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Consonant-vowel interactions in Modern Standard Latvian: a representational and constraint-based account

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In this article I provide a representational and a constraint-based analysis of four interacting palatalization processes operative in Modern Standard Latvian: velar affrication, velar palatalization, yod-palatalization and front vowel raising. The main advantage of the representational account developed here is that it treats all of the mentioned Latvian processes as strictly assimilatory, and at the same time avoids purely stipulative mechanisms characteristic of many feature-geometric approaches to cross-category interactions. The article also contributes to the debate on the role of geometric subsegmental representations in constraint-based computational models, by demonstrating that a principled account of locality, transparency and blocking effects in Latvian palatalization requires the reference to hierarchical autosegmental structures.

Keywords: Latvian; palatalization; Optimality Theory; feature geometry

1 Introduction

Cross-category interactions, and palatalization in particular, had a crucial role in informing theories of subsegmental representations as the main source of evidence for the constituency and affiliation of phonological features in the feature tree. However, the original ambition to develop a unified representational analysis capable of capturing all cross-linguistically attested palatalization patterns resulted in only limited success (see Kochetov 2011 for an overview). In the face of the broad typological variability of palatalization patterns, it proved impossible to both maintain the assumption of the universality of the feature tree, and keep the inventory of permissible operations restricted to autosegmental spreading and delinking. For this reason, the analyses adhering to the universality assumption had to invoke additional mechanisms, which obscured the assimilatory nature of palatalization and the relation between its component subprocesses, and even so did not always extend to all attested alternations.

The empirical focus of this paper is on four distinct yet interacting palatalization processes operative in Modern Standard Latvian: (i) yod-palatalization, whereby alveolar and velar consonants surface as their postalveolar/palatal counterparts when followed by the prevocalic /i, e/ (1a); (ii) velar affrication, whereby the underlying velar plosive surfaces as an alveolar affricate when followed by front vowels (1b); (iii) velar palatalization, whereby velar plosives alternate with palatal stops in the same context (1c); and (iv) front vowel raising, whereby /æ/ surfaces as [e] when followed by front non-low vowels or palatal/postalveolar consonants (1d).

- (1) Palatalization in Modern Standard Latvian
- a. Yod-palatalization
- | | | | |
|--------------|--------------------|----------------|--------------------|
| [t̥sa:.ɫ-u] | ‘chicken, GEN.PL.’ | [t̥sa:.l-i-m] | ‘chicken, DAT.SG.’ |
| [zu.ɟ-u] | ‘eel, GEN.PL.’ | [zu.t-i-m] | ‘eel, DAT. SG.’ |
| [sle:.d̥ʒ-u] | ‘switch, GEN.PL.’ | [at.-slæ:.g-a] | ‘key, NOM. SG.’ |
- b. Velar affrication
- | | | | |
|------------------|------------|--------------|--------------------|
| [drau.d̥ʒ-i:k-s] | ‘friendly’ | [drau.g-a-m] | ‘friend, DAT. SG.’ |
| [juo.t̥s-i:k-s] | ‘jocular’ | [juo.k-a-m] | ‘joke, DAT. SG.’ |
- c. Velar palatalization
- | | | | |
|-----------------|--------------------|-----------|------------------|
| [ban.c-ier-i-s] | ‘banker, NOM. SG.’ | [baŋ.k-a] | ‘bank, NOM. SG.’ |
| [mar.c-ier-i-s] | ‘marker, NOM. SG.’ | [mar.k-a] | ‘mark, NOM. SG.’ |
- d. Vowel raising
- | | | | |
|----------------|--------------|-------------|---------------------|
| [be:k-.ɟan-a] | ‘escape’ | [bæ:k.-tu] | ‘run, cond.’ |
| [se.t̥s-i:b-a] | ‘sequence’ | [sæ.k-uo-t] | ‘to follow’ |
| [se.kl-i:b-a] | ‘triviality’ | [sæ.kl-s] | ‘trivial, NOM. SG.’ |

In fact, each of the alternations illustrated in (1) poses a challenge for the traditional representational approaches such as Unified Feature Theory (UFT; Clements 1991 a; b; Hume 1992; Clements & Hume 1995) and (Revised) Articulator Theory ((R)AT; Sagey 1986; Halle 1995; Halle, Vaux & Wolfe 2000), which view palatalization as the spreading of the secondary place features from the vowel to the consonant. Thus, in the traditional models, all patterns where the target consonant undergoes the shift of the primary place of articulation (a; b and c) would necessitate some sort of post-assimilation restructuring to ensure that the secondary articulation is re-interpreted as primary articulation of the target consonant (this has been accounted for by tier promotion (Clements & Hume 1995) and equivalency relations (Halle, Vaux & Wolfe 2000)). Further, in cases where palatalization is accompanied by assibilation (a and b), the latter would have to be derived by redundancy rules (Sagey 1986; Lahiri & Evers 1991; Hume 1992). This move, apart from being stipulative, would require the explanation of why redundancy rules fail to apply in (c). Finally, the very fact that front vowels may cause three distinct changes in velar plosives ($/k/ \sim [t̥s]$, $/k/ \sim [c]$, $/k/ \sim [t̥ʃ]$) is difficult to explain in models where the only relevant feature that may spread onto a consonant from a front vowel is V-place-[cor] (or [-back]). In fact, the only pattern above that may be expressed as pure spreading assuming the traditional model of feature geometry is that where raising of $/æ/$ is triggered by the following front vowel (d). However, the fact that vowel raising may also be triggered by postalveolar/palatal consonants cannot be captured straightforwardly. In UFT, the problem lies in the fact that the aperture features expressing vocalic height are never the property of consonants in general, while in (R)AT, the feature [+high] characterizes dorsals.

The present paper demonstrates that palatalization patterns that proved challenging for the traditional representational theories can receive a straightforward account in the Parallel Structures Model (PSM; Morén 2003; 2006; 2007; Iosad 2012; Youssef 2013), which differs from classic feature geometric models in three crucial respects. First, it rejects the universality assumption and maintains that representations are language-specific and emergent, rather than universal and innate. Second, it maintains that vowels and consonants use the same set of features and structural primitives. Finally, it embraces modularity and maintains that phonological grammar is independent of phonetic considerations.

The goal of this paper is threefold. First, it is to provide a detailed description of the empirical facts of Latvian palatalization that to date have not been discussed in the generative literature. Second, it is to develop a unified representational analysis of these

processes, while using a restricted set of autosegmental primitives and operations. Third, it is to provide a constraint-based account that incorporates rich subsegmental representations and models Latvian palatalization as resulting from the interaction of well-established markedness and faithfulness constraints.

The paper is organized as follows. In Section 2, I provide the necessary background on the sound system of Modern Standard Latvian, present the four palatalization processes and introduce the main generalizations. In Section 3, I present the representational assumptions and lay out the representational analysis couched within the Parallel Structures Model, while Section 4 is dedicated to the constraint-based analysis formulated within Optimality Theory (Prince & Smolensky 1993/2004). Section 5 contains the summary and conclusions.

2 Data

2.1 Segmental inventory of Modern Standard Latvian

Latvian has a symmetrical system of 6 vowel phonemes, as shown in Table 1. Vowel length is contrastive in the language, and each vowel has a short and a long version (Laua 1997; Muižniece 2002; Markus & Grigorjevs 2003). In addition, Latvian is traditionally described as having 10 phonemic diphthongs: /ai/, /au/, /ei/, /ie/, /uo/, /iu/, /ui/, /eu/, /ɔu/, /ɔi/. Of these, /ui/, /eu/, /ɔu/, /ɔi/ are mostly attested in borrowings (NAGL 2015: 45)¹.

	Front		Back	
High	i	i:	u	u:
Mid	e	e:	ɔ	ɔ:
Low	æ	æ:	ɑ	ɑ:

Table 1: Vowel inventory of Latvian.

The inventory of consonant phonemes of Modern Standard Latvian comprises 26 segments, and distinguishes four places of articulation (labial, dental/alveolar, postalveolar/palatal, and velar). Traditionally, within the set of anterior coronals the distinction is made between the dentals and alveolars, such that only liquids are classified as the latter. In the set of posterior coronals, postalveolars and palatals are distinguished, the former set including the sibilants (cf. Laua 1997; Muižniece 2002; Markus & Grigorjevs 2003). These distinctions are ignored here, because – as I will show in the following sections – they are not phonologically relevant (note also that manner classes are complementary within the dental and alveolar series, and within the postalveolar and palatal series). The consonant inventory of Latvian assumed here is given in Table 2.

	Labial		Dental/Alveolar		Postalveolar/palatal		Velar	
Plosive	p	b	t	d	c	ɟ	k	g
Fricative	f		s	z	ʃ	ʒ	x	
Affricate			t͡s	d͡z	t͡ʃ	d͡ʒ		
Nasal		m		n		ɲ		
Approximant						j		
Lateral				l		ʎ		
Trill				r		(rʲ)		

Table 2: Consonant inventory of Latvian.

¹ Here and further, the abbreviation “NAGL” shall refer to the New Academic Grammar of Latvian, Auziņa et al. (2015).

Dental/alveolar and postalveolar/palatal series are almost perfectly symmetrical with respect to the manners of articulation. Palatal stops [c, ʃ] and palatal sonorants [ɲ, ʎ] are true palatals, and not palatalized counterparts of the corresponding dentals/alveolars (Laua 1997). Palatalized rhotic [rʲ] is the only segment in the language that has a secondary articulation. However, its status in the Modern Standard Latvian is somewhat marginal, with only few speakers still producing the contrast between plain and palatalized rhotics. While palatal stops /c, ʃ/ tend to occur before front vowels, the distribution of other postalveolar/palatal phonemes is not restricted to palatalizing contexts.

All obstruent phonemes come in voiced/voiceless pairs, except for the velar fricative /x/ and a labial fricative /f/ that lack voiced counterparts. Both segments have a very limited distribution in the language, and are only attested in borrowings. Traditional descriptions also typically mention the voiced fricatives /v, ʎ/ as having the phonemic status in the language (NAGL 2015: 57). Here, however, these are treated as positional variants of the underlying high vocoids (refer to Urek in prep. for a detailed discussion).

2.2 Yod-palatalization

Yod-palatalization is, perhaps, the most common and regular palatalization process in Latvian, and also the one that targets the widest range of segments across different morphological contexts. For reasons of space, the discussion here will be restricted to yod-palatalization in nominal paradigms (but refer to Steinbergs 1977 for the discussion of yod-palatalization in verbs).

In Latvian, all nominal stems have a theme vowel immediately following the root. The phonological inventory of theme vowels comprises four segments: /i, e, a, u/ (see Halle 1987; 1992 for details; Steinbergs 1977 for alternative treatment). When followed by vowel-initial suffixes, root-final alveolars and velars in stems characterized by front theme vowels /i, e/ undergo yod-palatalization, while root-final labials surface with the following palatal fricative [j]. The surface palatal fricative [j] in this context is due to the onset strengthening of front vowels /i, e/, which regularly applies in the language (see the discussion in Section 2.2):

(2) Iotization of labial-final roots

	GEN. PL.	DAT. SG.	
/buom-i-u/ →	[buo.m-ʎ-u]	[buo.m-i-m]	‘pole’
/skap-i-u/ →	[ska.p-ʎ-u]	[ska.p-i-m]	‘closet’
/zi:m-e-u/ →	[zi:.m-ʎ-u]	[zi:.m-e-j]	‘sign’
/map-e-u/ →	[ma.p-ʎ-u]	[ma.p-e-j]	‘folder’

In the dental/alveolar series, yod-palatalization affects the obstruents /t, d, s, z, ts, dz/ and non-rhotic sonorants /n, l/ and causes the shift to the postalveolar/palatal place of articulation. The rhotic trill /r/ normally fails to alternate in this context, due to the fact that the majority of speakers of the standard variety no longer produce a contrast between hard [r] and palatalized [rʲ] (Laua 1997). For those who do, /r/ is targeted by yod-palatalization on a par with other sonorants.

(3) Yod-palatalization of dentals/alveolars

	GEN. PL.	DAT. SG.	
/zut-i-u/ →	[zu.ʃ-u]	[zu.t-i-m]	‘eel’
/bri:d-i-u/ →	[bri:.ʒ-u]	[bri:.d-i-m]	‘moment’
/tas-e-u/ →	[ta.ʃ-u]	[ta.s-e-j]	‘cup’
/ez-i-u/ →	[e.ʒ-u]	[e.z-i-m]	‘hedgehog’

/la:ts̄-i-u/	→	[la:.t̪̯-u]	[la:.ts̄-i-m]	‘bear’
/dad̄z̄-i-u/	→	[da.d̄z̄-u]	[da.d̄z̄-i-m]	‘thistle’
/ziluon-i-u/	→	[ziluon̩-u]	[zi.luon̩-i-m]	‘elephant’
/pel-e-u/	→	[pe.l̩-u]	[pe.l̩-e-j]	‘mouse’

As the data in (3) show, the voicing specification of the segments targeted by yod-palatalization remains intact, and so does the manner of articulation in sonorants and sibilant obstruents. Plosive stops, however, undergo assibilation and surface as postalveolar fricatives (although palatal plosives and postalveolar affricates are available in the inventory). Two important observations are also in order concerning the palatalization trigger: first, /i, e/ only trigger palatalization of alveolars when prevocalic (cf. Dative singular forms); second, palatal fricative [j] never surfaces following palatal/postalveolar consonant. These properties will be crucial for the analysis developed in Section 3.3.2.

