this takes as its point of departure the notion that sibilants are articulatorily relatively complex. They require the orchestration of a number of distinct lingual gestures, some finely tuned (e.g. laminar grooving), in order to generate their high-perceptibility acoustic characteristics. Let us suppose that if the sibilant is forced to share its mora with another lingual consonant as a result of Coda Maximisation, articulatory undershoot involving one or more of these crucial gestures may result, giving a sound that is more highly confusable with other non-sibilants such as /θ/. Polmak Saami does indeed have another coronal fricative /θ/, with which the sibilants may be confused if their duration is compromised through the application of Coda Maximisation. For the time being I will merely assume a descriptive constraint $*ST]_\sigma$ that rules out representations of the relevant type.

(56) *ST]$_σ$ ≫ CODAMAX ≫ SONFALL (Polmak Saami)

a. sibilant+stop input

		/dææški/	*ST]$_σ$	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.		dææšk.ki	*!		*	*	
b.	☞	dææš.ki		*			
		/dææškki/	*ST]$_σ$	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.		dææšk.ki	*!		*	*	
b.	☞	dææš.ki		*			*

b. obstruent+stop input

		/mææθki/	*ST]$_σ$	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	mææθk.ki	✓		*	*	
b.		mææθ.ki		*!			
		/mææθkki/	*ST]$_σ$	CODAMAX	SONFALL	*CXCODA	WT-IDENT(C)
a.	☞	mææθk.ki	✓		*	*	
b.		mææθ.ki		*!			*

The final ranking for Polmak Saami is given in (57).

(57) Ranking for North Saami (Polmak dialect)
SYLFIN-$C_{μμ}$ ≫ <u>CODAMAX</u> ≫ *SONRISE ≫ SONFALL ≫ *CXCODA

3.5 Maattivuono Sea Saami

In the dialects we have examined so far, there have been no instances of Coda Maximisation immediately following an overlong consonant, to give C_1:C_2.C_2 or C_1:C_2C_3.C_3. In Sea Saami (Ravila 1932), however, Coda Maximisation is rampant and apparently applies in all of the environments in which it is blocked in North Saami. Sea Saami thus furnishes the evidence that SYLFIN-$C_{μμ}$ may be dominated by CODAMAX. Examples are given in (58) with page references to Ravila (R).

(58) Rampant Coda Maximisation in Sea Saami

a. In violation of *CxCoda

koðhk.kaahk	‘ant (nom.pl)’	R41
piijhp.puu	‘(smoking) pipe (acc/gen.pl)’	R38
laavht.tsaas	‘cream for making butter (loc.sg)’	R38
fierht.tuu	‘good weather (acc/gen.sg)’	R40
oajt.tuu	‘seal sp. (acc/gen.sg)’	R43
tiivk.kaaš	‘bell (dimin)’	R43
aarp.paahk	‘scar (nom.pl)’	R44
tæævj.jiis	‘frequent’	R46
peejv.viit	‘sun, day, gen/acc.pl’	R46
elv.vuus	‘hideous’	R47
porj.jaas	‘sail’	R47
mææjl.liihk	‘silver jewellery used on sash’	R46
levɲ.ɲiit	‘peat (acc/gen.sg)’	R49
suevŋ.ŋiis	‘hollow in the snow for protection’	R49

b. In violation of SylFin-$C_{\mu\mu}$

haamːs.suuhk	‘to bite, snap’	R48
vælːt.tiihk	‘to take’	R44
puolːt.tša	‘lichen-covered forest mound’	R43
polːn.nii	‘hillock’	R49
pumːp.pææ	‘chest, box’	R45
stæɲːt.tšii	‘ear-flap (on head-gear)’	R45

c. In violation of *SonRise

ruošm.maas	‘rusty (of water)’	R51
vuesm.miis	‘choosy about food’	R51
laašm.mutihk	‘become supple’	R51

d. In violation of *SonRise and SylFin-$C_{\mu\mu}$

seðːm.mii	‘lichen used in caulking’	R50
pæsːm.mii	‘skein of yarn’	R50
reæšːm.mii	‘rope on the side of a net’	R50

e. In violation of SonFall

fææsk.kiir	‘vestibule’	R41
aasp.puus	‘tasty morsel’	R41
kist.tiis	‘glove of reindeer skin’	R41
maajst.tuuj	‘he/she tasted’	R51
minst.taar	‘pattern’	R51
nuuvsk.kuu	‘snuff (gen/acc.sg)’	R51
oovst.tææn	‘east wind’	R51
hersk.ku.stat.taahk	‘to eat on the sly’	R51
mææjhl.lii	‘tree sap (acc/gen.sg)’	R46
tšiivhl.liit	‘pimple, pustule (acc/gen.pl)’	R46
tšææjhn.niis	‘woodpecker (loc.sg)’	R49

f. In violation of SonFall and SylFin-$C_{\mu\mu}$

es:k.kii	‘shoot (nom.sg)’	R41
pis:p.pa	‘bishop (nom.sg)’	R41
kes:t.tiihk	‘to sneeze’	R41
pil:ht.ta	‘ear-flap (on head-gear)’	R39
smil:ht.tšii	‘sloping ground’	R39
kum:hp.pe	‘wolf’	R42
pun:ht.tsii	‘bung’	R42

