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Affricates, Palatals and Iotization in Serbian: Representational Solutions to Longstanding Puzzles

1. Introduction

Standard Serbian has an interesting set of consonants and consonant-vowel interactions. It has a fairly extensive set of palatals and three sets of affricates, two of which are found at the same place of articulation but are articulatorily different in laminal versus apical. In addition, all non-palatal consonants undergo a morpho-phonological process called iotization before certain suffixes beginning with what looks like a high front segment. Iotization can have quite surprising results on the realization of the consonant depending on factors such as original place of articulation and original manner of articulation. From the perspective of traditional feature theory and autosegmental phonology, the combination of the inventory facts and consonant-vowel interactions are somewhat puzzling because there is no straightforward way to represent the segments such that the morpho-phonological alternations appear phonologically "natural". For example, it is difficult to explain how velar stops merge with the following high front segment to become apical palatal affricates (e.g. /k+i/ --> [t͡ʃ]), while labials do not merge and the high front segment becomes a palatal lateral (e.g. /p+i/ --> [pʎ]).

This paper reviews the segment inventory facts of Serbian from both an articulatory and a phonological perspective, and it proposes a straightforward phonological analysis of both the inventory and iotization. The analysis is couched in terms of the Parallel Structures Model of feature geometry (Morén 2003a, b, c), and there are several specific claims. First, palatal affricates are best analyzed as phonological stops. Second, the articulatory difference between dental and palatal consonants is one of laminal versus apical, but the phonological difference is the specification of a consonant coronal place feature versus a vowel coronal place feature, respectively. Third, the two palatal stop

series (palatal affricates, descriptively) are differentiated by the presence of only a vowel coronal feature (realized as non-laminal) versus both a vowel and a consonant coronal feature (realized as laminal).

This analysis not only provides an account of the segment inventory and iotization using a very economical feature set, but it also provides an account of the mapping of phonological feature specifications to otherwise surprising articulations. Two further results are that it explains the somewhat puzzling morpho-phonological effects of the palatal consonants on the realization of mid vowels, and it accounts for an interesting dialect split.

2. The Articulatory Facts

The consonants[1] of Serbian are usually described phonetically as in (1). These descriptions are based on Magner (1991) and Mønnesland (2002), but different IPA symbols and diacritics are used to capture as many articulatory details as possible. Latin orthographic correspondences are given throughout this paper for clarification.

(1) Narrow articulatory descriptions of consonants

	Labial		Dental		Alveolar	Palato-alveolar		Palatal		Velar	
Stop	[p] ‘p’	[b] ‘b’	[t̪] ‘t’	[d̪] ‘d’						[k] ‘k’	[g] ‘g’
Affricate			[t̪s̪] ‘c’			[t̪ʃʷ] ‘č’	[d̪ʒʷ] ‘dž’	[c͡ɕ] ‘ć’	[ɟ͡ʑ] ‘đ’		
Fricative	[f] ‘f’	[v] ‘v’	[s̪] ‘s’	[z̪] ‘z’		[ʃ] ‘š’	[ʒ] ‘ž’			[x] ‘h’	
Nasal		[m] ‘m’			[n] ‘n’				[ɲ] ‘nj’		
Lateral					[l] ‘l’				[ʎ] ‘lj’		
Rhotic					[r] ‘r’						

[1] I assume that the palatal glide [j] is the surface realization of the high front vowel [i] in non-nuclear position.

According to the traditional descriptions, one of the interesting aspects of this inventory is that there are two sets of post-alveolar affricates, usually described as differing in the location of the stop closure along the anterior-posterior dimension of the palate. However, a careful phonetic study by Miller-Ockhuizen and Zec (2003) has shown that the traditional description is incorrect. They conclude that both sets of post-alveolar affricates are articulated in the palato-alveolar region, with the difference being one of laminal versus apical. If we use this evidence to claim that Serbian differentiates between non-palatal coronal segments (i.e. dental and alveolar) and palatal coronal segments (i.e. apical and laminal palatals), and if we assume that the appropriate phonetic description of the dentals is really laminal, then we arrive at the more accurate picture of Serbian consonants given in (2).

(2) Broad articulatory descriptions of consonants

	Labial		Dental/ Alveolar		Palatal				Velar	
Stop	[p] 'p'	[b] 'b'	[t̪] 't'	[d̪] 'd'					[k] 'k'	[g] 'g'
Affricate			[t̪s̪] 'c'		[t̪ʃ] 'ć'	[d̪ʒ] 'đ'	[t̪ʃ] 'č'	[d̪ʒ] 'dž'		
Fricative	[f] 'f'	[v] 'v'	[s̪] 's'	[z̪] 'z'			[ʃ] 'š'	[ʒ] 'ž'	[x] 'h'	
Nasal		[m] 'm'		[n] 'n'				[ɲ] 'nj'		
Lateral				[l] 'l'				[ʎ] 'lj'		
Rhotic				[r] 'r'						

In looking at this distribution, it is clear that the laminal palatal affricates are more similar in articulation to the dental coronals than the traditional descriptions suggest. This will be crucial to the analysis of palatals and iotization presented below.