In the velar series, the process affects only the plosive stops /k, g/. The only other velar, the velar fricative /x/, has a very limited distribution in the language, and is only attested in borrowings. What seems like the only stem where /x/ is followed by a front theme vowel, /psix-e-/ ‘soul’, fails to alternate when followed by a vocalic inflection: /psix-e-u/ ~ [psix-u]².

As illustrated in (4a), as a result of yod-palatalization velar plosives shift to postalveolar affricates [t̪̯, d̪̯]. Although the underlying form of the root-final velars is obscured by the velar affrication triggered by front theme vowels, it can be inferred from the stems of other declensions derived from the same root³ (4b).

(4) Root-final velars

a. Yod-palatalization of velars

		GEN. PL.	DAT. SG.	
/skuolniek-e-u/	→	[skuol.nie.t̪̯-u]	[skuol.nie.ts̄-e-j]	‘schoolgirl’
/pus-aug-i-u/	→	[pus-.au.d̪̯-u]	[pus-.au.d̪̯-i-m]	‘teenager’

b. Underlying velars surface faithfully

		GEN. PL.	DAT. SG.	
/skuolniek-a-u/	→	[skuol.nie.k-u]	[skuol.nie.k-a-m]	‘schoolboy’
/aug-a-u/	→	[au.g-u]	[au.g-a-m]	‘plant’

Yod-palatalization may also apply vacuously in cases where the root underlyingly ends in a palatal consonant. The only two segments of postalveolar/palatal series that appear root-finally in stems characterized by front theme vowels are palatal plosives /c, ʃ/. Both surface faithfully when followed by the vocalic suffixes, while the front theme vowel deletes:

(5) Vacuous application of yod-palatalization

		GEN. PL.	DAT. SG.	
/zac-i-u/	→	[za.c-i-u]	[za.c-i-m]	‘hare’
/kuj-i-u/	→	[ku.j-i-u]	[ku.j-i-m]	‘ship’

² Velar fricative /x/ used to have a positional variant [ç] surfacing before front vowels, which nowadays only very few speakers produce (Laua 1997: 61). I don’t have the data that shows whether or not /x/ alternates with [ç] in yod-palatalization contexts for those speakers.

³ Discussing Latvian yod-palatalization, Steinbergs (1977: 77) maintains that there are no roots ending in underlying velars in palatalizing declensions. While it’s certainly true that velars never surface root-finally in these declensions due to velar affrication, some roots do surface with velars in declensions characterized by back theme vowels.

Even though our present discussion is limited to the alternations affecting nominal stems, it is important to note that yod-palatalization regularly applies in all cases where the root-final consonant comes to be followed by the prevocalic front vocoid (unless bled by yod-deletion, see (6a), and Footnote 5).

2.3 Velar affrication

Velar affrication is the process by which underlying velar stops /k, g/ surface as alveolar affricates [t͡s, d͡z] when followed by front vowels. In Latvian, the process may be triggered by front vowels /i, e, æ/, as well as their long counterparts /i:, e:, æ:/ (note the typologically uncommon front low trigger)⁴. Velar affrication routinely affects root-final velar plosives when followed by front-vowel-initial derivational suffixes (illustrated in (8)), and preconsonantal front theme vowels (see DAT. SG. forms in (4a)).

The relation between the underlying forms given in (6) and their surface correspondents deserves some further discussion. Note that vowel-initial derivational suffixes create the underlying hiatus with the preceding theme vowel (on the assumption that derivation is stem-based; see Urek 2016 for the argument specific to Latvian; Bermúdez-Otero 2013 for the stem-based vs. root-based derivation more generally). In (6), the hiatus is resolved by eliding the theme vowel, which creates the context for velar affrication (see also Halle 1992 on hiatus resolution in Latvian). Note that the elision of the pre-vocalic front theme vowel bleeds yod-palatalization⁵.

(6) Velar affrication

a. Velar affrication triggered by /i/			
/draug-a-iŋ-s/	→	[drau.d͡z-iŋ-ŋ]	'friend, masc. dim.'
/iuok-a-iŋ-s/	→	[juo.t͡s-iŋ-ŋ]	'joke, dim.'
/skuolniek-e-i:t-e/	→	[skuol.nie.t͡s-i:.t-e]	*[skuol.niet͡s-i:t-e] 'schoolgirl'
/pus-aug-i-i:t-i-s/	→	[pus-.au.d͡z-i:.t-i-s]	*[pus-aud͡z-i:t-i-s] 'teenager'
b. Velar affrication triggered by /e/			
/draug-a-en-e/	→	[drau.d͡z-e.n-e]	'friend, fem.'
/vilk-a-en-e/	→	[vil.t͡s-e.n-e]	'she-wolf'
c. Velar affrication triggered by /æ/			
/tsu:k-a-æ:n-s/	→	[tsu:.t͡s-æ:n-s]	'piglet'
/kung-a-æ:n-s/	→	[kun.d͡z-æ:n-s]	'young lord'

Notably, velar affrication fails to apply before inflectional suffixes (in nominal, as well as verbal and adjectival paradigms), which leads me to regard it as a stem-level process. This is illustrated in (7):

(7) Lack of velar affrication before inflectional suffixes

/vilk-a-i/	→	[vil.k-i]	*[vil.t͡s-i]	'wolf, NOM.PL.'
/draug-a-i/	→	[drau.g-i]	*[drau.d͡z-i]	'friend, NOM.PL.'
/iauk-a-i/	→	[jau.k-i]	*[jau.t͡s-i]	'nice, NOM.PL. MASC.'
/darg-a-i/	→	[dar.g-i]	*[dar.d͡z-i]	'expensive, NOM.PL. MASC.'
/sak-Ø-i/	→	[sa.k-i]	*[sa.t͡s-i]	'say, 2ND SG. PRES.'
/muok-Ø-i/	→	[muo.k-i]	*[muo.t͡s-i]	'torture, 2ND SG. PRES.' ⁶

⁴ The diphthongs where the first component is front, i.e. /ei/, /ie/, /iu/, /eu/ do not occur morpheme-initially in suffixes.

⁵ Note that front theme vowels elide in hiatus contexts only when followed by front-vowel-initial *derivational* suffixes (the process known as yod-deletion; see Endzelins 1951: 182–183), and get resyllabified in the onset elsewhere.

⁶ Note that Steinbergs (1977: 107) gives the 2nd SG. form [muot͡s-i] where affrication applies, and concludes that the affrication is triggered by inflections as well. However, the form *[muot͡s-i] is ungrammatical in

2.4 Velar palatalization

Velar palatalization is a process by which velar plosives /k, g/ surface as palatal stops [c, ʃ] before front vowels. Velar palatalization is much less common than velar affrication, and seems to be primarily associated with the forms that are outside of core vocabulary. Let us explore this point a bit further.

There is a number of derivational suffixes that trigger the alternation between velar stops and palatal stops – such are, for instance, nominalizing suffixes [-ier-, -er-, -ij-] and [-ism-], and the adjectivizer [-isk-] (see AGL 1959⁷ for descriptions and further examples). The suffix [-isk-] stands out in this list by virtue of being (i) productive (ii) part of the core lexicon. Notably, forms derived with [-isk-] may exhibit either [k, g] ~ [c, ʃ] or [k, g] ~ [t͡s, d͡z] alternation. The former pattern, however, seems to be reserved for recent borrowings, while the latter affects the stems belonging to core vocabulary (i.e. native or sufficiently nativized stems). This is illustrated below:

(8)	Velar coronalization triggered by [-isk-]				
	Nativized	[skuol.niek-s]	‘schoolchild’	[skuol.nie.t͡s-isk-s]	‘schoolchild-like’
	stems	[kunk-s]	‘lord’	[kun.d͡z-isk-s]	‘lordly’
	Foreign	[i.de.o.lok-s]	‘ideologist’	[i.de.o.lo.ʃ-isk-s]	‘ideologic’
	stems	[de.mi.urk-s]	‘demiurg’	[de.mi.ur.ʃ-isk-s]	‘demiurgic’

Forms derived with the borrowed nominalizing suffix [-ism-] may also trigger either coronalization pattern. This suffix only combines with foreign stems, and the type of palatalization it produces is traceable to the source language (supposedly, German – see Mathiasen 1996: 20). Thus, as shown in (9), if [k] ~ [t͡s] alternation applies in German then it also applies in Latvian, while if no alternation occurs in German, Latvian applies [k] ~ [c]. The patterns are also consistent with ‘criticism’ and ‘mysticism’ being more frequent, and therefore more nativized, than ‘autarchism’ and ‘psychologism’.

(9)	Velar coronalization triggered by [-ism-]				
	NOM. SG.	<i>Latvian</i>	<i>German</i>		
	[qu.tark-s]	‘autarch’	[qu.tar.c-ism-s]	[autark-ism-us]	‘autarchism’
	[psi.ho.lok-s]	‘psychologist’	[psi.ho.lo.ʃ-ism-s]	[psyçolog-ism-us]	‘psychologism’
	[kri.ti.k-a]	‘critique’	[kri.ti.t͡s-ism-s]	[kritits-ism-us]	‘criticism’
	[mis.ti.k-a]	‘mystique’	[mis.ti.t͡s-ism-s]	[mystits-ism-us]	‘mysticism’

Although it has to be noted that [-ism-] itself is a borrowing, and it is unclear whether forms derived with it are perceived as plurimorphemic by native speakers, or stored non-analytically (not to mention that they are highly unlikely to be encountered and processed during childhood).

Nominalizing suffixes [-ier-, -er-, -ij-], while themselves being borrowings, only combine with foreign stems, where they consistently trigger [k, g] ~ [c, ʃ] alternation:

(10)	Velar palatalization triggered by derivational suffixes			
	[baŋ.k-a]	‘bank’	[ban.c-ie.r-i-s]	‘banker’
	[mar.k-a]	‘mark’	[mar.c-ie.r-i-s]	‘marker’
	[kruog-s]	‘tavern’	[kruo.ʃ-e.r-i-s]	‘tavern-keeper’
			[spi.c-e.r-i-s]	‘speaker’
	[ki.rurk-s]	‘surgeon’	[ki.rur.ʃ-i.ʃ-a]	‘surgery’
	[qu.tark-s]	‘autarch’	[qu.tar.c-i.ʃ-a]	‘autarchy’

modern Standard Latvian (see, e.g., Ceplitis et al. 2007). The only verbal form where affrication before a front vowel applies is [te:t͡s-i], which is an individual lexical exception.

⁷ Here and further AGL 1959 shall refer to.

Thus it appears that velar palatalization is a property of foreign stems and/or suffixes. There is, however, one notable exception to this generalization. Diminutive suffix [-el-] combines with core stems and consistently triggers velar palatalization. Consider:

(11) Diminutive velar palatalization

			DAT. SG.		
/zɪrg-a-el-i-s/	→	[zɪr.j-e.l-is]	[zɪr.g-a-m]		‘horse’
/li:dak-a-el-e-Ø/	→	[li:.da.c-e.l-e]	[li:.da.k-a-j]		‘pike’
/tsu:k-a-el-e-Ø/	→	[tsu:.c-e.l-e]	[tsu:.k-a-j]		‘pig’

However, [-el-] is exceptional for other reasons as well. For example, unlike all other vowel-initial suffixes, it also causes palatalization of alveolar sibilants (but, notably, not sonorants or plosives). Being a diminutive suffix, it is likely that irregular palatalization patterns triggered by [-el-] is a case of so-called expressive palatalization, and as such it should be distinguished from phonological palatalization proper (see Endzelīns 1951 and Rūķe-Draviņa 1959 for the same intuition; and Kochetov & Alderete 2010 on expressive palatalization patterns cross-linguistically).

2.5 Vowel raising

Vowel raising is a process by which the low front vowel /æ/ raises to [e] when followed by a trigger. The set of segments that trigger vowel raising includes both vocoids and consonants. The former include all front non-low vocoids, i.e. [j, i, i:, e, e:] as well diphthongs where the first component is front /ei, ie, iu, eu/, while the latter set comprises all postalveolar/palatal consonants, both obstruents [ʃ, ʒ, tʃ, dʒ, c, ɟ] and sonorants [ɲ, ʎ] (AGL 1959; Laua 1997; Muižniece 2002 etc.).

Before we look at the data, it has to be said that in Modern Standard Latvian the distribution of [e] and [æ] is no longer always predictable from the phonological context (but see AGL 1959: 23 and Laua 1997: 113 for historical background). Thus, both the instances of [æ] in palatalizing contexts, and the instances of [e] outside of those are attested (refer to Muižniece 2002: 33-44 for a detailed discussion). Consider:

(12) Exceptions to vowel raising

a. Vowel raising misapplies before front vowels

[bæ:r.n-i] ⁸	‘child, NOM.PL.’	cf.	[be:r.n-ij-]	‘child, DIM.’
[æ.zæ.r-i]	‘lake, NOM.PL.’	cf.	[e.ze.r-ij-]	‘lake, DIM.’

b. Vowel raising applies without an overt trigger

[be:g-a:m]	‘run, 1ST PL. PAST’	cf.	[bæ:.g-am]	‘run, 1ST PL. PRES.’
[tsep-a:m]	‘bake, 1ST PL. PAST’	cf.	[tsæ.p-am]	‘bake, 1ST PL. PRES.’