The tableau in (59) illustrates the triumph of CodaMax over SylFin-$C_{\mu\mu}$.

(59) CodaMax ≫ SylFin-$C_{\mu\mu}$ (Sea Saami)

		/pol:nii/	CodaMax	SylFin-$C_{\mu\mu}$	*SonRise	SonFall	*CxCoda	Wt-Ident(C)
	☞	pol:n.nii		*		*	*	
		pol:.nii	*!					*
		/pol:nnii/	CodaMax	SylFin-$C_{\mu\mu}$	*SonRise	SonFall	*CxCoda	Wt-Ident(C)
	☞	pol:n.nii		*		*	*	*
		pol:.nii	*!					

The ranking for Maattivuono Sea Saami is given in (60).

(60) Ranking for Maattivuono Sea Saami
CodaMax ≫ SylFin-$C_{\mu\mu}$ ≫ *SonRise ≫ SonFall ≫ *CxCoda

4. DEGREE OF PERCEIVED INTEGRATION (DPI)

The typological space in which the five dialects of Northwest Saamic described in the previous sections vary can be characterised initially by the fixed ranking in (61).

(61) SYLFIN-$C_{\mu\mu}$ ≫ *SONRISE ≫ SONFALL ≫ *CXCODA

The typology of Coda Maximisation arises from varying the points at which CODAMAX interdigitates with this fixed ranking. The five possibilities that result are shown in (62) along with the varieties that attest them. As we go down the list, Coda Maximisation becomes more 'aggressive'.

(62) Typology of Coda Maximisation in Northwest Saamic

a. SYLFIN-$C_{\mu\mu}$ ≫ *SONRISE ≫ SONFALL ≫ *CXCODA ≫ CODAMAX
   Forest Lule
b. SYLFIN-$C_{\mu\mu}$ ≫ *SONRISE ≫ SONFALL ≫ CODAMAX ≫ *CXCODA
   West Finnmark
c. SYLFIN-$C_{\mu\mu}$ ≫ *SONRISE ≫ CODAMAX ≫ SONFALL ≫ *CXCODA
   Jukkasjärvi
d. SYLFIN-$C_{\mu\mu}$ ≫ CODAMAX ≫ *SONRISE ≫ SONFALL ≫ *CXCODA
   Polmak
e. CODAMAX ≫ SYLFIN-$C_{\mu\mu}$ ≫ *SONRISE ≫ SONFALL ≫ *CXCODA
   Sea Saami

The typology of Coda Maximisation appears to reveal a hierarchy of implications. If Coda Maximisation is permitted to give rise to complex codas that rise in sonority, the same language will allow complex codas whose sonority profiles are flat. Violation of SONFALL implies violation of *CXCODA, and violation of *SONRISE entails in its own turn violation of SONFALL. Given this, we can assume the existence of a proper inclusion hierarchy *SONRISE ⊃ SONFALL ⊃ *CXCODA. More surprising, though, is that if the language allows Coda Maximisation following an overlong consonant, it will also tolerate complex codas with flat, or rising sonority profiles. I have not uncovered evidence of a dialect, call it Sea Saami′, that permits Coda Maximisation following an overlong consonant generally, while at the same time prohibiting coda clusters whose sonority rises or remains flat independent of the number of the number of moras in the rhyme. The question is whether this implication merely holds for the set of languages studied or if it might reveal deeper relations of stringency between SYLFIN-$C_{\mu\mu}$ and the other constraints on syllable structure, albeit in some non-obvious way. Given its current formulation, SYLFIN-$C_{\mu\mu}$ entails no violation on any of the other constraints making the assumption of a fixed ranking appear arbitrary. If the observed hierarchy is real, it must be the case that at some abstract level of phonological structure, violation of SYLFIN-$C_{\mu\mu}$ entails violation of all the other constraints. When this abstract level of phonological structure is laid bare, we should find a stringency hierarchy A > B > C > D, where A, B, C and D fulfill the functional roles hitherto ascribed to *CXCODA, SONFALL, *SONRISE and SYLLFIN-$C_{\mu\mu}$ respectively.