From an articulatory perspective, the vowel system of Standard Serbian is quite simple. There are five vowels (ignoring vowel length), as shown in (3).

(3) Narrow articulatory descriptions of vowels

	Front	Central	Back
High	[i] 'i'		[u] 'u'
Mid lax	[ɛ] 'e'		[ɔ] 'o'
Low		[a] 'a'	

3. The Distributional Facts[2]

Within morphemes, all consonants are fully contrastive regardless of the quality of the preceding or following vowel. (4) provides examples of consonant contrasts before [i] and [a]. Although voiced obstruents are not listed, they also found to be contrastive.

(4) Consonant contrasts before [i] and [a]

a.	/p/	potpis	[pɔt̪piʂ]	'signature'
		paprika	[paprika]	'pepper'
b.	/t̪/	tigar	[t̪igar]	'tiger'
		tata	[t̪at̪a]	'dad'
c.	/k/	kiša	[kiʃa]	'rain'
		kako	[kakɔ]	'how'
d.	/t̪͡ʂ/	cigareta	[t̪͡ʂigareʈa]	'cigarette'
		car	[t̪͡ʂar]	'tsar'
e.	/t̪͡ʃ/	čist	[t̪͡ʃiʂt̪]	'clean'
		čaša	[t̪͡ʃaʃa]	'glass
f.	/t̪̻͡ʃ̻/	ćevapćići	[t̪̻͡ʃ̻ɛvapt̪̻͡ʃ̻it̪̻͡ʃ̻i]	'meat patties'
		ćaća	[t̪̻͡ʃ̻at̪̻͡ʃ̻a]	'papa'
g.	/f/	oficir	[ɔfit̪͡ʂir]	'officer'
		fazan	[faʐan]	'pheasant'
h.	/ʂ/	sir	[ʂir]	'cheese'
		sada	[ʂaɖa]	'now'
i.	/ʃ/	šišmiš	[ʃiʃmiʃ]	'bat'
		šašav	[ʃaʃav]	'crazy'
j.	/x/	hitro	[xit̪rɔ]	'cleverly'
		hapsi	[xapʂi]	'to arrest'

[2] All data and descriptions are from Magner (1991) and Mønnesland (2002).

k.	/m/	mir	[mir]	‘peace/calm’
		magla	[magla]	‘fog’
l.	/n/	ni	[ni]	‘not’
		nanovo	[nanɔvɔ]	‘again’
m.	/ɲ/	njiva	[ɲiva]	‘meadow’
		cvjetnjak	[t̪s̪vjɛt̪ɲak]	‘flower garden’
n.	/l/	lipa	[lipa]	‘lime tree’
		lako	[lakɔ]	‘easy’
o.	/ʎ/	ljiljan	[ʎiʎan]	‘lily’
		ljiljan	[ʎiʎan]	‘lily’
p.	/r/	riba	[riba]	‘fish’
		rano	[ranɔ]	‘early’

Despite the fact that these segments are contrastive, several phonological and morpho-phonological processes occur in this language. We will not discuss voicing alternations here, but concentrate on iotization. Iotization is a morpho-phonological process by which all non-palatal consonants undergo mutation when the following suffix has a particular meaning and begins with what is usually described as “j”. A sample of these morphological contexts and alternations are listed in (5).

(5) Subset of iotization contexts
- Comparatives formed with –ji, e.g. tanak [t̪anak] ‘thin’ ~ tanji [t̪aɲi] ‘thinner’
- The past passive participle with –jen, e.g. hvaliti [xvaliṭi] ‘to praise’ ~ hvaljen [xvaʎɛn] ‘praised’
- Neuter nouns formed with –je, e.g. veseli [vɛs̪ɛli] ‘cheerful’ ~ veselje [vɛs̪ɛʎɛ] ‘joy’
- Feminine nouns formed with –ja, e.g. volim [vɔlim] ‘I like’ ~ volja [vɔʎa] ‘will’

In iotization, the place of articulation (and sometimes the manner) of the consonant is affected, as we see in (6) through (10).