However, in some cases synchronic alternation between [e, e:] and [æ, æ:] is regular, productive and clearly determined by the phonological context. Since the primary focus of this paper is the assimilatory nature of vowel raising, and not its morphological conditioning, it is these transparent cases that are the subject of the subsequent discussion.

Let us first consider cases of vowel raising triggered by front vocoids⁹. As you can see in (13) below, /æ/ raises to [e] whenever some front non-low vocoid follows. The process affects all low front vowels in the word as long as no other vowel intervenes between the target and the trigger (cf. [pele:ts-i-s] ~ [pælə:k-s]).

⁸ These forms suggest that vowel raising is only triggered by stem-level morphemes. However, this generalization does not seem to hold of verbal paradigm, where a number of vocalic inflections trigger the process as well (see Muižniece 2002: 33–44 for the data).

⁹ Throughout this section, examples are taken from the Latvian Dictionary of Spelling and Pronunciation (LDSP) (Ceplītis et al. 2007).

- (13) Vowel raising
- a. Vowel raising before /i/
- | | | | | | |
|--------------|---|-----------------|---------------|-------------|---------------|
| /mæln-i-s/ | → | [mel.n-i-s] | 'black horse' | [mæln-s] | 'black, ADJ.' |
| /pælæ:k-i-s/ | → | [pe.le:ts̄-i-s] | 'gray horse' | [pæ.læ:k-s] | 'gray, ADJ.' |
- b. Vowel raising before /e/
- | | | | | | |
|--------------|---|----------------|----------------|-----------|----------------|
| /tsælm-en-e/ | → | [tsel.m-e.n-e] | 'honey agaric' | [tsælm-s] | 'stump' |
| /zvæ:r-en-e/ | → | [zve:r-e.n-e] | 'beast, FEM' | [zvæ:r-s] | 'beast, MASC.' |
- c. Raising of /æ/ blocked by intervening vowels
- | | | | | | |
|---------------|---|---------------|---------------------|--------------|------------|
| /mæ-l-uo-i-u/ | → | [mæ.l-uo-j-u] | 'lie, 1 SG PRES' | [me.l-i-s] | 'liar' |
| /bæ:d-a-i-u/ | → | [bæ:d-a-j-u] | 'grieve, 1 SG PRES' | [be:d-i:k-s] | 'mournful' |

Let us now turn to the cases where vowel raising is triggered by consonants. As I have already mentioned, [æ] alternates with [e] when followed by all postalveolar/palatal consonants [ʃ, ʒ, tʃ, dʒ, c, ʝ, ɲ, ʎ]. However, in most stems that show such alternation, postalveolar/palatal consonants in question are themselves the result of yod-palatalization, and therefore it is not immediately possible to attribute vowel raising to the palatal/postalveolar consonant rather than the underlying high front vowel. Consider:

- (14) Yod-palatalization and vowel raising in verbs
- | | | | | | |
|------------|---|---------------------------|-----|------------|----------|
| | | 1 st SG. PRES. | | COND. | |
| /plæs-j-u/ | → | [ple.ʃ-u] | cf. | [plæs-.tu] | 'spread' |
| /smæl-j-u/ | → | [sme.ʎ-u] | cf. | [smæl-.tu] | 'scoop' |

An unambiguous example showing that underlying palatal/postalveolar consonants can trigger vowel raising would be the one where the base-final /æ/ is followed by a non-alternating suffix starting with a palatal/postalveolar consonant. The only such suffix seems to be the nominalizing derivational suffix /-ʃan-/, which combines with verbal stems and produces the names of activities and processes (AGL 1959: 150). As you can see below, /æ/ indeed raises to [e] when followed by /-ʃan-/.

- (15) Vowel raising before /-ʃan-/
- | | | | | | | |
|--------------|---|--------------|----------|-----|------------|---------------|
| /bæ:g-ʃan-a/ | → | /be:k-ʃan-a/ | 'escape' | cf. | [bæ:k-.tu] | 'run, COND.' |
| /tsæp-ʃan-a/ | → | /tsep-ʃan-a/ | 'baking' | cf. | [tsæp-.tu] | 'bake, COND.' |

Dispreference for low mid vowels followed by palatal/postalveolar consonants is also manifested as a static phonotactic restriction on roots. The relevant data comes from the non-alternating roots ending in palatal/postalveolar consonants, which never surface with a low front vowel:

- (16) Mid front vowel in non-alternating roots
- | | | | | | |
|------------|---|----------|-----|------------|-------------|
| | | GEN. PL. | | DAT. SG. | |
| /ue:j-a-u/ | → | [ve:j-u] | cf. | [ve:j-a-m] | 'wind' |
| /me:ʒ-a-u/ | → | [me:ʒ-u] | cf. | [me:ʒ-a-m] | 'forest' |
| /ueʎ-a-u/ | → | [ve.ʎ-u] | cf. | [ve.ʎ-a-j] | 'underwear' |
| /peʎ-a-u/ | → | [peʎ-u] | cf. | [peʎ-a-j] | 'profit' |

3 Representational Analysis

A substantial body of work following the publication of SPE (Chomsky & Halle 1968) demonstrated that phonological features, which were at the time regarded as properties of discrete segments, may behave largely independently of the segments that they characterize (e.g. interact non-locally). This led to the proposal that phonological features are autosegmental units aligned on separate representational tiers, and subject to locality conditions

defined on these tiers (Goldsmith 1976 a; b; 1981; Clements 1976; Thrainsson 1978). Further, the observation that certain non-arbitrary sets of features tend to re-occur in phonological processes (Cressey 1974) gave rise to the hierarchical model of feature organization, as the one shown in Figure 1 where feature constituency could be defined in terms of dominance and dependency (Clements 1985; Sagey 1986; Halle 1995 among others).

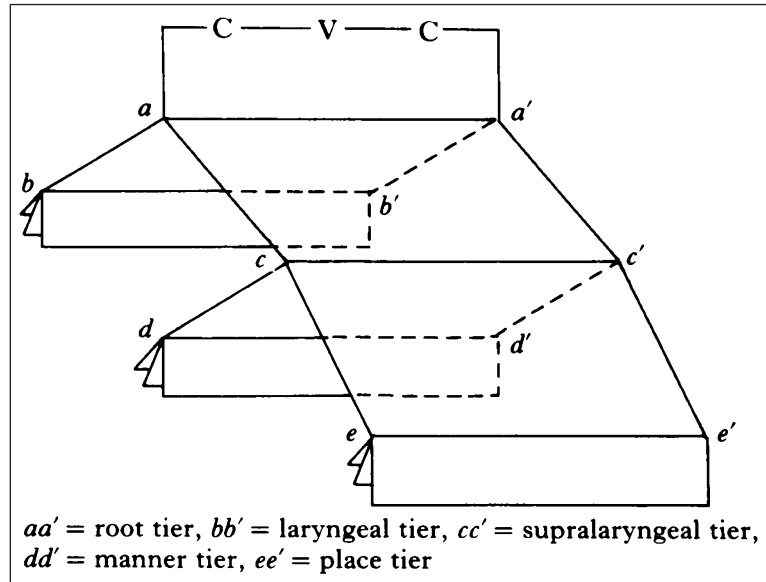


Figure 1: Hierarchical feature geometry (from Clements 1985).

There was, however, a certain amount of disagreement as to what constitutes the primary source of evidence for phonological structure. Thus, one school of thought, (Revised) Articulator Theory ((R)AT, represented, most notably, by Sagey 1986; Halle 1995; Halle, Vaux & Wolfe 2000), maintained that the architecture of the feature tree should be constrained by the structure of the articulatory tract itself, in such a way that the grouping of terminal features into higher-level constituents would reflect which articulatory organs are involved in the production of corresponding articulatory gestures. Within this model, therefore, *phonetic plausibility* of proposed feature groupings is paramount¹⁰. Another school of thought, referred to here as the Unified Feature Theory (UFT, most notably; Clements 1985; Hume 1992; Clements & Hume 1995) maintained that the evidence from cross-linguistic phonological patterning of individual features and feature sets should be primary in determining the structure of the feature tree. In UFT, then, the primacy is given to the *functional plausibility* of the proposed feature grouping. Further differences in detail between (R)AT and UFT are oftentimes a direct consequence of this initial conceptual choice.

Parallel Structures Model adopted in this paper builds on the insights of the earlier representational theories, while at the same time being different in a number of crucial respects (PSM; Morén 2003; 2006; 2007; Iosad 2012; Youssef 2013) Like UFT, PSM adopts autonomy view of phonology, and therefore maintains that featural and structural composition of phonological segments should be determined solely on the basis of phonological patterning that these segments exhibit (cf. Clements 1985). However, while both UFT and (R)AT use *cross-linguistic* evidence from phonological processes in the attempt to uncover the structure of the *universal* feature tree, PSM focuses on phonological evidence from

¹⁰This is not to say that functional evidence is altogether ignored in (R)AT. However, the set of possible phonological representations is defined by anatomical naturalness considerations (see Halle, Vaux & Wolfe 2000: 389–391).

individual languages to arrive at *language-specific* geometric representations. This results in descriptively adequate, parsimonious and formally simple structures, which reflect interrelation of phonological processes within a given language.

3.1 Theoretical assumptions: Parallel Structures Model

In PSM, just like in (R)AT and UFT, the phonological representation of a segment has the form of a branching hierarchy. Within this hierarchy, three classes of constituents are distinguished: root node, class nodes and individual features. Constituents of different types occupy different autosegmental tiers, as shown in Figure 2

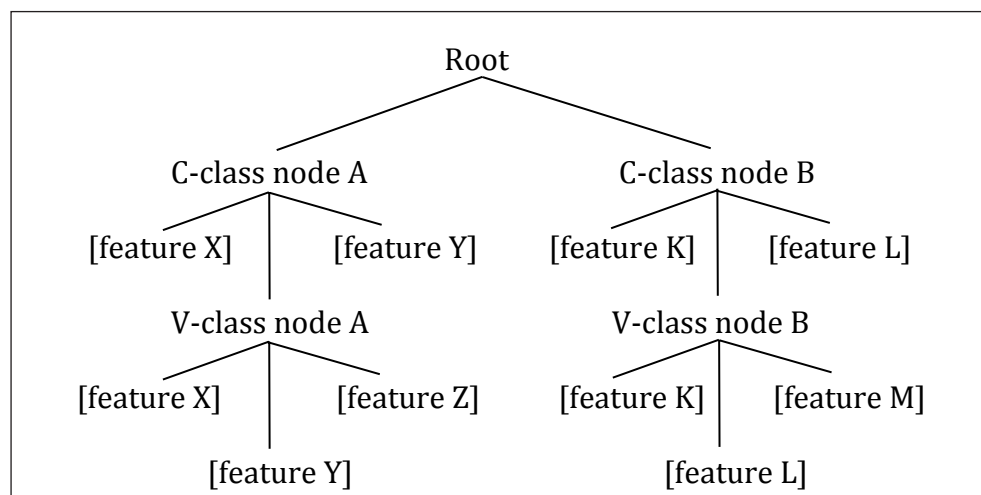


Figure 2: PSM geometry (from Iosad 2012: 34).

Structurally, these constituents differ in whether or not they are terminal and in whether or not they can be recursive, i.e. dominate a constituent of the same type (cf. Clements 1991a). Individual features are always terminal, and cannot dominate other features or nodes (unlike in UFT and earlier versions of AT). In PSM, all features are organized under class nodes, which implies that all features are subject to the same conditions on spreading. This is in contrast with AT and UFT, both of which allowed certain features to either link directly to the root node or to be contained within the root node itself (Sagey 1986; McCarthy 1988; Clements & Hume 1995; Halle 1995; Halle, Vaux & Wolfe 2000)¹¹. Class nodes are non-terminal in the original proposal (i.e. required to dominate features, Morén 2003), but the version of PSM adopted here also allows bare class nodes (see Krämer 2006; 2009; Blaho 2008; Iosad 2012). Class nodes in PSM may be recursive. Those class nodes that are not dominated by any other class nodes are labeled C-class nodes (C-place, C-manner, etc.), while class nodes that are dominated by one class node of the same type are labeled V-class nodes. The number of levels of recursion is not formally restricted, but only one is typically used (Iosad 2012).

In PSM, the set of phonological operations is restricted to autosegmental spreading and delinking (although some analyses appeal to tier promotion as well, see Iosad 2012; Youssef 2013), such that all and only the constituents in the hierarchical structure may spread and delink. This entails that several features or class nodes may spread or delink together only if they are exhaustively dominated by some superordinate node (although

¹¹ The place within the root node was reserved for major class features such as [sonorant] and [consonantal], and the main motivation for such configuration was the fact that the major class features do not assimilate or delete unless in a process that affects the whole segment, as in total assimilation and deletion (McCarthy 1988). In PSM, there are no features that encode major classes. Where there is evidence for it, class-like behavior of e.g. obstruents may be captured by any shared feature or node.

cf. Youssef 2013 on partial spreading in PSM). In spreading, crossing of association lines and skipping anchors is forbidden. As in other autosegmental models, locality is defined on each tier. This predicts that the processes involving V-class features are more likely to operate long-distance than those involving C-class features – because segments specified for V-class nodes are a subset of segments specified for C-class nodes (first proposed by Clements 1991b to account for the asymmetries in spreading between consonantal and vocalic features).