In the remainder of this section, I'd like to motivate and explain a representational solution that facilitates the expression the stringency relation suspected to hold between D and the other constraints. The proposal rests on two assumptions. First of all, whenever Coda Maximisation applies, the constraint in (63) against complex moraic codas is violated.

(63) $*[CC]_{\mu}$
Moras branching to more than one consonant are disallowed.

As a first step in reconstruing the relationship between the constraints let us assume that A, B, C and D all entail violations of (63). The second assumption is that the constraints A, B, C and D are abstracted from a unitary markedness scale. The markedness scale in question encodes phonetic knowledge about the *degree of perceived integration* (dpi) of the syllable rhyme. The dpi may be thought of as a representation of the degree to which a given syllable is confusable with a disyllable. For example, a syllable rhyme with monotonically falling sonority, e.g. [$_R$ alt], will have a higher dpi according to this scale than a syllable rhyme whose sonority profile is rising or non-monotonically falling, e.g. [$_R$ atl]. The central idea, however, is that a variety of different perceptual dimensions, including sonority, duration, fundamental frequency and intensity profiles all contribute to determining the dpi of a given syllable rhyme. The lower the dpi of the syllable rhyme, the less palatal a violation of (63) becomes.

The application of Coda Maximisation following an overlong consonant must result in a rhymal structure that is in some sense inherently more marked in terms of its dpi than a rising sonority coda cluster in a bimoraic syllable. A trimoraic syllable must have a lower dpi than any kind of bimoraic rhyme, including one in which the coda rises in sonority. There is some evidence to suggest that the quantity profile of a trimoraic syllable is [μ_s μ_w μ_s], i.e. the third mora is rhythmically strong. In sonorant-initial clusters C_1ː.C_2(C_3), where C_1 and C_2 are heterorganic, overlong C_1 is realised phonetically with an excrescent vowel immediately following (Bagemihl 1989; Levin 1987). The vowel is schwa-like, or else it coarticulates with the vowels in the neighbouring syllables. Examples of the phenomenon in West Finnmark Saami are given in (64).

(64) Excrescence in West Finnmark Saami
a. Heterorganic clusters (excrescence)

C_1ː.C_2	skuolː.fii	[skuollᵊ.fii]	'owl (nom.sg)'
	kirː.jii	[kirrⁱ.jii]	'book (nom.sg)'
C_1ː.C_2C_3	torː.skii	[torrᵊ.skii]	'cod (nom.sg)'
	horː.sta	[horrᵒ.sta]	'sackcloth (nom.sg)'

b. Homorganic clusters (no excrescence)

C_1ː.C_2	kaanː.ta	[kaanː.ta]	'boy (nom.sg)'
	šalː.tii	[šalː.tii]	'bridge (nom.sg)'
C_1ː.C_2C_3	rinː.htšii	[rinː.n̥tšii]	'naked (nom.sg)'

This excrescence is not exclusively motivated by the transition between consonants, since the vowel is absent following a monomoraic consonant.

(65) No excrescence following monomoraic consonant

C_1C_2.C_3	torsː.kii	[torsː.kii]	'cod (acc/gen.sg)'
	hors.taa	[hors.taa]	'sackcloth (acc/gen.sg)'

The pattern of excrescence is consistent with the idea that trimoraic rhymes have low dpi as a result of the transition between the weak mora and the third (strong) mora. The third mora of a trimoraic syllable is, as it were, always on the threshold of breaking away to form its own syllable. This is borne out by other dialects of North Saami, in which excrescence has been phonologised as epenthesis, resulting in fully trisyllabic reflexes of etymologically disyllabic words, e.g. *ho.ro.sta*. In Sea Saami, excrescence takes place even where the stressed syllable undergoes Coda Maximisation, as shown in (66).