Labials are followed by the palatal lateral:

(6) a. /p/ --> [pʎ] tup [t̪up] ‘dull’ ~ tuplji [t̪upʎi] ‘duller’
b. /b/ --> [bʎ] grub [grub] ‘coarse’ ~ grublji [grubʎi] ‘coarser’

c. /v/ --> [vʎ] kriv [kriv] ‘crooked’ ~ krivlji [krivʎi] ‘more crooked’
d. /m/ --> [mʎ] bezuman [bɛz̪uman] ‘mad’ ~ bezumlje [bɛz̪umʎɛ] ‘madness’

All non-labial fricatives become apical palatals regardless of original place of articulation:

(7) a. /s̪/ --> [ʃ] iznositi [iz̪nɔs̪it̪i] ‘wear out’ ~ iznošen [iz̪nɔʃɛn] ‘worn out’
b. /x/ --> [ʃ] tih [t̪ix] ‘quiet’ ~ tiši [t̪iʃi]‘quieter’
c. /z̪/ --> [ʒ] brz [brz̪] ‘fast’ ~ brži [brʒi] ‘faster’

Laminal alveolar stops become laminal palatal affricates:

(8) a. /t̪/ --> [t̪͡ʃ] vratiti [vrat̪it̪i] ‘to return’ ~ vraćen [vrat̪͡ʃɛn] ‘returned’
b. /d̪/ --> [d̪͡ʒ] mlad [mlad̪] ‘young’ ~ mlađi [mlad̪͡ʒi] ‘younger’

Voiceless velar stops become apical palatal affricates:

(9) /k/ --> [t̪͡ʃ] jak [jak] ‘strong’ ~ jači [jat̪͡ʃi] ‘stronger’

Voiced velar stops become apical palatal fricatives[3]:

(10) /g/ --> [ʒ] blag [blag] ‘mild’ ~ blaži [blaʒi] ‘milder’

These facts present several puzzles that are not particularly easy to solve using traditional SPE-type phonological features (Chomsky and Halle 1968) or the popular autosegmental feature geometries (e.g. Clements and Hume 1995). First, we must decide what the relevant phonological features are that distinguish among all consonants in this language, particularly the two sets of palatal affricates since they are articulated at the same place of articulation. Second, we must explain the morpho-phonologically conditioned changes of place resulting from iotization – in particular, the odd transformation of velars into apical palatals and the addition of a palatal lateral following labial segments. Finally, we must explain why both laminal alveolar and velar stops become affricates when

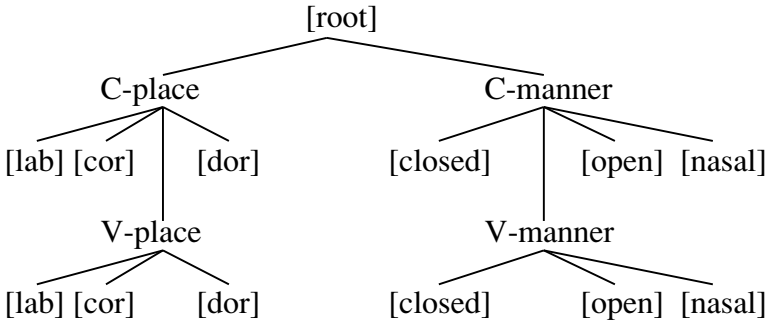
[3] The stop-fricative alternation of the voiced velars is not addressed in this paper.

they become palatal. We will show that the Parallel Structure Model of feature geometry (Morén 2003a, b, c) provides a straightforward analysis not only of the inventory facts, but also of the puzzling consonant alternations.

4. Phonological Background – The Parallel Structures Model

This analysis will make use of the Parallel Structures Model of feature geometry (Morén 2003a, b, c), which is a synthesis of a number of proposals found in the phonological literature for representing the internal organization of and the interactions among speech sounds (e.g. Chomsky and Halle 1968, Sagey 1990, Clements 1991, Steriade 1993). The main premise of this model is that the phonological system is economical and makes use of the same structures and features whenever possible. To this end, vowel and consonant representations are not fundamentally different, nor are place of articulation or manner of articulation representations. The basic fully-specified representation relevant to the Serbian data to be discussed is shown in (11).

(11)



Note that the PSM assumes a restrictive and economical grammar such that features and class nodes are only available in a given language if there is direct evidence for them from the inventory facts or phonological processes. The following two subsections briefly illustrate the Parallel Structures Model representations for different places and manners found cross-linguistically. This will place the analysis of Serbian within a broader theoretical context.

4.1 Place of Articulation in the Parallel Structures Model

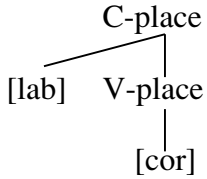
The representation of passive place of articulation assumed here is basically that of Clements (1991). Consonants and vowels have the same set of place features, but associate them with different class nodes. While simple obstruents only have a consonant place node, vowels have a vowel place node dependent on the consonant place node. As discussed by Clements, this representation of place provides a very straightforward account of consonant secondary place articulations, as well as place harmony asymmetries between consonants and vowels (not discussed here).