Another important restriction of the theory is that any given feature can only associate to a class node of one type. Re-associating from, say, Place node to Manner node is prohibited (Iosad 2012). However, re-association from V-class to C-class within the same type of the node is possible (Iosad 2012; cf. *tier promotion mechanism* in Clements & Hume 1995). Some analyses couched within PSM also allow cross-planar spreading, i.e. direct spreading of features from the V-class node of one segment to the C-class node of another (Youssef 2013; cf. the original proposal in Hume 1992). While tier-promotion and cross-planar spreading are often invoked to account for the fact that vowels may trigger full palatalization of consonants (which is seen as re-association of V-place features under a C-place node), I show below that no such mechanisms are necessary to account for the Latvian data.

Unlike in classic geometric models, in PSM class nodes and features are assumed to be abstract entities that lack phonetic substance, which means that there is no universally fixed correspondence between phonological constituents and their phonetic correlates. Instead, the mapping between a phonological representation and its phonetic realization is language-specific. This entails both that identical configurations can have different phonetic interpretations in different languages, and that the same phonetic symbol can stand for different phonological representations. In practice, however, the labels used for the nodes often refer to phonetic categories such as Place or Manner (Iosad 2012; Youssef 2013). The same applies to terminal feature labels, which in practice are often formulated in articulatory terms, e.g. [labial], [coronal], [open]. The existence of some phonological feature in a given language is only motivated if at least one of the following conditions is met: a) the feature is necessary to designate contrast, or b) the feature functions in some phonological process¹²

Building on the insights of UFT (Clements 1991; Clements & Hume 1995), PSM assumes that the underlying structures of vowels and consonants are completely parallel, and identical sets of privative features are available for both. Class-node affiliation of a specific phonological feature is determined solely on the basis of the phonological behavior of that feature in a specific language. Unlike UFT, where C-class node, for instance, was reserved for consonantal features, PSM places no such restrictions on feature affiliation. Rather, C- and V- are used as mere labels to refer to the position of the feature in the hierarchical structure. The model, therefore, predicts that consonants and vowels should be able to interact directly, and allows capturing such interaction as feature spreading.

3.2 Palatalization in Latvian: features and representations

In this Section I develop the representational analysis of Latvian palatalization couched within the Parallel Structures Model. It is important to keep in mind that while geometric representations clearly define the set of possible alternations within a given language, they are not sufficient to discriminate between the theoretically possible and the actually

¹² Feature specifications may also be motivated by static phonotactic patterns (e.g. the reference to the class of sonorants might be necessary to state syllable wellformedness conditions, but not otherwise).

attested patterns. The output that derives from the given input is not uniquely determined by the input itself, but rather by the language-specific constraint ranking that selects the optimal output candidate from the list of available options. The goal of this section, therefore, is to demonstrate that all palatalization processes of Latvian may be captured by a non-contradictory representational analysis that does not make use of the primitives or operations other than those introduced in Section 3.1. The phonological motivation for each of the patterns will be discussed in Section 4, where I will demonstrate that the output representations provided here are indeed selected as optimal by the constraint ranking of Latvian. I will also consider some of the representationally possible but unattested patterns, and discuss the reasons for their non-application.

3.2.1 Features

In what follows I argue for the featural and structural composition of Latvian segments. I take the point of departure in palatalization patterns introduced in Section 2, and extend the analysis to all consonantal and vocoid phonemes of Latvian. In the spirit of modularity, in doing so I only consider phonological patterns of Latvian as evidence for the language-specific underlying representations.

3.2.1.1 Place Features

Let us start by considering the yod-palatalization process, since it affects the largest set of segments. Yod-palatalization targets the set of dental/alveolar consonants /t, d, s, z, \widehat{ts} , \widehat{dz} , n, l, r/ as well as velar plosives /k, g/, and outputs the set of postalveolar/palatal consonants [ʃ, ʒ, $\widehat{tʃ}$, $\widehat{dʒ}$, ɲ, λ , r^l]. Recall that all outputs of yod-palatalization trigger front vowel raising from /æ/ to [e], while dental/alveolar targets of yod-palatalization don't. This suggests that the feature discriminating between targets and outputs of yod-palatalization is the same feature that discriminates between /æ/ and [e]. The fact that vowel raising may apply across intervening consonants indicates that the feature in question attaches under a V-class node. Let us designate this feature as V-place-[coronal] (note that PSM features lack phonetic substance, and are intended as labels reflecting phonological patterning).

Further triggers of vowel raising include palatal stops /c, ɟ/ and front non-low vocoids /j, i, e/. I, therefore, propose that these segments, too, are specified for V-place-[coronal]. This gives us a phonological class of segments characterized by the presence of V-place-[coronal] comprising /ʃ, ʒ, $\widehat{tʃ}$, $\widehat{dʒ}$, ɲ, λ , r^l, c, ɟ, j, i, e/, which is a class of triggers of vowel raising¹³.

Yod-palatalization, just like vowel raising, is a process by which some segment comes to share the V-place-[coronal] specification of the preceding trigger. There are, however, two important differences. First, yod-palatalization applies only where the target is immediately adjacent to the trigger, and fails to skip over the intervening consonants or vowels. Second, yod-palatalization sometimes involves the change of manner as well – plosive stops surface as postalveolar fricatives or affricates as a result of the process. Let us discuss this second property in some detail.

The propensity of palatalization processes to output sibilants is a well-known cross-linguistic tendency (Bhat 1978; Bateman 2007; Kochetov 2011). It is, therefore, very tempting to analyze assibilation as an assimilatory process as well. In fact, the attempt to this end was made in Clements (1985), who treated manner-changing palatalization as involving two steps, the first of them being spreading of [+continuant, +strident] from the triggering vocoid to the consonant. Further work within UFT gave up this solution quoting its

¹³For reasons of space, I omit the discussion of diphthongs here.

phonetic implausibility, and instead assumed that assibilation frequently accompanying place-changing palatalization is non-assimilatory and is achieved through the application of redundancy rules (Lahiri & Evers 1991; Hume 1992). This is also the solution advocated in Sagey (1984), and subsequent work within (R)AT (Halle 1995; Halle, Vaux & Wolfe 2000; cf. also Chomsky & Halle 1968: 422 on the role of ‘marking conventions’ in manner-changing palatalization). In contrast, the theoretical stance of PSM, where features are substance-free, and their phonetic correlates are determined on a language-specific basis, makes the analysis of assibilation as an assimilatory process perfectly feasible.

The fact that in Latvian the assibilation of alveolar and velar plosives is triggered by front vocoids is evidence to postulate some feature [X] as a shared phonological property of sibilant consonants and front vocoids¹⁴. Note that in yod-palatalization, the change of manner is always accompanied by the shift to postalveolar articulation, which suggests that feature [X] forms a constituent with V-place-[coronal]. Note also that [X] never skips over intervening segments – assibilation in Latvian only applies when the trigger is string-adjacent to the target. This indicates that [X] is affiliated under C-class node. Velar affrication, where the change of manner is accompanied by coronalization, is a reason to assume that [X] is in fact C-place-[coronal].

At this point, Latvian coronals are classified into three partially overlapping sets: (i) segments specified for V-place-[coronal], i.e. /ʃ, ʒ, tʃ, dʒ, ɲ, ʎ, rʲ, c, ʧ, j, i, e/; (ii) segments specified for C-place-[coronal], i.e. /s, z, ts, dz, ʃ, ʒ, tʃ, dʒ, j, i, e, æ/, and (iii) segments that are specified for both, i.e. /ʃ, ʒ, tʃ, dʒ, j, i, e/. Notice that plosives /t, d/, as well as sonorants /n, l, r/ figure in none of these sets, because they pattern with neither C-place-[cor] nor V-place-[cor] segments. Therefore, /t, d, n, l, r/ are treated here as phonologically placeless.

To recapitulate, so far we have established the following about the palatalization triggers: (i) the triggers of vowel raising are characterized by V-place-[coronal]; (ii) the triggers of velar affrication are characterized by C-place-[coronal]; and (iii) the triggers of yod-palatalization are characterized by the presence of both C-place-[cor] and V-place-[cor]. Some of the segments in question are illustrated below in Figure 3 (manner and laryngeal specifications omitted):

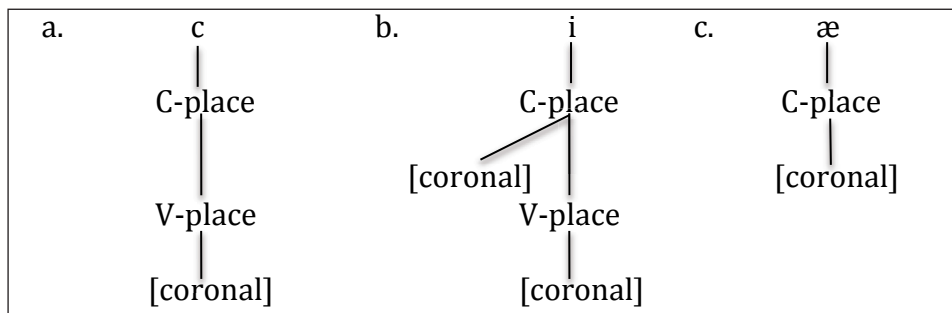


Figure 3: Palatalization triggers.

Here it is important to note that while all respective triggers of palatalization processes are specified for the features indicated above, it is not necessarily true that all segments specified for these features act as triggers. That is, while vowel raising is triggered by **all** segments that are specified for V-place-[coronal], the same does not hold for the triggers of velar affrication and yod-palatalization. For instance, of all the segments specified for

¹⁴Note that even though anterior sibilants /s, z/ are never the output of assibilation, they pattern with sibilant affricates /ts, dz/ with respect to the sibilant place assimilation process not discussed here (see Steinbergs 1977: 11).

C-place-[cor], only a subset in fact triggers velar affrication: /j, i, e, æ/. While at the first glance this might seem like an unwelcome result, it in fact highlights the importance of the principled division of labour between representation and computation, and the need to carefully consider the motivation for phonological processes in substance-free computation. We will return to this question in Section 3.3.

Let us now turn to place specifications of labials and velars. Recall that labial consonants fail to participate in yod-palatalization. I propose that this is due to the incompatibility between [coronal] and [labial] features. This, in turn, necessitates that all labial consonants are specified for C-place-[labial]. Recall further that vowels /u, o, a/ block vowel raising, which suggests that these are specified for V-place features. I suggest that /u, o/ are V-place-[labial], while /a/ is V-place-[dorsal], as shown in Figure 4 below.

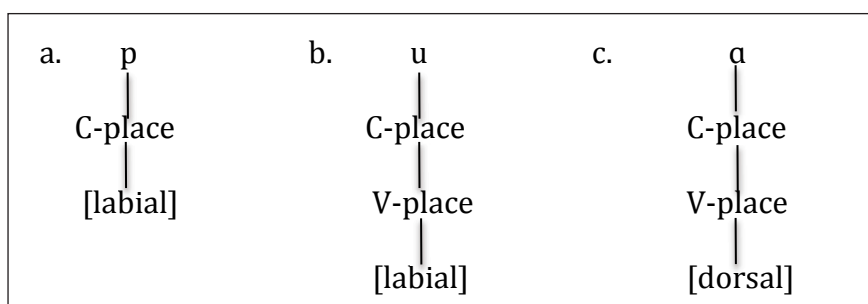


Figure 4: Labial and dorsal segments.

The evidence for place specification of velar plosives /k, g/ comes from the fact that they trigger nasal place assimilation process, by which alveolar nasal /n/ surfaces as [ŋ] when followed by a velar consonant, e.g. [baŋk-a] ~ [bants-ɪŋ-a] ‘bank’ ~ ‘bank, dim.’ (Laua 1997; Steinbergs 1977). Since the process is sensitive to morpheme boundaries (Steinbergs 1977: 18), it can not be plausibly construed as purely phonetic. Therefore, I take it as evidence for the existence of the feature [dorsal] that resides under the C-place node. Consider now the place specifications of the target (a) and outputs of velar coronalization (b), velar palatalization (c) and yod-palatalization of a velar target (d) in Figure 5 below. Note that the presence of C-place-[cor] correlates with sibilancy, while V-place-[cor] indicates the posterior place of articulation.

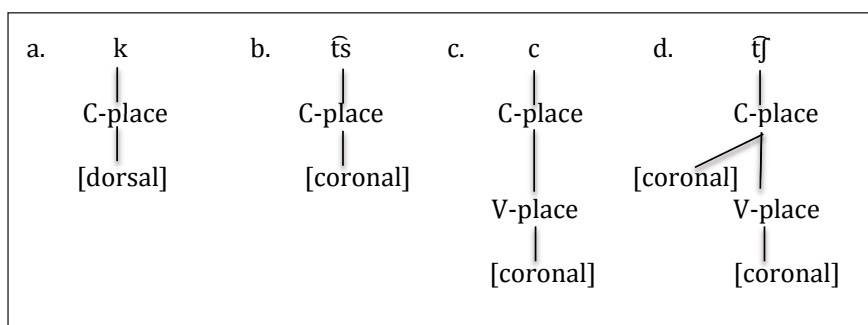


Figure 5: Targets and outputs of palatalization.