(66) Excrescence in Sea Saami

C_1ː.C_2	skuel:f.fii	[skuell^{ə}f.fii]	'owl (nom.sg)'
	kir:j.jii	[kirr^{ə}j.jii]	'book (nom.sg)'
C_1ː.C_2C_3	tor:sk.kii	[torr^{ə}sk.kii]	'morsel'
	hor:st.ta	[horr^{o}st.ta]	'sackcloth'

The alternating moraic structure finds additional support in the behaviour of trimoraic syllables cross-linguistically as well. In Estonian, for example, trimoraic syllables optionally pattern metrically with disyllables, so that any trisyllable $[\mu_s\ \mu_w\ \mu_s]_\sigma$ may optionally be analysed as $[\mu_s\ \mu_w]_\sigma\ [\mu_s]_\sigma$ (Bye 1997 and references therein). These patterns are suggestive of the idea that a tautosyllabic transition from a weak mora to a strong mora compromises the perception of the $[\ldots\ \mu_w\ \mu_s\ldots]$ substring as part of a coherent rhymal unit. At some level of abstraction, the same must be true when the syllable coda contains a sonority rise or plateau. The representation of the dpi of the rhyme thus derives from more than one phonological source. In addition to sonority and quantity, tone may also influence the degree of perceived rhymal integration. A monotonic fall [HL] or rise [LH] in the rhyme will be perceived as closer to the prototype of an integrated rhyme than a fall-rise [HLH] or a rise-fall [LHL]. The dpi-scale is encoded into the language user's phonetic knowledge. By hypothesis, this scale encodes the knowledge that a trimoraic syllable rhyme $[\mu_s\ \mu_w\ \mu_s]$ has a lower dpi than a bimoraic syllable with a rising sonority coda cluster $C^{-}C^{+}$ and is therefore universally more confusable with a disyllable $[\mu_s\ \mu_w]_\sigma\ [\mu_s]_\sigma$. A rising sonority cluster in turn has lower dpi than a level sonority cluster $C^{=}C^{=}$. This is expressed in the dpi-scale in (67).

(67) The dpi-scale

$[\ldots\ \mu_w\ \mu_s\ \ldots] > [\ldots C^{-}C^{+}\ldots] > [\ldots C^{=}C^{=}\ldots] > [\ldots C^{+}C^{-}\ldots]$

Following de Lacy (2004), such scales are made accessible to phonological computation as scalar features. He proposes the hierarchy to feature convention in (68).

(68) Hierarchy to feature convention

For a hierarchy H = | α > β > … γ |

a. There is a phonological feature [H]

b. [H]'s value is a string of length *n*–1, where *n* is the number of elements in H.

c. For a value *v*, [*v* H] refers to an element E in H such that
   for every distinct element F in H such that F > E
   there is a distinct *o* in *v*.
   The remaining elements in *v* are *x*'s.

Applying (68) to the dpi-scale, we generate the feature specifications in (69). Each feature is projected at the level of the syllable rhyme.

(69) Feature [dpi]

[*xxx* dpi]	falling sonority rhymes
[*xxo* dpi]	level sonority rhymes
[*xoo* dpi]	rising sonority rhymes
[*ooo* dpi]	trimoraic rhymes

The relevant constraints for these specifications are shown in (71).

(70) *Rhyme integration constraints

a. *[dpi]

b. *[*o* dpi]

c. *[*oo* dpi]

d. *[*ooo* dpi]

The constraints in (70) stand in a stringency hierarchy in (71). Each constraint in the hierarchy is more stringent than the constraint to its right.

(71) *[dpi] > *[*o* dpi] > *[*oo* dpi] > *[*ooo* dpi]

The *[dpi] constraints do not generate the attested pattern alone. On its own, *[*ooo* dpi] only penalises trimoraic syllable rhymes, which, as we have seen, are allowed in Northwest Saamic; it does not penalise the presence of a complex coda mora. Each constraint in the hierarchy must be locally conjoined within the syllable with $*[CC]_\mu$ (63) to yield the stringency hierarchy in (72). It is this that spells out the content of the stringency hierarchy A > B > C > D. For constraint conjunction see Smolensky (1993, 1995).

(72) $\{*[\text{dpi}]\ \&_\sigma\ *[CC]_\mu\}$ >
$\{*[o\ \text{dpi}]\ \&_\sigma\ *[CC]_\mu\}$ >
$\{*[oo\ \text{dpi}]\ \&_\sigma\ *[CC]_\mu\}$ >
$\{*[ooo\ \text{dpi}]\ \&_\sigma\ *[CC]_\mu\}$ >

Let us consider the typological implications of this interpretation of the constraints that interact with CODAMAX. We began this section with a fixed ranking in (61), shown again in (73).