Segments with simple place of articulation are those with only one C-place or V-place feature specified. For example, [t] has a single C-place with a dependent coronal feature, while [i] has a single V-place with a dependent coronal feature.

(12) a. Coronal consonant place, e.g. [t] b. Coronal vowel place, e.g. [i]

There are two additional types of place segments, both of them complex in that they have more than one dependent feature specification. In the first type, there is a consonant feature as well as a vowel feature. These correspond to what is usually described as secondary place articulation.

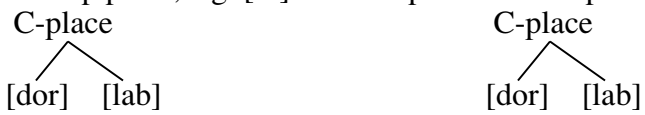
(13) Secondary place, e.g. [p^{j}]



The second type of complex place has two dependent features on a single class node. In the case of consonants, these can correspond to velaric airstream (clicks) if the segment is a stop, or complex place if the segment

is a fricative.

(14) a. Complex stop place, e.g. [⊙] b. Complex fricative place, e.g. [f͡ŋ]

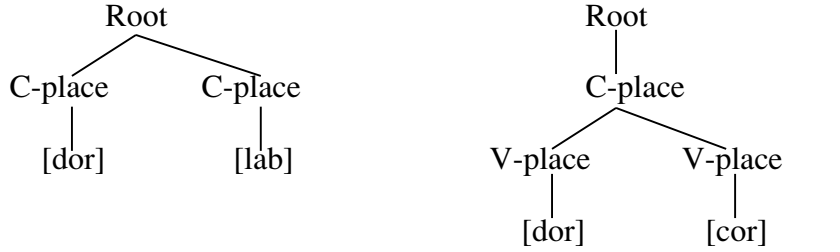


If the complex place segment is a vowel, then we find phonologically central or round vowels.

(15) a. Complex vowel place, e.g. [ʉ] b. Complex vowel place, e.g. [y]

Finally, there is also the possibility of contour place, that is, two different features associated with two different class nodes of the same type. The representations in (16) are examples of contour consonant place and contour vowel place.

(16) a. Double place, e.g. [k͡p] b. Place diphthongs, e.g. [ɯ͡i]



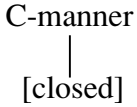
4.2 Manner of Articulation in the Parallel Structures Model

As the name of the model and the structure in (11) suggests, the Parallel Structures Model makes use of parallel structures and features wherever possible. As we saw in the domain of place of articulation, consonants and vowels have the same place features associated with different, but related, place-class nodes. Further, both consonants and vowels may have simple, complex or contour place.

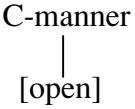
Using the parallelism found in place of articulation as a guide, the Parallel Structures Model assumes that consonants and vowels also use the same features and similar structures in the domain of manner of articulation. Within this model, manner is defined, roughly, as degrees of vocal tract constriction, where simple obstruents have both a more closed and a more open articulation (stops versus fricatives), as do simple vowels (high versus low). Unifying the constriction generalizations of obstruents and vowels, the Parallel Structures Model assumes that obstruents have a C-manner that is specified as [closed] and/or [open], while vowels have a V-manner (dependent on C-manner) which can also be specified as [closed] and/or [open].

As shown in (17) and (18), simple stops and fricatives have a single C-manner with either a [closed] or [open] dependent feature, respectively, while simple high and low vowels have a single V-manner with either a [closed] or [open] dependent feature, respectively.

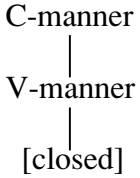
(17) a. Stop manner, e.g. [t]



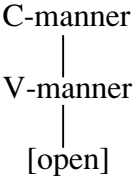
b. Fricative manner, e.g. [s]



(18) a. High vowel, e.g. [i]

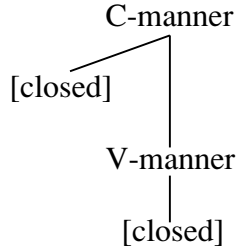


b. Low vowel, e.g. [a]

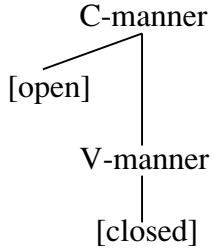


In this model, the manner equivalent to secondary place articulation is a sonorant consonant. That is, a sonorant consonant has both a C-manner feature and a V-manner feature, as shown in (19) for lateral and rhotic approximants.