3.2.1.2 Laryngeal and manner features

Let us now turn to laryngeal specifications. I propose that in Latvian, the presence of the laryngeal node characterizes the class of obstruents (following Blaho 2008; Iosad 2012). In voiced obstruents, the C-laryngeal node dominates the feature [voice], while in voiceless obstruents it is bare, as illustrated in Figure 6 (see Iosad 2012: 37) on bare nodes as contrastive

non-specification). This is necessary for two reasons. First, because in Latvian only obstruents can participate in voicing assimilation (Laua 1997; Steinbergs 1977), while sonorants – although phonetically voiced – neither trigger nor undergo the process. Second, because Latvian obstruents as a class are excluded from the nucleus position (unlike sonorants and vowels, see below).

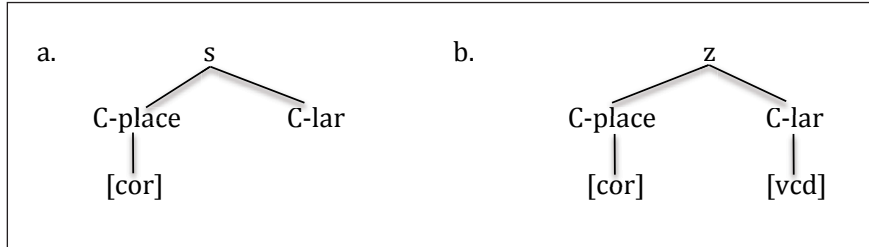


Figure 6: Voiceless and voiced obstruents.

Let us now discuss the manner distinctions among the Latvian segments. The manner distinctions in obstruents are of the most relevance for us here, because they are crucially implicated in palatalization. Recall that in yod-palatalization, alveolar plosives /t, d/ alternate with postalveolar fricatives [ʃ, ʒ], while velar plosives /k, g/ alternate with postalveolar affricates [tʃ, dʒ]. This is consistent with velar plosives and affricates being phonological stops, and alveolar plosives and fricatives being phonologically mannerless. This would also explain the fact that only velar plosives, but not alveolar plosives, may alternate with palatal stops [c, j]. The relevant representations are introduced in Figure 7.

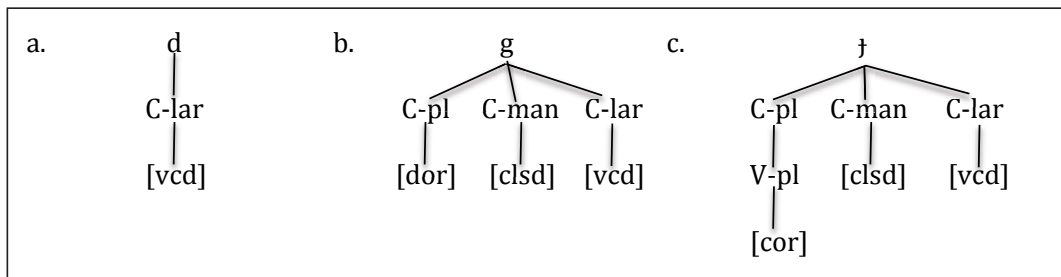


Figure 7: Obstruent stops.

Talking about manner specifications, it is necessary to address the issue of how major class distinctions may be captured (which was the matter of some debate in the early days of feature geometry – see McCarthy 1988). Since PSM maintains the autonomy of phonology, the traditional major-class distinctions grounded in phonetics are of no relevance here. What matters is whether the phonological patterns of Latvian in fact give the evidence for the traditional dichotomies like sonorants vs. obstruents, consonants vs. vocoids, etc.

The need for the former seems to be motivated by palatalization patterns. Recall that sonorants never assibilate as a result of yod-palatalization. Here I propose that this is due to the feature co-occurrence restrictions, i.e. some feature associated with sonorants being incompatible with C-place-[cor]. Here I designate the feature as C-manner-[open]. Note that the reference to the class of sonorants might be independently required by the syllable wellformedness constraints (e.g. to capture the fact that in Latvian sonorants never occur as a first element of a complex onset – see Auziņa 2005 on syllable phonotactics in Latvian).

The evidence for the irrelevance of consonants vs. vowels dichotomy for Latvian comes from syllable phonotactics, which indicates that the language actually cuts across this

traditional distinction. As we have already seen, a subset of Latvian vocoids /j, i, e/ may be parsed into onsets and codas (the situation with /æ/ is not quite clear because I know of no cases where it would appear in hiatus). Likewise, the position in the syllable nuclei is not exclusively reserved for vowels. In Latvian, sonorant consonants /m, n, ņ, l, r/ may occupy the nuclear position if preceded and followed by the tautosyllabic obstruent (the absence of /ʌ/ in this set is likely just the accidental gap). The view that a sonorant consonant forms a true nucleus in these cases is shared in most of the literature on the topic (Bond 1994; Kariņš 1996; Laua 1997; Muižniece 2002; Auziņa 2005; among others, but see Matthews 1959 for the alternative view). The relevant data is provided below:

(17) Consonantal nuclei in Modern Standard Latvian

- [pu.tŋ-s] ‘bird’
- [ni.kŋ-s] ‘angry’
- [mi.tʀ-s] ‘moist’
- [ri.tŋ-s] ‘rythm’
- [ka.kʌ-s] ‘neck’
- [kra:.[ŋ-s] ‘splendid’
- [kra.sŋ-s] ‘oven’
- [stin.gʀ-s] ‘strong’

	C-place			C-manner		C-lar	V-place			V-manner		
	[lab]	[cor]	[dor]	[clsd]	[open]	[vcd]	[cor]	[dor]	[lab]	[open]	[clsd]	[nas]
p	✓					∅						
b	✓					✓						
t						∅						
d						✓						
s		✓				∅						
z		✓				✓						
t͡s		✓		✓		∅						
d͡z		✓		✓		✓						
c				✓		∅	✓					
č				✓		✓	✓					
š		✓				∅	✓					
ž		✓				✓	✓					
t͡ʃ		✓		✓		∅	✓					
d͡ʒ		✓		✓		✓	✓					
m	✓				✓							✓
n					✓							✓
l					✓						✓	
r					✓							
ņ					✓		✓					✓
ʌ					✓		✓				✓	
rʲ					✓		✓					
k			✓	✓		∅						
g			✓	✓		✓						
x			✓			∅						
j		✓			✓		✓					
i		✓					✓				✓	
e		✓					✓					
æ		✓						∅				
a								✓			✓	
o									✓		✓	
u									✓		✓	

Table 3: Feature specification of Latvian inventory.

Note now that vowels /a, o/ are still banned from syllable margins. I propose to capture this fact by assigning them the V-manner-[open] specification. Now we are in the position to formulate some general syllable well-formedness restrictions. Namely, “segments specified for C-lar may not occupy syllable nuclei” and “segments specified as V-manner-[open] may not occupy syllable margins”.

The obvious question that arises is how or whether at all the restrictions on the sequence of elements within the syllable constituents can be captured in this way. While the implementation of the Sonority Sequencing Principle in a substance-free model that allows for radical underspecification is an exciting and largely overlooked issue, here I will not pursue this discussion any further because it will lead us too far astray from the principal concerns of this paper.

Table 3 summarizes the feature specifications of the Latvian inventory (where Ø indicates the presence of a bare node); note again that “C” and “V” in node labels are intended solely to indicate the level of recursion, and do not imply that only “consonantal” or “vocalic” features may be associated to the given node:

3.2.2 Representations

3.2.2.1 Yod-palatalization

As we have seen above, yod-palatalization may target phonologically placeless segments /t, d, n, l, r/, which as a result come to possess both C-place and V-place features. This indicates that yod-palatalization involves the spreading of the constituent that may link directly under the root node, i.e. C-place-[cor]-V-place-[cor] as shown in Figure 8. Note that the deletion of the yod-palatalization trigger is motivated by the syllable-wellformedness considerations that are enforced in computation – these will be discussed in Section 4.

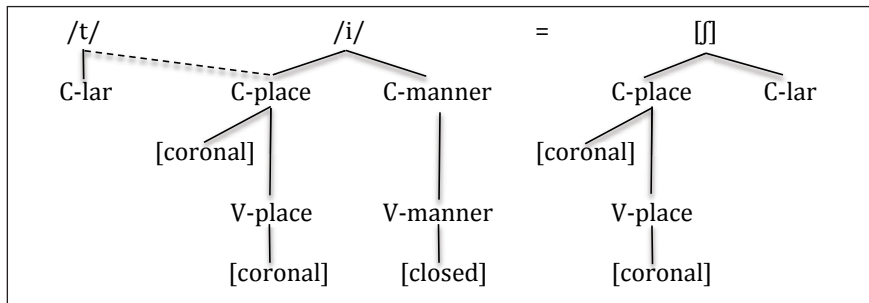


Figure 8: Yod-palatalization of alveolar plosives.

In velar targets, yod-palatalization causes the delinking of the original [dorsal] feature, which reflects feature-cooccurrence restrictions. Note also that the spreading of C-pl[cor]-V-pl[cor] to the segment that is already specified for a C-place node results in the configuration where a single root node dominates two instances of C-place as in Figure 9. I assume here that configurations where the identical portions of structure are dominated by the same node are automatically repaired through fusion (this solution is also adopted in Wolf 2007: 10).

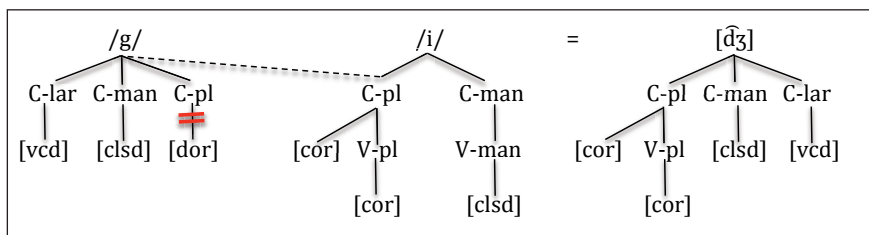


Figure 9: Yod-palatalization of velar plosives.

In yod-palatalization of sibilant targets illustrated in Figure 10, assibilation applies vacuously (here again, the identical structures dominated by the same node are repaired through fusion):

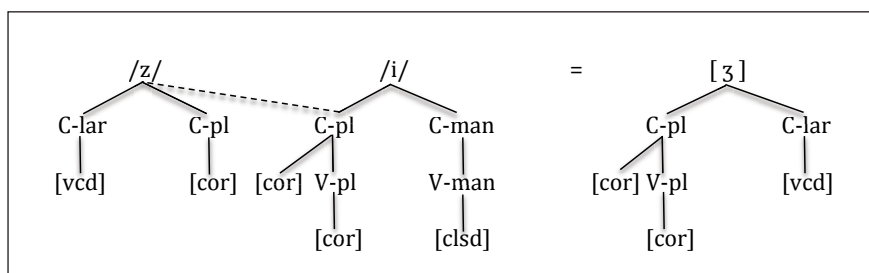


Figure 10: Yod-palatalization of sibilants.

Recall that yod-palatalization of sonorants never results in assibilation. I suggest that this is due to the feature co-occurrence restrictions against segments that are simultaneously specified for C-manner[open] and C-place[coronal]. The output candidates containing such structures are optimally repaired by delinking [coronal] from C-place node as shown in Figure 11.

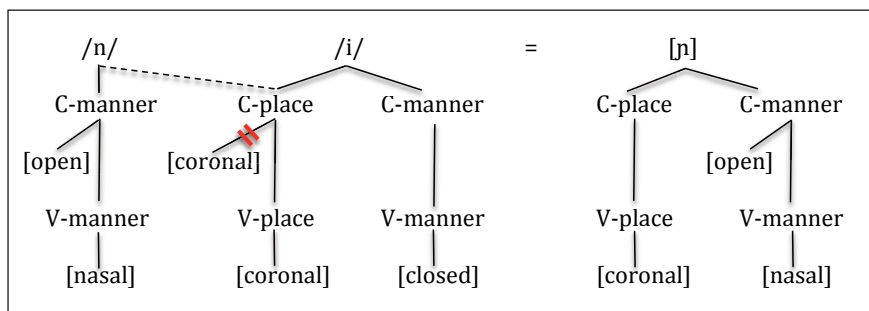


Figure 11: Yod-palatalization of sonorants.

Recall that labial consonants block yod-palatalization. In the configuration shown in Figure 12, C-place of the vocoid cannot spread across the C-place of the labial – this would mean that a valid target (root node of the labial) is skipped (see Kiparsky 1981; Archangeli & Pulleyblank 1994; Padgett 1995, among many others on skipping valid anchors). Spreading to the root-node of the labial, in turn, is forbidden due to the incompatibility between [labial] and [coronal] features. The spreading of the V-place node is blocked by the same considerations.