(73) SYLFIN-$C_{\mu\mu}$ ≫ *SONRISE ≫ SONFALL ≫ *CXCODA

A core tenet of the work on stringency theory, however, is that there are no fixed rankings. The constraints in a stringency hierarchy are intrinsically unranked. Suppose that there is a hierarchy of constraints of decreasing stringency, $\mathbf{X}^i > \mathbf{X}^{i-1} > \mathbf{X}^{i-2} > \ldots > \mathbf{X}^n$, and a constraint $\mathbb{C}$ such that $\mathbf{X}^i \gg \mathbb{C}$. In this case, the ranking relative to $\mathbb{C}$ of all the constraints of stringency less than *i* is indifferent, as long as there is no other constraint $\mathbb{D}$ in the grammar for which there is evidence that $\mathbf{X}^i \gg \mathbb{D}$ *and* $\mathbb{D} \gg \mathbf{X}^{<i}$, in which case the anti-Pāṇinian ranking $\mathbf{X}^i \gg \mathbf{X}^{<i}$ would be true by transitivity. For example, if the most stringent constraint of the hierarchy in (72), $\{*[\text{dpi}]\ \&_\sigma\ *[CC]_\mu\}$, dominates CODAMAX, then a candidate with Coda Maximisation will always incur a fatal violation on $\{*[\text{dpi}]\ \&_\sigma\ *[CC]_\mu\}$ and it would never surface. In this case the evidence for ranking the less stringent (more specific) constraints either high or low will

simply be absent, and the relative ordering of {*[*o* dpi] $\&_\sigma$ *[CC]$_\mu$}, {*[*oo* dpi] $\&_\sigma$ *[CC]$_\mu$} and {*[*ooo* dpi] $\&_\sigma$ *[CC]$_\mu$} will be indeterminate.

Now consider a case in which $\mathbb{C}$ is dominated by a constraint $\mathbf{X}^j$ where $j<i$, i.e. $\mathbf{X}^j$ is *less stringent* than $\mathbf{X}^i$. If the effect of the ranking $\mathbf{X}^j \gg \mathbb{C}$ is to be visible, and learnable as distinct from the ranking $\mathbb{C} \gg \mathbf{X}^j$, then $\mathbb{C}$ must also dominate the more stringent constraint $\mathbf{X}^i$. Otherwise the grammar will be extensionally equivalent with the grammar in which $\mathbb{C}$ *dominates* $\mathbf{X}^j$, e.g. $\mathbf{X}^i \gg \mathbb{C} \gg \mathbf{X}^j$. For example, if a language permits Coda Maximisation to give level sonority codas, then CODAMAX must dominate {*[*o* dpi] $\&_\sigma$ *[CC]$_\mu$}. However, since Coda Maximisation is tolerated at all, it must also be the case that CODAMAX dominates the more stringent constraint {*[dpi] $\&_\sigma$ *[CC]$_\mu$}, since if {*[dpi] $\&_\sigma$ *[CC]$_\mu$} dominated CODAMAX there would be no Coda Maximisation in the first place. In general, if the ranking $\mathbf{X}^j \gg \mathbb{C}$ is to be learnable, then $\mathbb{C}$ must dominate all constraints of stringency greater than *j*. Given that there are five constraints in the system, there are 5! = 120 total orderings on the set of constraints. However, if four of the constraints in the system stand in a stringency hierarchy, the number of extensionally distinct rankings is still only 5. The typology of Coda Maximisation may then be reconstrued as in (74).

(74) Typology of Coda Maximisation in Northwest Saamic without fixed rankings

a. ranked: {*[dpi] $\&_\sigma$ *[CC]$_\mu$} $\gg$ <u>CODAMAX</u>
   free: {*[*o* dpi] $\&_\sigma$ *[CC]$_\mu$}, {*[*oo* dpi] $\&_\sigma$ *[CC]$_\mu$}, {*[*ooo* dpi] $\&_\sigma$ *[CC]$_\mu$}
   Forest Lule
b. ranked: {*[*o* dpi] $\&_\sigma$ *[CC]$_\mu$} $\gg$ <u>CODAMAX</u> $\gg$ {*[dpi] $\&_\sigma$ *[CC]$_\mu$}
   free: {*[*oo* dpi] $\&_\sigma$ *[CC]$_\mu$}, {*[*ooo* dpi] $\&_\sigma$ *[CC]$_\mu$}
   West Finnmark
c. ranked: {*[*oo* dpi] $\&_\sigma$ *[CC]$_\mu$} $\gg$ <u>CODAMAX</u> $\gg$ {*[*o* dpi] $\&_\sigma$ *[CC]$_\mu$},{*[dpi] $\&_\sigma$ *[CC]$_\mu$}
   free: {*[*ooo* dpi] $\&_\sigma$ *[CC]$_\mu$}
   Jukkasjärvi
d. ranked: {*[*ooo* dpi] $\&_\sigma$ *[CC]$_\mu$} $\gg$ <u>CODAMAX</u> $\gg$ {*[*oo* dpi] $\&_\sigma$ *[CC]$_\mu$},{*[*o* dpi] $\&_\sigma$ *[CC]$_\mu$},{*[dpi] $\&_\sigma$ *[CC]$_\mu$}
   Polmak
e. ranked: <u>CODAMAX</u> $\gg$ {*[*ooo* dpi] $\&_\sigma$ *[CC]$_\mu$},{*[*oo* dpi] $\&_\sigma$ *[CC]$_\mu$},{*[*o* dpi] $\&_\sigma$ *[CC]$_\mu$},{*[dpi] $\&_\sigma$ *[CC]$_\mu$}
   Sea Saami