(19) a. Lateral approximant, e.g. [l]

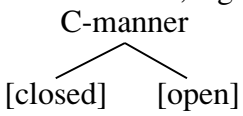


b. Rhotic approximant, e.g. [ɹ]

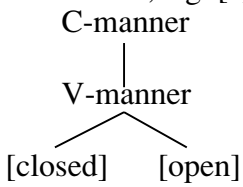


The manner equivalents to velaric airstream and central vowels, i.e. complex segments with more than one feature per class node, are lateral fricatives and mid vowels.

(20) a. Lateral fricative, e.g. [ɬ]

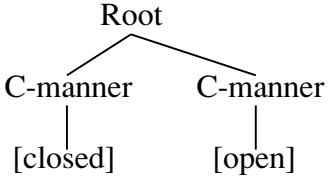


b. Mid vowel, e.g. [e]

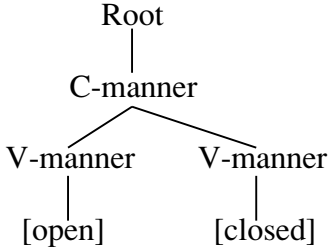


Finally, just as in place of articulation, we can have contour manner segments comprised of two features associated with two different class nodes of the same type. In the case of consonants, these are affricates, and in the case of vowels, these are height diphthongs.

(21) a. True affricates, e.g. [p͡f]



b. Height diphthongs, e.g. [æ͡i]



One major result of viewing manner in this way is that it eliminates the need for separate major class features since the major classes of consonants, vowels, obstruents and sonorants are defined representationally, not featurally. This explains the observation that the major class features do not act like the other features (Schein and Steriade

1986, McCarthy 1988). The claim of the Parallel Structures Model is that they are not features at all, therefore they should not act like features.

(22) Consonant class: presence of a C-manner feature
Vowel class: absence of a C-manner feature
Sonorant class: presence of a V-manner feature
Obstruent class: absence of a V-manner feature

	C-manner features	V-manner features	Classes	
Stops and fricatives	✓		obstruent	consonant
Approximants	✓	✓	sonorant	
Vowels		✓		vowel

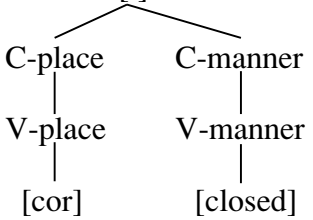
With that brief background in the Parallel Structures Model, let us move on to an analysis of the segment inventory and iotization patterns in Serbian.

5. The Phonology of Serbian Vowels

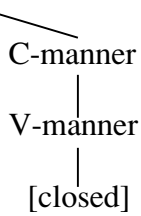
Let us start with an examination of the contrastive vowel inventory and determine the most economical feature set necessary to explain it. Recall that there are three distinct heights, which are easily accounted for using V-manner[open] for the low vowel, V-manner[closed] for the high vowels, and V-manner[open, closed] for the mid vowels. Since the low vowel does not show a place contrast, and the only evidence for non-low vowel place comes from the interaction of consonants with front vowels, we must assume that only front vowels have a place feature, as shown in (23) and (24).

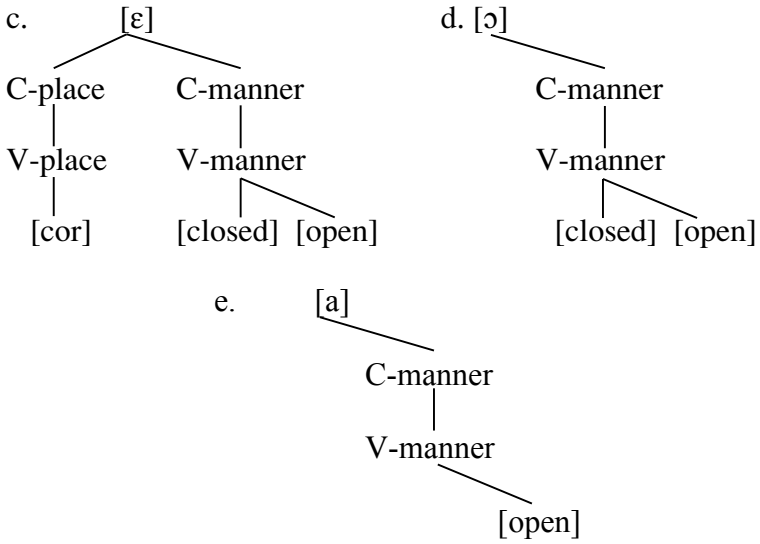
(23) Serbian contrastive vowel representations

a. [i]



b. [u]





(24) Phonological features for Serbian vowels

		V-place	V-manner	
		[cor]	[closed]	[open]
'i'	[i]	✓	✓	
'e'	[ɛ]	✓	✓	✓
'u'	[u]		✓	
'o'	[ɔ]		✓	✓
'a'	[a]			✓

6. The Phonology of Serbian Consonants

In looking at the descriptive inventory in (2), it is clear that here are at least three descriptive places to be mapped to place representations, and there are six different descriptive manners to be mapped to manner representations. If we ignore the palatal consonants for the moment, we can combine [labial], [coronal] and [dorsal] with the appropriate manner representations and derive the segments in (25) (not including laryngeal features).