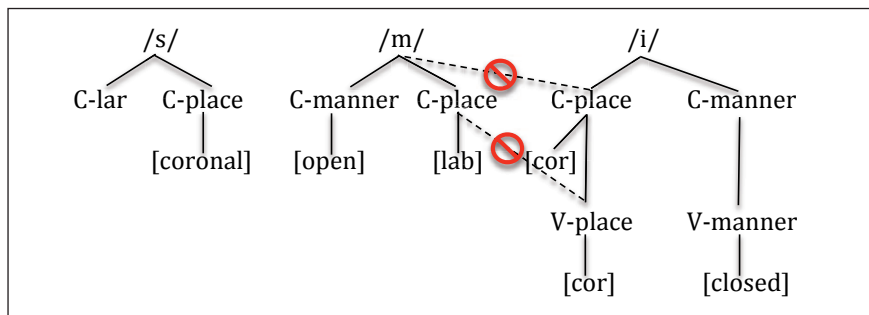


Figure 12: Yod-palatalization blocked by intervening labials.

3.2.2.2 Velar coronalization

Recall that, unlike yod-palatalization, velar affrication never outputs postalveolar segments. This indicates that the structure that spreads under velar affrication is not the

constituent dominated by the C-place node, but rather the individual feature [coronal] from under the C-place node as illustrated in Figure 13. This accounts for the fact that the output of velar affrication does not trigger vowel raising, which involves the spreading of features dominated by V-place.

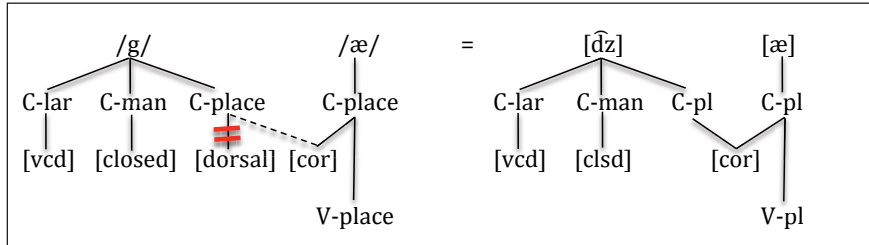


Figure 13: Velar affrication.

Velar palatalization, on the other hand, involves the spreading of the V-place node dominating [coronal], as shown in Figure 14. The result is a non-sibilant palatal segment, which may trigger vowel raising.

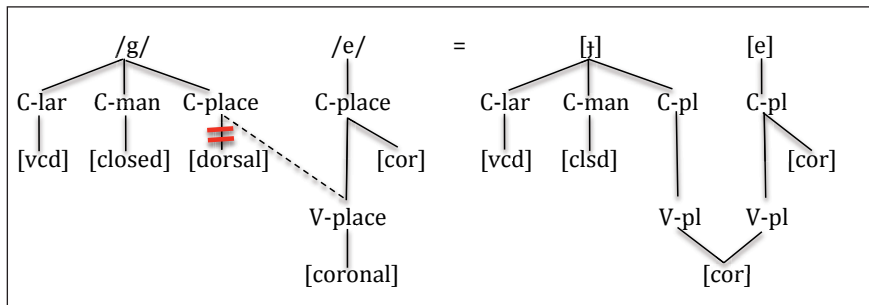


Figure 14: Velar palatalization.

3.2.2.3 Vowel raising

Vowel raising is triggered by all segments specified for V-place-[coronal]. This fact alone is consistent with both the spreading of the V-place-[coronal] constituent, and the spreading of the individual feature [coronal] that links under the V-place node. Recall, however, that vowel raising may apply across the intervening consonants, including those that are specified for a C-place node. If vowel raising were due to the spreading of the V-place-[cor] constituent, we would expect it to interact with all consonants specified for a C-place node, as shown in Figure 15:

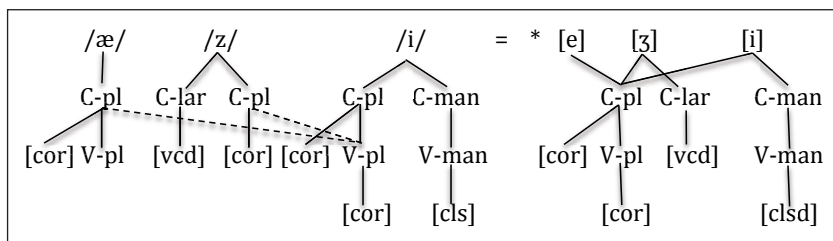


Figure 15: Vowel raising as spreading V-place-[coronal].

The scenario illustrated in Figure 15, however, is not what happens in Latvian, where consonants that lack V-place specifications are transparent to vowel raising. This indicates

that vowel raising involves the spreading of the individual feature [coronal] that links under the the V-place node as shown in Figure 16 below:

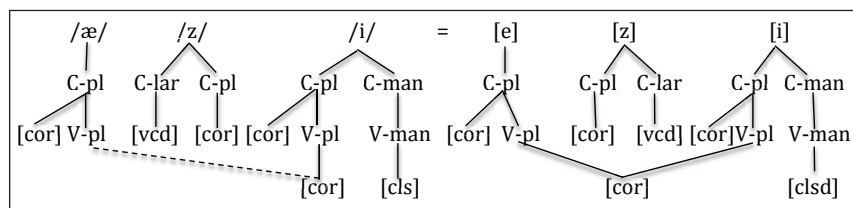


Figure 16: Vowel raising across intervening consonants.

Predictably, vowel raising across the intervening non-front vowels is blocked by feature co-occurrence constraint that prohibits a segment from being simultaneously associated with V-place-[coronal] and V-place-labial (or V-place-[dorsal]). This is illustrated in Figure 17 below:

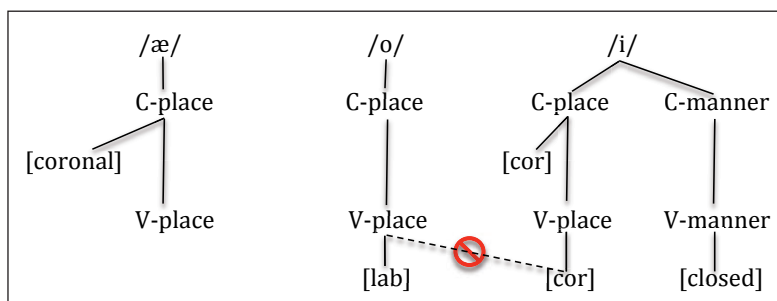


Figure 17: Vowel raising blocked by intervening vowels.

4 Constraint-based analysis

In this Section, I develop a constraint-based analysis of palatalization processes of Modern Standard Latvian. The analysis is couched within the Parallel Optimality Theory framework (Prince & Smolensky 1993/2004). I also assume that the phonological grammar is organized in three strata – stem level, word level and phrase level – each associated with its own ranking of constraints (Stratal OT, see Bermúdez-Otero 2011; 2012). Under this view, morphosyntactic constituents created by root-to-stem and stem-to-stem derivation are subject to the stem-level phonology, while fully inflected words are subject to the word-level phonology. As we will see, the stratal approach makes it possible to account for the asymmetrical behavior of the derivational and inflectional suffixes with respect to palatalization patterns that they may trigger.

Unlike many previous OT-based approaches to palatalization (e.g. Rubach 2003; Bateman 2007; Krämer 2009), I assume no constraints that explicitly ban surface strings where a non-palatal consonant is followed by a front vowel. Instead, I show that palatalization applies to satisfy high-ranking constraints penalizing certain marked structures and geometric configurations (cf. Uffmann 2005 on structural constraints; Iosad 2012 on constraint schemata in substance-free computation). Likewise, I use no constraints that explicitly enforce feature spreading (e.g. AGREE, ALIGN or SPREAD). Rather, I argue that feature spreading is selected as an optimal way of satisfying structural markedness by the interaction of well-established markedness and faithfulness constraints. As I will show in the following pages, the analysis developed here not only is descriptively adequate in that it captures the palatalization processes in Latvian, but also has an explanatory value because it makes the motivation for such processes explicit.

4.1 Yod-palatalization

There are two crucial properties of yod-palatalization that have to be noted: first, it is triggered by high front vocoids only where they would be syllabified in the onset position (i.e. prevocally); second, the trigger of yod-palatalization never surfaces following the palatalized segment. The relevant data are repeated below:

(18) Yod-palatalization

	GEN. SG.		NOM. SG.	
/buom-i-a/	→ [buo.m- <u>ɨ</u> -a]	cf.	[buo.m-i-s]	'pole'
/zut-i-a/	→ [zu. <u>ʃ</u> -a]	cf.	[zu.t-i-s]	'eel'
/ruon-i-a/	→ [ruo. <u>ɲ</u> -a]	cf.	[ruo.n-i-s]	'seal'
/slæ:g-i-a/	→ [sle:. <u>ɖʒ</u> -a]	cf.	[sle:. <u>ɖz</u> -i-s]	'switch'

Onset syllabification of the prevocalic front vocoids is due to the high-ranking ONSET constraint that prohibits hiatus (for reasons of space, full discussion of Latvian syllabification is not provided here), while yod-deletion is motivated by the markedness constraint that penalizes complex onsets, *ComplexOnset¹⁵. To account for the fact that the offending onset cluster is not resolved by the deletion of its leftmost element – i.e. the segment affiliated with the root – *ComplexOnset is dominated by the positional faithfulness constraint MaxRoot.

- (19) ***COMPLEXONSET** – assign one violation mark for every instance where more than one segment is associated with an onset position.

MAXROOT– assign one violation mark for every root segment in the input that does not have a correspondent in the output (McCarthy & Prince 1995; Casali 1997).

Here it has to be noted that complex onsets created by affixation are very rare. Prefixation never triggers re-syllabification, so the consonants that came to be adjacent as a result of prefixation remain heterosyllabic, while complex onsets created by suffixation will be protected by MaxAffix. Note that this presupposes that theme vowels are not protected by MaxAffix. Under the assumption that positional faithfulness constraints protect segments associated with positions of certain salience – grammatical, psychological and/or perceptual (Beckman 1998) – it makes sense that a theme vowel is not protected by these constraints. In inflected forms, the information conveyed by a theme vowel – i.e. the syntactic category of the form – is completely superfluous. For this reason, the theme vowel deletes if its presence creates a phonologically sub-optimal string regardless of whether it occurs on the right (as in case of complex onset) or a left edge of the offending sequence. To give the example of the latter, the theme vowel elides to resolve hiatus created by vocalic inflection and thematized stem: /mas-a-u/ → [mas-u] 'sister, ACC. SG.' cf. /mas-a-j/ → [mas-a-j] 'sister, DAT. SG.'

The fact that the coronal features of the underlying front theme vowel are preserved in the output is attributed to the high-ranking MaxLink constraints.

- (20) **MAXLINK-C-PLACE [coronal]** – assign one violation mark for every feature C-place-[coronal] in the input that does not have a correspondent in the output (Morén 1999; 2006; Blaho 2004).

MAXLINK-V-PLACE [coronal] – assign one violation mark for every feature V-place-[coronal] in the input that does not have a correspondent in the output (Morén 1999; 2006; Blaho 2004).

¹⁵This analysis is analogous to what Iosad (2012: 273–276) proposes for Bothoa Breton, where prevocalic [i] triggers palatalization of the preceding coronal. Iosad (ibid) analyzes the process as coalescence triggered by *ComplexOnset, and also attributes the failure of certain segments to undergo it to feature co-occurrence constraints.

Candidates with palatalization (i.e. those that satisfy MaxLink and *ComplexOnset constraints) incur violations on the faithfulness constraints requiring the identity between the place specifications of the input segments and those of their output correspondents. Candidates with segmental deletion violate low-ranking MAX.

(21) **IDENT(C-place)** – assign one violation mark for every instance where some root node x_i in the input differs from its correspondent x_o in the output with respect to the C-place specification.

IDENT(V-place) – assign one violation mark for every instance where some root node x_i in the input differs from its correspondent x_o in the output with respect to the V-place specification.

MAX – assign one violation mark for every segment in the input that does not have a correspondent in the output (McCarthy & Prince 1995).

The relevant ranking is illustrated in the tableau below – note that /i/ is syllabified in the onset in all cases (irrelevant nodes are omitted):

(22) Yod-palatalization: /zut-i-u/ → [zuʃ-u] ‘eel, GEN. PL.’

zu t - i -u							
	MaxRoot	MaxLink V-pl[cor]	*CmplxOns	ID(C-place)	MaxLink C-pl[cor]	ID(V-place)	MAX
a. zu . t - i -u			*!				
b. zu . - i -u	*!						*
c. zu . ʃ -u				*		*	*
d. zu . t -u		*!			*		

In the tableau in (22), the faithful candidate (a) violates the markedness constraint penalizing complex onsets. Candidate (b) is eliminated because the onset cluster is repaired by deleting the root segment. Candidate (d), where the underlying vocoid is deleted, violates

the constraints demanding faithfulness to the underlying [coronal] feature. Thus, the candidate with palatalization is correctly selected as optimal despite the violations incurred on the ID constraints.

Let us now consider the yod-palatalization of velars¹⁶. Recall that the original [dorsal] specification of the target segment delinks due to the feature co-occurrence constraint defined below:

- (23) * [dorsal] [coronal] – assign one violation mark for every configuration where a root node is simultaneously associated with a [coronal] and a [dorsal] feature.

In (24), the faithful candidate crucially violates the *ComplexOnset constraint. Candidate (b), where the onset cluster is resolved by deleting the root segment, is ruled out by the positional faithfulness constraint. Candidate (c) contains a root node dominating both [coronal] and [dorsal]. As a result, the spreading candidate with [dor] delinking is correctly predicted to surface.