5. CONCLUSIONS

A striking feature of the Northwest Saamic languages is coda-maximising syllabification to enhance the prominence of a stressed syllable. The extent of Coda Maximisation in this group ranges from non-existent, in some dialects of Lule Saami, to rampant, as in Sea Saami. In West Finnmark Saami, Coda Maximisation is restricted to the position following a monomoraic sonorant, and Coda Maximisation is blocked following (a) an overlong consonant, (b) any consonant of lower sonority, (c) any voiceless consonant. In Maattivuono Sea Saami, Coda Maximisation applies maximally to all stressed syllables. A study of the microtypology of Coda Maximisation in five varieties of Northwest Saamic reveals that the environments in which Coda Maximisation is tolerated may be ranged in a strict implicational hierarchy. Initially, these environments do not seem to constitute a natural class, at least on any received understanding of what the set of phonological primitives includes. It was proposed that this hierarchy is based on a phonetic scale encoding the degree of perceptual integration of the syllable rhyme. This scale is represents phonetic knowledge about the extent to which certain kinds of transitions between subrhymal elements (segments, moras, or tones) compromise the perception of the rhyme as an integrated unit. The complex codas that result from Coda Maximisation are less tolerated the lower the dpi of the syllable rhyme. Future work will hopefully place the dpi scale on a firmer phonetic basis and explore its relevance for other languages.

ACKNOWLEDGMENTS

I would like to express my thanks to Beth Hume, Martin Krämer, Ove Lorentz, Curt Rice, Pekka Sammallahti, and an anonymous reviewer for comments on this work. Any remaining errors of fact or interpretation remain my sole responsibility.

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[1] Saami (earlier: Lappish) is a branch of the Finno-Ugric family of languages spoken in Norway, Sweden and Finland. Here I will adopt the ethonym 'Saami' in referring to individual languages and, following Sammallahti, 'Saamic' to refer to any superordinate grouping of Saami languages, thus: West Saamic, Northwest Saamic, East Saamic. In

Ethnologue (http://www.ethnologue.com/), the term Lappic is used to refer to any superordinate grouping, but Saami is used for individual languages.

[2] The southern group of Western Saamic includes South Saami and Ume Saami. Eastern Saamic includes Inari, Skolt, Akkala, Kildin and Ter.

[3] Abbreviations used: acc[usative], gen[itive], nom[inative], part[iciple], pres[ent], pl[ural], s[in]g[ular].

[4] North Saami consists of three main dialect groups: Sea Saami, Finnmark Saami and Torne Saami.

[5] Examples from dialects other than West Finnmark Saami are taken from sources that utilise Finno-Ugric Transcription. For accessibility and typographical convenience, all examples have been retranscribed into IPA. [š] = [ʃ].

[6] This naturally raises interesting questions about how to represent the difference between /a/, /aa/ and /aá/ phonologically. This is a detail I will leave to future research.

[7] The first member of an obstruent cluster is a [+spread glottis] fricative, either one of the sibilants /s š/ or, in those variants that have it, the voiceless dental fricative /θ/. Non-coronal fricatives, i.e. /f/, are not permitted. The second member of the cluster is always [–continuant], i.e. plosive or nasal. However, the only nasal that may occur in an obstruent-initial cluster is /m/. For plosives, the contrast between [+spread glottis] and [–spread glottis] is neutralised in this position.

[8] The source of the alternation may be assumed to be morphological: the nominative singular in these cases is marked by a consonantal mora, which associates to the consonant immediately following the stressed nucleus of the foot.