(25) Phonological features for Serbian non-palatal consonants

			C-place			C-manner			V-manner
			[lab]	[cor]	[dor]	[closed]	[open]	[nasal]	[closed]
Obstruents	'p'	[p]	✓			✓			
	'f'	[f]	✓				✓		
	't'	[t̪]		✓		✓			
	'c'	[t͡s̪]		✓		✓	✓		
	's'	[s̪]		✓			✓		
	'k'	[k]			✓	✓			
	'h'	[x]			✓		✓		
Sonorants	'm'	[m]	✓			✓		✓	✓
	'n'	[n]				✓		✓	✓
	'l'	[l]				✓			✓
	'r'	[r]					✓		✓

There are two things to note about this chart. First, we represent the non-palatal coronal sonorants as having no place. There are two reasons for this: 1) given that there is no phonological evidence that these segments are specified with a place, an economical view of the grammar requires us to assume that no place feature is present, and 2) we will show below that a coronal place specification implies either a phonetic dental realization or a palatal realization, and since the non-palatal sonorant consonants are phonetically alveolar (Mønnesland 2002), they cannot have a place specification.

The second thing to note about the chart is that although the nasals can easily contrast with the other consonants without having to be specified as sonorants (i.e. having a V-manner[closed] feature in addition to C-manner[closed, nasal]), there is independent evidence from syllabification and accent that the nasals behave like sonorants in this language (Zec 1988). Thus, they have both a consonant and a vowel manner feature.

With the majority of the contrastive consonants in Serbian representationally and featurally accounted for, we now return to the palatals. Since one of the basic tenets of the Parallel Structures Model is that complex representations cannot be assumed without either contrast or process evidence, we have to wonder about the status and representations

of the palatal affricates. That is, although we have inventory evidence suggesting that the non-palatal affricate is, in fact, an affricate since it contrasts with both a stop and a fricative at the same place of articulation, we cannot say the same for the palatal affricates. As seen in (26), the palatal obstruents that are phonetically affricated are not in contrast with stops, and the laminal affricates do not even contrast with laminal fricatives.

(26) Broad articulatory descriptions of coronal obstruents

	Dental/ Alveolar		Palatal			
Stop	[t̪] ‘t’	[d̪] ‘d’				
Affricate	[t̪s̪] ‘c’		[t̪ʃ] ‘ć’	[d̪ʒ] ‘đ’	[t̪ʃ] ‘č’	[d̪ʒ] ‘dž’
Fricative	[s̪] ‘s’	[z̪] ‘z’			[ʃ] ‘š’	[ʒ] ‘ž’

From these facts, and the lack of any evidence that they are phonologically contour manner segments, we are left with the conclusion that there are no phonological affricates found in the palatal region in this language. Rather, the segments that are usually described as phonetic palatal affricates are really phonological palatal stops with accompanying phonetic release frication, as shown in (27).

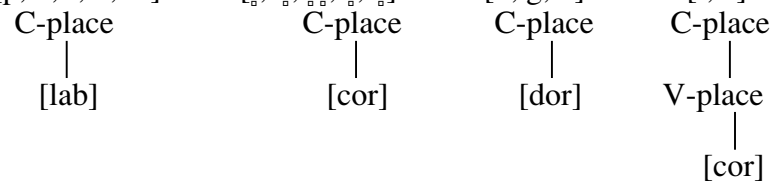
(27) Broad articulatory descriptions of coronal obstruents (revised)

	Dental/ Alveolar		Palatal			
Stop	[t̪] ‘t’	[d̪] ‘d’	[c̪] ‘ć’	[ɟ̪] ‘đ’	[c̪] ‘č’	[ɟ] ‘dž’
Affricate	[t̪s̪] ‘c’					
Fricative	[s̪] ‘s’	[z̪] ‘z’			[ʃ] ‘š’	[ʒ] ‘ž’

From an inventory perspective, the only thing remaining is to determine how to differentiate among the coronal stops. We propose that the best way to account for the inventory and alternation facts is to

analyze all palatal consonants as having a vowel place feature of [cor]. If we assume the Parallel Structures Model representations of consonant and vowel place, then we may analyze the following segments as having the following place representations (we will return to other relevant segment-internal structures below):

(28) a. [p, b, f, v, m] b. [t̪, d̪, t̪s̪, s̪, z̪] c. [k, g, x] d. [i, ɛ]



What is important to note here is that the C-place[cor] specification implies a *laminal gesture*. Thus, the non-laminal palatal consonants are minimally specified with a single V-place[cor][4], while the laminal palatal consonants have both a C-place[cor] and a V-place[cor], as shown in (29).