- (24) Yod-palatalization: /sl æ:g-i-u/ → [sle:ḁʒ-u] ‘switch, GEN. PL.’

	slæ:g -i -u								
a.						*!			
b.			*!						*
c.		*!				*		*	*
d.							*	*	*

¹⁶In fact, at the word level, where yod-palatalization applies, there are no root-final velars followed by front theme vowels anymore – this is because those underwent the stem-level process of velar coronalization. However, as yod-palatalization is surface-true, it would not affect the result of the computation.

Recall that where the target of yod-palatalization is a sonorant, assibilation fails to apply. This is due to the feature co-occurrence constraint that bans structures where a root node is simultaneously associated with C-place-[coronal] and C-manner-[open]. The fact that the constraint is never violated in Latvian indicates that it occupies the topmost stratum in the hierarchy. The relevant evaluation is illustrated in (26).

(25) ***C-manner- [open] &C-place- [coronal]** – assign one violation mark for every configuration where a root node is simultaneously associated with C-place-[coronal] and C-manner-[open] (Morén 2006).

(26) Yod-palatalization: /ruon-i-u/ → [ruoj̥-u] ‘seal, GEN. PL.’

<pre> r uo n - i -u C-man C-pl [opn] V-pl [cor] </pre>	*C-man-[opn] &C-pl[cor]	MaxRoot	MaxLink V-pl[cor]	*CmplxOns	ID(C-place)	MaxLink C-pl[cor]	ID(V-place)	MAX
a. <pre> r uo. n - j -u C-man C-pl [opn] V-pl [cor] </pre>				*!				
b. <pre> r uo. - j -u C-pl [cor] V-pl [cor] </pre>		*!						*
c. <pre> r uo . N -u C-man C-pl [opn] V-pl [cor] </pre>	*!							*
d. <pre> r uo . n -u C-pl [cor] V-pl [cor] </pre>					*	*	*	*

Recall that where the prevocalic high front vowel is preceded by a labial segment, yod-palatalization and yod-deletion do not apply. I suggest here that this is due to the high-ranking markedness constraint that bans structures in which a root node simultaneously dominates [coronal] and [labial]. Note that this constraint is not sensitive to the class node affiliation of the offending features. The constraint MaxLink[labial], in turn, ensures that the constraint on feature co-occurrence is not satisfied through the delinking of [labial]

(cf. the analysis developed in Iosad 2012: 276 for Bothoa Breton, where labials escape coalescence with prevocalic [i] due to feature co-occurrence constraint and faithfulness to the original place specification).

(27) ***[labial] [coronal]** – assign one violation mark for every configuration where a root node is simultaneously associated with [labial] and [coronal] (Morén 2006).

MAXLINK [labial] – assign one violation mark for every feature [labial] in the input that does not have a correspondent in the output (Morén 2006; 1999; Blaho 2004).

In (28), candidate (b) crucially violates MaxLink-V-pl[cor] constraint. Candidate (c) contains a root node that dominates both [labial] and [coronal] and is penalized by the high-ranking constraint on feature co-occurrence. Candidate (d), where the [labial] feature delinked to satisfy the feature co-occurrence constraint is banned by MaxLink[lab]. As a result, the faithful candidate (a) is predicted to surface regardless the violation incurred on *ComplexOnset.

(28) Iotization: /buom-i-u/ → [buom-j-u] ‘pole, GEN. PL.’

	*[lab][cor]	MaxLink[lab]	MaxRoot	MaxLink V-pl[cor]	*CmplxOns	ID(C-place)	MaxLink C-pl[cor]	ID(V-place)	MAX	
a.					*					
b.				*!			*		*	
c.		*!				*		*	*	
d.			*!			*		*	*	

To recapitulate, in this section we have seen that yod-palatalization is crucially motivated by complex onset avoidance, embodied in the highly-ranked *ComplexOnset constraint.

While the prevocalic front vocoid deletes, the coronal features associated with it are preserved on the adjacent segment, causing it to palatalize. When the adjacent segment is incompatible with palatalization, MaxLink constraints prefer the candidate where the prevocalic front vocoid surfaces faithfully.

4.2 Velar coronalization

Let us now consider the two velar coronalization processes, velar affrication and velar palatalization. The relevant data are repeated below:

- (29) Velar coronalization
- a. Velar affrication
- | | | | |
|-----------------|---|-------------------------------|------------|
| /draug-a-i:g-s/ | → | [draud̥z-i:k-s] ¹⁷ | 'friendly' |
| /iuok-a-i:g-s/ | → | [juots-i:k-s] | 'jocular' |
- b. Velar palatalization
- | | | | |
|-----------------|---|-----------------|---------------|
| /ideolog-isk-s/ | → | [ideoloʝ-isk-s] | 'ideological' |
| /demiurg-isk-s/ | → | [demiurʝ-isk-s] | 'demiurgic' |

Velar coronalization differs from yod-palatalization in two important respects: (i) yod-palatalization applies in all cases where the consonant comes to be followed by the prevocalic front vocoid, while velar coronalization is a morphologized process that is only triggered by derivational suffixes and theme vocoids; (ii) outputs and targets of velar coronalization are equally well-formed from the point of view of syllable structure. The former observation leads me to conclude that velar coronalization is a stem-level phenomenon.

The observation in (ii) indicates that velar coronalization is not motivated by syllable wellformedness considerations. Rather, I propose that velar coronalization is driven by the markedness constraint against the C-place-[dorsal] configuration:

- (30) ***C-place-[dorsal]** – assign one violation mark for every root node that dominates C-place-[dorsal].

*C-place-[dorsal] can be satisfied in two ways: by delinking the [dorsal] feature itself, or by delinking *C-place-[dorsal] constituent. The latter option is prohibited MaxLink-Place constraint, which militates against the deletion of the underlying place nodes. Simple delinking of the [dorsal] feature is dispreferred by *Bare-Place constraint that militates against empty place nodes (which is similar in spirit to the Have-Place constraint, see Lombardi 2001) – as we will see below, this constraint also plays a crucial role in vowel raising.

- (31) ***BARE-PLACE** – assign one violation mark to every instance of a bare place node.

MaxLink-Place – assign one violation mark for every place node in the input that does not have a correspondent in the output.

Jointly, these constraints ensure that the optimal candidate is the one where the original [dorsal] feature is replaced by another place feature via spreading. Note that the violation of *C-place-[dor] is never repaired by spreading C-place specifications from consonants, or V-place specifications of non-coronal vowels. Although not shown in the tableau, the latter is attributed to the fact that only V-place-[cor] is compatible with the C-manner-[clsd] of the underlying velar. In turn, spreading C-place specifications of the following consonants is blocked because it would produce a phonotactically illicit string – in Latvian, neither [c, ʝ] nor [t̪s, d̪z] may occur as the first element of a cluster.

¹⁷Note regressive voicing assimilation.

The tableau below illustrates velar coronalization before front vowels.¹⁸ In (32), the faithful candidate is ruled out by the *C-place-[dorsal] constraint. Candidate (b), where [dorsal] is delinked, crucially violates *Bare-Place, while candidate (c), where the entire node is delinked is penalized by MaxLink-Place. Candidates (d), (e) and (f) all repair *C-place-[dor] by spreading. Since all of these candidates violate ID(C-place), the constraint that decides among these candidates in ID(V-place). As a result, both candidates with palatalization are ruled out, and the candidate (d), where only assibilation applies, is correctly selected as optimal.

(32) Velar affrication: /li:da k -a -ijŋ-a/ → [lidats̺ijŋ-a] ‘pike, dim. NOM. SG.’

/li:da k -a -ijŋ-a/ ¹⁹ C-pl [dor] C-pl [cor] V-pl [cor]	MaxLink-Place	*Bare-Place	*C-place-[dor]	ID(C-pl)	ID(V-pl)
a. li:da . k -ijŋ- C-pl [dor] C-pl [cor] V-pl [cor]			*!		
b. li:da . T -ijŋ- C-pl [cor] C-pl [cor] V-pl [cor]		*!		*	
c. li:da . t -ijŋ- C-pl [cor] C-pl [cor] V-pl [cor]	*!			*	
d. li:da . ts̺ -ijŋ- C-pl [cor] C-pl [cor] V-pl [cor]				*	
e. li:da . c -ijŋ- C-pl [cor] C-pl [cor] V-pl [cor]				*	*!
f. li:da . t͡ɕ -ijŋ- C-pl [cor] C-pl [cor] V-pl [cor]				*	*!

¹⁸ MaxLink constraints are ranked low at the stem level. Because the target of velar coronalization never deletes, these play no role in the evaluation.

Note that the ranking in (32) predicts that velar affrication should be the preferred strategy whenever the underlying representation contains a velar followed by a front vowel. On the one hand, this is a welcome result, because velar affrication is by far the most common alternation that affects such strings. On the other hand, we still have to account for the fact that sometimes such sequences are repaired by velar palatalization.

Note that the candidate (e) in tableau (32) is harmonically bounded by candidate (d), since candidate (d) fares better or equally well on all the constraints. This means that no ranking of the constraints in (32) would prefer candidate (e) over (d). Considering that velar palatalization only applies in stems that are outside of core vocabulary¹⁹, one way to get the desired result is to assume that such stems are subject to a separate cophonology that contains a high-ranked *C-place-[coronal] (see Inkelas et al. 2007). The alternative possibility is to attribute /k, g/ → [c, ɟ] alternation to stem allomorphy. Under the latter account, the foreign stems that alternate between velar and palatal stops will have two allomorphs, e.g. /ideolog-a/ and /ideoloɟ-Ø-/. The lexical entry for such stems would also specify the phonological context where each of the allomorphs may surface, such that the one with a palatal stop may surface before front-vowel initial derivational suffixes, while the one with a velar stop may surface elsewhere. Here I remain agnostic as to which of these options is employed in Latvian.

4.3 Vowel raising

Finally, let us discuss vowel raising. The relevant data is repeated below:

- (33) Vowel raising
- | | | | |
|--------------|---|---------------|---------------|
| /mæln-i-s/ | → | [meln-i-s] | 'black horse' |
| /pælæ:k-i-s/ | → | [pele:ts-i-s] | 'gray horse' |

The only target of vowel raising is the front low vowel /æ/, which is also the only segment that is underlyingly specified for a bare V-place node. Therefore, I propose that vowel raising is favoured by the high-ranking *Bare-Place constraint (see the definition in (31) above). The crucial property of vowel raising is the fact that it is uni-directional: the assimilating feature only spreads to the targets to the left of the trigger. Therefore, following McCarthy (2009), I suggest that the directionality of spreading should be stipulated directly by means of the Final[F] constraint:

- (34) **FINAL [F]** – for each instance of [F], assign one violation mark for every case where the input correspondent of the rightmost segment linked with [F] in the output follows the rightmost segment linked with [F] in the input. (see McCarthy 2009 for the formal definition).

In other words, the constraint in (34) would penalize the candidate where the assimilating feature is spreading rightwards. The effect of the high-ranking Final[F] is illustrated below with the example of vowel raising. Consider (only relevant constraints are shown):

- (35) Vowel raising

Although high-ranked, Final[F] is not undominated in Latvian. In cases where a stem-final palatal/postalveolar consonant is followed by a tautosyllabic monosegmental morpheme /-s/ (NOM. SG. MASC. inflection in nominal and adjectival paradigms), palatal assimilation applies progressively, which indicates that the constraint enforcing palatal assimilation in tautosyllabic clusters outranks Final[F]. Consider:

¹⁹ Velar palatalization triggered by the diminutive suffix [-el-] is expressive, and therefore subject to different restrictions.

/æCiCæ/	Final[F]	MaxLink-Place	*Bare-Place	ID(V-place)
<p>a.</p>			**!	
<p>b.</p>	*!			**
<p>c.</p>			*	*

(36) Progressive palatal assimilation

/teʎ-s/	→	[teʎ-j]	‘calf’	cf.	[pol-s]	‘pole’
/meʒ-s/	→	[meʃ-j]	‘forest’	cf.	[kaus-s]	‘cup’
/viŋ-s/	→	[viŋ-j]	‘he’	cf.	[u:den-s]	‘water’

5 Conclusions

In this paper I have developed a representational and constraint-based analysis of four distinct yet interacting processes involving palatals/postalveolars in Modern Standard Latvian: velar affrication, velar palatalization, yod-palatalization and front vowel raising.

The main advantage of the representational account developed here is that it treats all of the mentioned Latvian processes as strictly assimilatory, and at the same time avoids purely stipulative mechanisms characteristic of many previous feature-geometric approaches to cross-category interactions. The paper also provides empirical support for one of the cornerstone postulates of PSM, as it shows that the nature of consonant-vowel interactions in Latvian necessitates that both classes of segments draw on the same restricted set of features and structural primitives.