[9] In a biliteral sonorant-initial cluster, C_1 may be any voiced median continuant /v ð j/, any homorganic nasal /m n ŋ/ (except /ɲ/), any homorganic sonorant stop /b d ɟ g/ or liquid /l r/. C_2 may be any plain occlusive /p t ts tš c k/, any of the fricatives /f s š/, either of the glides /v j/, or the liquids /l r/. Sonorant-initial clusters whose C_2 is a [+spread glottis] consonant or a pre-stopped nasal are also possible, but they are analysed as triliteral clusters here. With a sibilant /S/ in C_2, C_1 may be either of the glides /v j/, the nasals /m n ŋ/, or the liquid /r/. C_3 must be a non-affricate lingual oral stop /t k/. If C_2 is /m/, the sibilant may be either /s/ or /š/. In all other cases, C_2 is /s/. Where C_1 and C_3 are homorganic, the supralaryngeal feature specifications of C_1 spread onto /h/. Thus /kumːhpe/, 'wolf (nom.sg)', and /kumhpe/, '*id.* (acc/gen.sg)' are realised phonetically as [kumː.m̥pe] and [kumm̥.pe] respectively.

[10] Plain sonorant-initial clusters without Coda Maximisation (C_1C_2) are also permitted in West Finnmark Saami, but since there are drastic restrictions on their distribution I abstract away from them here. Sonorant-initial clusters of the form C_1C_2 only occur in the so-called 'allegro' form found in certain morphological and lexical environments (Sammallahti 1977, 1998). The allegro apparently represents a phonologisation of processes occurring during accelerated speech and is associated with the non-final member(s) of a compound PrWd and expones certain verbal categories, such the 2sg imperative form and the connegative, which is the infinitive form selected by the negative verb. For some commonly occurring verb forms, the allegro has become lexicalised. Phonologically, the allegro foot is distinguished by the requirement that the nuclei in both the stressed and unstressed syllable must be short. Shortening in the unstressed syllable is also associated with qualitative changes. While the vowel inventory in the unstressed syllable of a 'largo' foot includes /ii e a aa o uu/, the corresponding allegro inventory is /e a o/. Examples: /tšaalii/→*tšaále*, 'write!', /keasii/→*keáse*, 'pull!', /poahtii-/→*poáðan*, 'I come', /kuodtii-/→*kuótte*, 'carry!'. The third mora of a trimoraic syllable may also optionally delete, e.g. *aalːtuu*, 'female reindeer', *aálːto-*

piel:luu ~ *aálto-piel:luu*, 'bell on female reindeer (nom.sg)'; *jah:kii*, 'year', *jahke-peal:lii*, 'half year (nom.sg)'; *vuol:kaa* (largo) ~ *vuólka* (allegro) 'he/she goes'; *šad:taa* (largo) ~ *šadta* (allegro) 'he/she grows'; *aal:kaa* (largo) ~ *aálka* (allegro) 'he/she begins'.

[11] C_2 may be either one of the sibilants /s/ or /š/, or the sonorant /h/. With /h/ in C_2, C_1 may be either of the glides /v j/ (/ð/ does not occur in triliteral clusters), the nasals /m n ŋ/, or the liquids /l r/. C_3 must be [–continuant].

[12] The term 'hypercharacterised' is adapted from Sherer (1994).

[13] One piece of evidence in favour of this syllabification is the excrescence of a vowel following C1 in heterorganic C1 overlong clusters. For more information on this, see §4.

[14] An anonymous reviewer suggests simplifying the analysis of weight by representing length contrasts using skeletal slots (Clements and Keyser 1983; Levin 1985; McCarthy 1979) or root nodes (Selkirk 1990) without any possibility of sharing. The reviewer points out that the weight-based analysis is not in fact motivated by the pattern of stress assignment, which, as shown in §2.1, is quantity-insensitive, and claims that in the absence of evidence apart from the lexical length contrast a moraic analysis lacks credibility. According to the kind of analysis the reviewer suggests, a plain geminate would consist of a single melodic unit linked to two skeletal slots or root nodes, while an overlong geminate would be linked to three. Rejecting the possibility of sharing would certainly have the virtue of maintaining a direct relationship between segments and timing units, thus obviating the need to posit the admittedly complex syllable structures in §2.4.1. I believe nevertheless that there are reasons to reject a skeletal/root node analysis of geminates. For concreteness I'll explain this with reference to an X-slot analysis. Most cogent is that the mora-based and X-slot analyses diverge in their predictions about how the set of rhymes should partition into natural classes. The X-slot approach cannot make the required distinction between moraic and segmental hypercharacterisation that is essential for distinguishing syllables with overlength as a natural class. To see this, consider the difference between feet of the form CVC:.CVX, with an overlong foot-medial consonant, and feet of the form $CVC_1C_2.C_2VX$, with a foot-medial cluster with maximisation of the coda. For the X-slot approach, the prediction is clearly that these two structures should pattern alike, since the coda of the first syllable contains two X-slots. Nevertheless, they clearly pattern differently as borne out by several quantity-related phenomena in West Finnmark Saami. We'll review three of these briefly. (1) There is a process that lengthens short unstressed /a/ following a short stressed nucleus, e.g. /namma/→*nammaa*, 'name (nom.sg)', /tola/→*tolaa*, 'fire (acc/gen.sg)', but /kiela/→*kiela* (not **kielaa*), 'language (acc/gen.sg)'. Following an *overlong* foot-medial consonant or consonant cluster, however, this lengthening is blocked, e.g. /tsum:ma/→*tsum:ma* (not **tsum:maa*), 'kiss (nom.sg)'. Crucially, however, the process is *not* blocked following a $C_1C_2.C_2$ or $C_1C_2.C_3$ cluster, e.g. /palva/→*palvvaa*, 'cloud (acc/gen.sg)', /palhtša/→*palh.tšaa*, 'bad thing (ski, knife, etc.; acc/gen.sg)'. The observed difference is easily characterised on the assumption that the first syllable of *tsum:ma* is trimoraic but the first syllable of *palvvaa* is bimoraic. The X-slot analysis on the other hand fails to provide a motivation for the difference. (2) Quantitative truncation in allegro forms optionally reduces a trimoraic syllable to bimoraic by deleting one of the moras of a bimoraic consonant, e.g. *aal:tuu*, 'female reindeer', *aál:to-piel:luu* ~ *aálto-piel:luu*, 'bell on female reindeer (nom.sg)'. This might also be modeled by deletion of an X-slot, but the X-slot theory would also seem to predict, counterfactually, that a $C_1C_2.C_2$ cluster (derived by Coda Maximisation) should reduce to $C_1.C_2$ in an allegro form.