(29) a. [ç̪, ɟ, ʃ̪, ʒ̪, ɲ, ʎ] b. [ç̪, ɟ̪]

This complex place specification for the laminal palatal stop helps to account for several things. First, it explains why the laminal palatal stop is the only palatal segment with a laminal gesture. Second, it explains why the apical palatal obstruents can be either stops or fricatives, while the laminal palatal obstruents are always stops. That is, if segments with only one place feature (e.g. V-place[cor]) and one manner feature (e.g. V-manner[open]) are structurally less complex than segments with two place features (e.g. C-place[cor] and V-place[cor]) and one manner

[4] The specification of a consonant with only a vowel place of articulation might seem odd at first glance. However, there is no principled reason this should not occur, and it might make sense from a historical perspective since the Slavic languages seem to make extensive use of vowel place features to distinguish among consonant classes generally (e.g. palatal, labial and velar secondary places).

feature (e.g. V-manner[open]), then the basic tenet of the Parallel Structures Model which says that the presence of a more marked segment implies the presence of a minimally different less marked segment can be used here to explain the palatal obstruent manner asymmetry. Third, it explains why it is the laminal palatal consonants which are lost in those dialects which have only one palatal stop (Mønnesland 2002). The laminal consonants are lost because they are structurally more complex/marked than the apical consonants.

To summarize, the chart in (30) provides a featural overview of the Serbian segment inventory (ignoring voicing). Note that this inventory is maximally economical and maximally parallel.

(30) Phonological feature specifications for Serbian segments

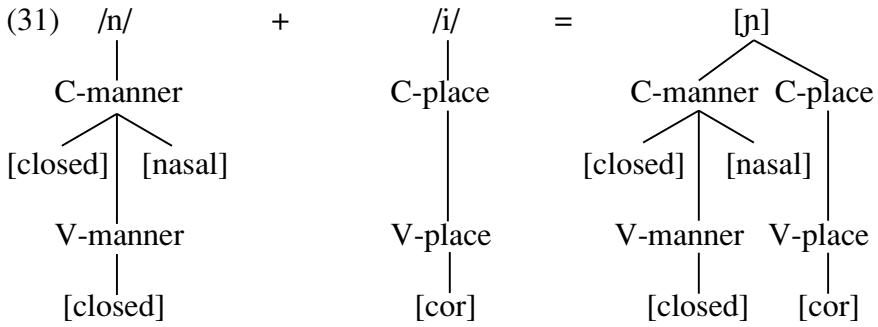
		C-place			V-place	C-manner			V-manner	
		[lab]	[cor]	[dor]	[cor]	[closed]	[open]	[nasal]	[closed]	[open]
'p'	[p]	✓				✓				
'f'	[f]	✓					✓			
'm'	[m]	✓				✓		✓	✓	
't'	[t̪]		✓			✓				
'c'	[t̪s̪]		✓			✓	✓			
's'	[s̪]		✓				✓			
'n'	[n]					✓		✓	✓	
'l'	[l]					✓			✓	
'r'	[r]						✓		✓	
'ć'	[ç]		✓		✓	✓				
'č'	[ç]				✓	✓				
'š'	[ʃ]				✓		✓			
'nj'	[ɲ]				✓	✓		✓	✓	
'lj'	[ʎ]				✓	✓			✓	
'k'	[k]			✓		✓				
'h'	[x]			✓			✓			
'i'	[i]				✓				✓	
'e'	[ɛ]				✓				✓	✓
'u'	[u]								✓	
'o'	[ɔ]								✓	✓
'a'	[a]									✓

7. Analysis of Serbian Iotization

Using the inventory discussion as a backdrop, we can now provide a very simple explanation for the iotization alternations, including both the change of non-palatal stops to palatal "affricates" and the change of velar stops to "apical" palatals. We propose that iotization is a morpho-phonological process merging a heightless[5] front segment with the preceding consonant (ignoring the labials for the moment). In this merging, the vowel place and consonant manner are always kept, but other features delete due to co-occurrence restrictions. Let us start with the sonorant consonants.