A notable trend in OT-based analyses of palatalization (and assimilatory processes more generally) is the use of constraints explicitly demanding assimilation between the

consonant and the following front vocoid. Examples include Kramer (2009), using PAL constraint defined as “dorsal segment has an additional link to the V-place-[coronal] of the following vocoid”, as well as various accounts employing well-established constraints like AGREE [-back] (Gonzalez 2014), ALIGN[coronal] (Zubritskaya 1995), and SHARE (V-place-[coronal]) (Iosad 2012). While making it possible to account for the data at hand, the analyses using the constraints exemplified above run the risk of obscuring phonological motivations for the application of palatalization or, for that matter, other assimilatory processes (see also Uffmann 2005 for some discussion on this point). In contrast, the constraint-based analysis proposed here treats palatalization as motivated by the need to repair marked structures (e.g. complex onsets) and geometric configurations (e.g. bare class nodes). Unlike in many previous OT-based analyses of the process, feature spreading is not directly enforced, but rather selected as an optimal repair strategy by the well-established markedness and faithfulness constraints. The paper also contributes to the debate on the role of geometric subsegmental representations in constraint-based computational models (Uffmann 2005), by demonstrating that a principled account of locality, transparency and blocking effects in Latvian palatalization requires the reference to hierarchical autosegmental structures.

Competing interests

The author declares that she has no competing interests.

References

- Archangeli, Diana & Douglas Pulleyblank. 1994. *Grounded phonology*. Cambridge, MA: MIT Press.
- Auziņa, Ilze. 2005. *Latviešu valodas izrunas datormodelēšana* [Computer modeling of Latvian pronunciation]. Riga: University of Latvia doctoral dissertation.
- Auziņa, Ilze, Ieva Brenķe, Juris Grigorjevs, Inese Indričāne, Baiba Ivulāne, Andra Kalnača, Linda Lauze, Ilze Lokmane, Dace Markus, Daina Nītiņa, Gunta Smiltņiece, Baiba Valkovska & Anna Vulāne. 2015. *Latviešu valodas gramatika* [The grammar of the Latvian language]. Riga: Latviešu valodas institūts.
- Bateman, Nicoleta. 2007. *A crosslinguistic investigation of palatalization*. San Diego: University of California doctoral dissertation.
- Bermúdez-Otero, Ricardo. 2011. Cyclicity. In Marc van Oostendorp, Colin Ewen, Elizabeth Hume & Keren Rice (eds), *The Blackwell companion to phonology*, vol. 4, 2019–2048. Malden, MA: Wiley-Blackwell.
- Bermúdez-Otero, Ricardo. 2012. The architecture of grammar and the division of labour in exponence. In Jochen Trommer (ed.), *The morphology and phonology of exponence* (Oxford Studies in Theoretical Linguistics 41), 8–83. Oxford: Oxford University Press.
- Bermúdez-Otero, Ricardo. 2013. The Spanish lexicon stores stems with theme vowels, not roots with inflectional class features. *Probus* 25. 3–103.
- Bhat, D.N.S. 1978. A general study of palatalization. In Joseph H. Greenberg (ed.), *Universals of human language*, vol. 2, 47–91. Stanford, CA: Stanford University Press.
- Blaho, Sylvia. 2004. Privative [voice] in Optimality Theory. Presented at the 12th Manchester Phonology Meeting. Manchester, Great Britain.
- Blaho, Sylvia. 2008. *The syntax of phonology: A radically substance-free approach*. Tromsø: University of Tromsø doctoral dissertation.
- Bond, Dzintra. 1994. Latvian syllable onsets and rhymes. *Linguistica Baltica* 3. 87–100.
- Casali, Roderic F. 1997. Vowel elision in hiatus contexts: Which vowel goes? *Language* 73. 493–533. DOI: <http://dx.doi.org/10.2307/415882>

- Ceplītis, Laimdots, Aina Miķeļsone, Tamara Porīte & Silvija Rage. 2007. *Latviešu valodas pareizrakstības un pareizrunas vārdnīca*. [Dictionary of orthography and pronunciation of the Latvian language]. Riga: Avots.
- Chomsky, Noam & Morris Halle. 1968. *The sound pattern of English*. New York: Harper and Row.
- Clements, G. Nick. 1976. *Vowel harmony in nonlinear generative phonology: an autosegmental model*. Bloomington, Indiana: Indiana University Linguistics Club.
- Clements, G. Nick. 1985. The geometry of phonological features. *Phonology* 2. 225–252. DOI: <http://dx.doi.org/10.1017/S0952675700000440>
- Clements, G. Nick. 1991a. Place of articulation in consonants and vowels: a unified theory. In *Working Papers of the Cornell Phonetics Laboratory* 5. Ithaca: Cornell University.
- Clements, G. Nick. 1991b. Vowel height assimilation in Bantu languages. In *Working Papers of the Cornell Phonetics Laboratory* 5. Ithaca: Cornell University.
- Clements, G. Nick & Elizabeth V. Hume. 1995. The internal organization of speech sounds. In John Goldsmith (ed.), *The handbook of phonological theory*, 245–306. Cambridge, MA. & Oxford: Basil Blackwell.
- Cressey, William W. 1974. Homorganic in generative phonology. *Papers in Linguistics* 7. 69–81. DOI: <http://dx.doi.org/10.1080/08351817409370363>
- Endzelins, Jānis. 1951. *Latviešu valodas gramatika* [The grammar of the Latvian language]. Riga: Latvijas valsts izdevniecība.
- Goldsmith, John. 1976a. An overview of Autosegmental Phonology. *Linguistic Analysis* 2. 1.
- Goldsmith, John. 1976b. *Autosegmental phonology*. Cambridge, MA: MIT doctoral dissertation.
- Goldsmith, John. 1981. Accent in Tonga: an autosegmental account. In G. Nick Clements, (ed.), *Harvard studies in phonology II*, 178–187. Bloomington, Indiana: Indiana University Linguistics Club.
- Gonzalez, Carolina. 2014. Prevocalic velar advancement in Chilean Spanish and Proto-Romance. In Marie-Hélène Côté & Eric Mathieu (eds.), *Variation within and across romance languages; selected papers from the 41st linguistic symposium on romance languages (LSRL)* (Current Issues in Linguistic Theory, vol. 333) 277–296. Amsterdam/Philadelphia: John Benjamins. DOI: <http://dx.doi.org/10.1075/cilt.333.19gon>
- Halle, Morris. 1987. The morphophonemics of latvian declension. In Robert Channon & Linda Shockey (eds.), *In honor of ILSE LEHISTE*, 375–379. Dordrecht: Foris Publications. DOI: <http://dx.doi.org/10.1515/9783110886078.375>
- Halle, Morris. 1992. The Latvian declension. In Geert Booij & Jaap van Marle (eds.), *Yearbook of morphology 1991*, 33–47. Dordrecht: Kluwer. DOI: http://dx.doi.org/10.1007/978-94-011-2516-1_4
- Halle, Morris. 1995. Feature geometry and feature spreading. *Linguistic Inquiry* 26 (1). 1–46.
- Halle, Morris, Bert Vaux & Andrew Wolfe. 2000. On feature spreading and the representation of place of articulation. *Linguistic Inquiry* 31 (3). 387–444. DOI: <http://dx.doi.org/10.1162/002438900554398>
- Hume, Elizabeth. 1992. *Front vowels, coronal consonants and their interaction in nonlinear phonology*. Ithica, NY: Cornell University doctoral dissertation.
- Iosad, Pavel. 2012. *Representation and variation in substance-free phonology: a case study in celtic*. Tromsø: University of Tromsø doctoral dissertation.
- Kariņš, A. Krišjānis. 1996. *The prosodic structure of latvian*. University of Pennsylvania doctoral dissertation.
- Kiparsky, Paul. 1981. Vowel Harmony. Ms. Stanford University.
- Kochetov, Alexei. 2011. Palatalization. In Colin Ewen, Elizabeth Hume, Marc van Oostendorp & Keren Rice (eds.), *Blackwell companion to phonology*, 1666–1690. Oxford: Wiley Blackwell.


- Kochetov, Alexei & John Alderete. 2010. Patterns and scales of expressive palatalization: typological and experimental evidence. Ms. University of Toronto & Simon Fraser University.
- Krämer, Martin 2006. The emergence of the comparatively unmarked. In Donald Baumer, David Montero & Michael Scanlon (eds.), *Proceedings of the 25th west coast conference on formal linguistics*, 236–244. Somerville, MA: Cascadilla Proceedings Project.
- Krämer, Martin. 2009. *The phonology of Italian*. Oxford: Oxford University Press.
- Laua, Alise. 1997. *Latviešu literārās valodas fonētika*. 4., pārstrādātais un papildinātais izdevums [Phonetics of literary Latvian. 4th edition, updated and revised]. Riga: Zvaigzne ABC.
- Markus, Dace & Juris Grigorjevs. 2003. *Fonētikas pētīšanas un vizualizēšanas metodes*. [Methods for phonetics research and visualization]. Riga: Rasa ABC.
- Mathiassen, Terje. 1996. *A short grammar of latvian*. Columbus: Slavica Publishers.
- Matthews, William. 1959. Phonematic system of literary Latvian. In Ēvalds Sokols, Kārlis Graudiņš & Elfrīda Šmite (eds.), *Veltījums akadēmiķim profesoram Dr. Jānim Endzelīnam viņa 85 dzīves un 65 darba gadu atcerei* [Dedication to professor Dr. Janis Endzelins in memory of his 85 years of life and 65 years of work], 181–200. Riga: Valodas un literatūras institūts.
- McCarthy, John J. 1988. Feature geometry and dependency: A review. *Phonetica* 43. 84–108.
- McCarthy, John J. 2009. Harmony in harmonic serialism. Ms. University of Massachusetts, Amherst.
- McCarthy, John & Alan Prince. 1995. Faithfulness & reduplicative identity. In Jill Beckman, Laura Walsh-Dickey & Suzanne Urbanczyk (eds.), *University of Massachusetts occasional papers in linguistics 18: papers in optimality theory*, 249–384. Amherst: Graduate Linguistics Student Association.
- Morén, Bruce. 1999. *Distinctiveness, coercion and sonority: a unified theory of weight*. College Park: University of Maryland doctoral dissertation.
- Morén, Bruce. 2003. The Parallel Structures model of feature geometry. In *Working Papers of the Cornell Phonetics Laboratory* 15, 194–270. Ithaca, NY.
- Morén, Bruce. 2006. Consonant–vowel interactions in Serbian: features, representations and constraint interactions. *Lingua* 116 (8). 1198–1244.
- Morén, Bruce. 2007. The division of labour between segment-internal structure and violable constraints. In Sylvia Blaho, Patrik Bye & Martin Krämer (eds.), *Freedom of analysis?* (Studies in Generative Grammar 95), 313–344. Berlin: Mouton de Gruyter.
- Muižniece, Lalita. 2002. *Latviešu valodas praktiskā fonoloģija*. [Practical phonology of Latvian]. Riga: Rasa ABC.
- Padgett, Jaye. 1995. Feature classes. In Jill Beckman, Laura Walsh-Dickey & Suzanne Urbanczyk (eds.), *University of Massachusetts occasional papers in linguistics 18: papers in optimality theory*, 385–420. Amherst: Graduate Linguistics Student Association.
- Prince, Alan and Paul Smolensky. 1993/2004. *Optimality Theory: constraint interaction in generative grammar*. Malden, MA and Oxford: Blackwell.
- Rubach, Jerzy. 2003. Polish palatalization in Derivational Optimality Theory. *Lingua* 113. 197–237.
- Rūķe-Draviņa, Velta. 1959. *Diminutive im Lettischen*. Lund: AB PH. Lindstedts Univ.-Bokhandel.
- Sagey, Elizabeth. 1986. *The representation of features and relations in non-linear phonology*. Cambridge, MA: MIT doctoral dissertation.
- Sokols, Ēvalds, Anna Bergmane, Rūdolfs Grabis & Milda Lepika (eds.). 1959. *Mūsdienu latviešu literārās valodas gramatika, I: Fonētika un morfoloģija*. [Grammar of modern lit-

- erary Latvian. Volume I: Phonetics and morphology]. Riga: LPSR Zinātņu akadēmijas izdevniecība.
- Steinbergs, Aleksandra. 1977. *The phonology of Latvian*. Urbana-Champaign: University of Illinois doctoral dissertation.
- Thráinsson, Höskuldur. 1978. On the phonology of Icelandic preaspiration. *Nordic Journal of Linguistics* 1. 3–54.
- Uffmann, Christian. 2005. Optimal geometries. In Marc van Oostendorp & Jeroen van de Weijer (eds.) *The internal structure of phonological segments*, 27–62. Mouton de Gruyter.
- Urek, Olga. 2016. *Palatalization in Latvian*. Tromsø: UiT the Arctic University of Norway doctoral dissertation.
- Wolf, Matthew. 2007. For an autosegmental theory of mutation. In Leah Bateman, Michael O’Keefe, Ehren Reilly & Adam Werle (eds.), *University of Massachusetts occasional papers in linguistics* 32: *papers in optimality theory III*, 315–404. Amherst: GLSA.
- Youssef, Islam. 2013. *Place assimilation in Arabic: contrasts, features and constraints*. Tromsø: University of Tromsø doctoral dissertation.
- Zubritskaya, Ekaterina. 1995. *The categorial and variable phonology of Russian*. University of Pennsylvania doctoral dissertation.

How to cite this article: Urek, Olga. 2016. Consonant-vowel interactions in Modern Standard Latvian: a representational and constraint-based account. *Glossa: a journal of general linguistics* 1(1): 22. 1–34, DOI: <http://dx.doi.org/10.5334/gjgl.83>

Published: 20 July 2016

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