This is also false, e.g. /kieltii/→*kieltte* (not **kielte*), 'deny!'. (3) In Kautokeino Saami there is a process that, at least on one reasonable interpretation of the motivation behind it, may be taken as evidence for the moraic status of geminates. A geminate undergoes overlengthening before a (non-derived) bimoraic nucleus, e.g. /jahkii/→*jah:kii*, 'year (nom.sg)'; /palluu/→*pal:luu*, 'fear (nom.sg)'; /hilppuuh/→*hilp:puuh*, 'wild creatures (nom.pl)'; /nirhpaaš/→*nirh:paaš*, 's.o. who gets offended easily (nom,sg)'; contrast the forms /hivsseh/→*hivsseh* (not **hivs:seh*), 'closet (nom.sg)'; /kolkkoh/→*kolkkoh*, 'male reindeer exhausted from rutting (nom.sg)'; /kalmmeš/→*kalmmeš*, 'sensitive to cold'. The motivation would seem to have to do with the optimisation of foot structure, in this case the avoidance of a spondee (an interpretation suggested to me by Beth Hume, p.c.). If the quantitative properties of overlong consonants were not encoded in terms of moras, it would be difficult to describe this process. The question of the relative merits of skeletal and mora-based analyses is nevertheless a current one and is prompted by the finding that there are languages in which the phonological patterning of geminates does not seem to diagnose moraicity. In particular there are languages in which CVV syllables in general attract stress, but closed syllables, *including those closed by a geminate*, do not. Examples include Malayalam (Curtis 2003) and Selkup (Davis 1994; Tranel 1991). This finding speaks to the issue whether the relation between stress and segmental prominence is best encoded indirectly, in terms of the interaction of prominence and syllable weight (expressed moraically; Zec 1995), and the interaction of weight and stress (Prince 1990), or in such a way as to allow both weight and prominence to interact with stress directly. The results of recent research may be interpreted as favouring the view that prominence and stress may interact directly. Gordon (2002) examines the factors involved in syllable weight and provides evidence that weight distinctions correlate with the total perceptual energy of the syllable rhyme. This measure cuts across a number of distinct phonological dimensions, including moraic quantity, coda and nuclear sonority. Furthermore, a number of languages have more finely grained weight hierarchies whose interaction with stress assignment are difficult to model on the assumptions of the indirect model (Hayes 1995; Morén 2000). Taken together, I think these findings subvert the reliance on moraicity as the sole bearer of syllable weight distinctions and liberate the mora to serve as a purely quantitative unit.

[15] Kiparsky relates the absence of post-vocalic Coda Maximisation in General Fenno-Swedish to the fact that these dialects lack a contrast between heavy and superheavy syllables. The dialects in which Coda Maximisation *does* apply post-vocalically are precisely those dialects with a constrast between heavy and superheavy syllables.

[16] There is some geographic variability in Collinder's data as to whether Coda Maximisation applies or not. In some grammars, CODAMAX is dominated by *CXCODA. As we have already seen, in the Forest dialects of Lule Saami Coda Maximisation is absent.