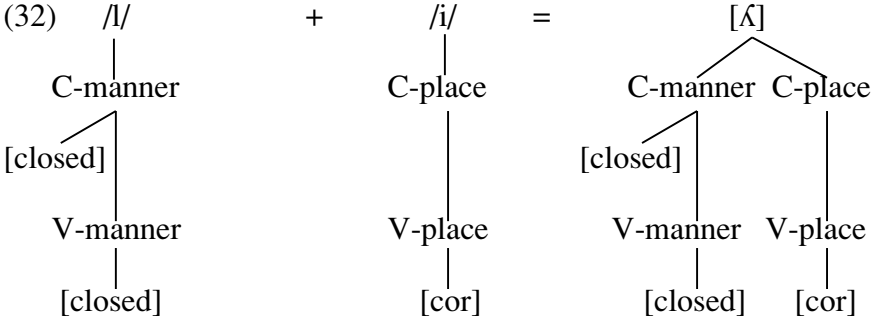
Recall that the non-palatal nasal and lateral become palatal, and the following vocalic segment does not surface as a separate segment. This is straightforwardly accounted for using the representational account given in (31) and (32).

(31)



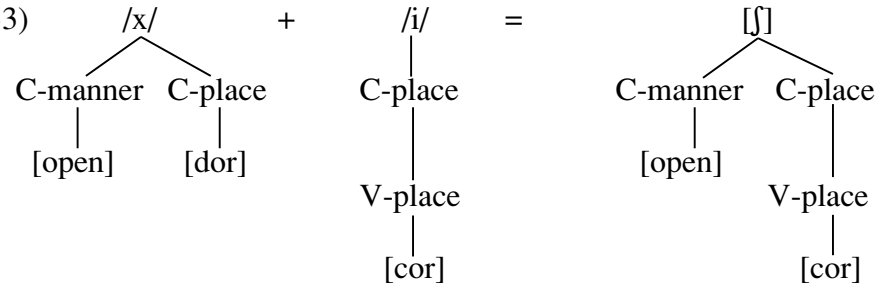
[5] Nothing in this analysis crucially relies on the characterization of the iotizing segment as heightless. However, assuming a mannerless segment with a vocalic place specification at the left edge of particular morphemes may help to explain, rather than just describe, why these morphemes cause preceding consonant alternations, while other morphemes beginning with high front vocalic segments do not.

(32)



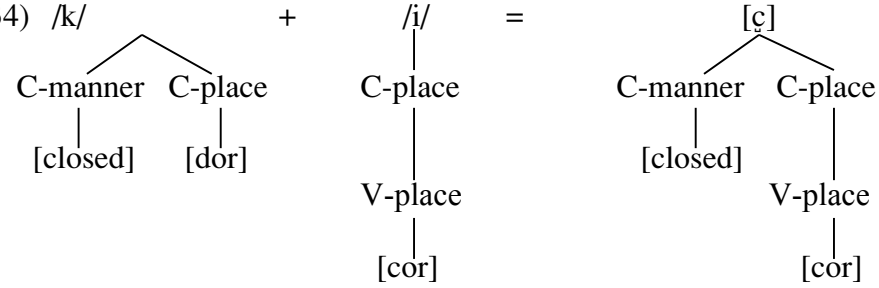
The velar fricative becomes a (non-laminal) palatal fricative by keeping the C-manner[open] of the fricative and the V-place[cor] of the vowel, but losing the C-place[dor]. The loss of the dorsal feature is due to a restriction against a single segment having both a coronal and a dorsal feature. The non-laminality is a result of not having a C-place[cor].

(33)



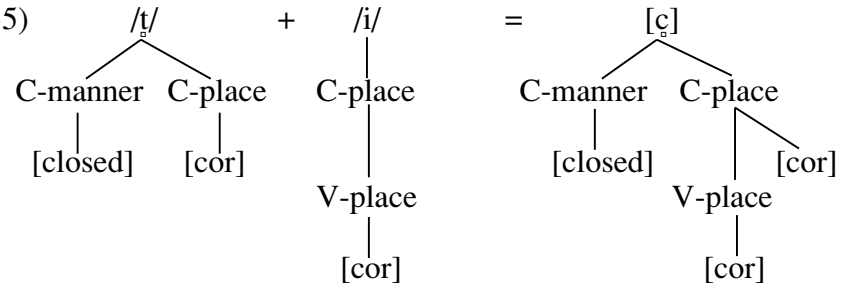
The velar stop becomes a (non-laminal) palatal stop in the same way, by keeping the C-manner[closed] and losing the C-place[dor]. Thus, it is the interpretation of the palatal "affricate" as a phonological stop that makes this process phonologically "natural". If the palatal were actually an affricate, it would be very difficult to motivate the addition of a continuant feature in this context.

(34) /k/ + /i/ = [c̟]



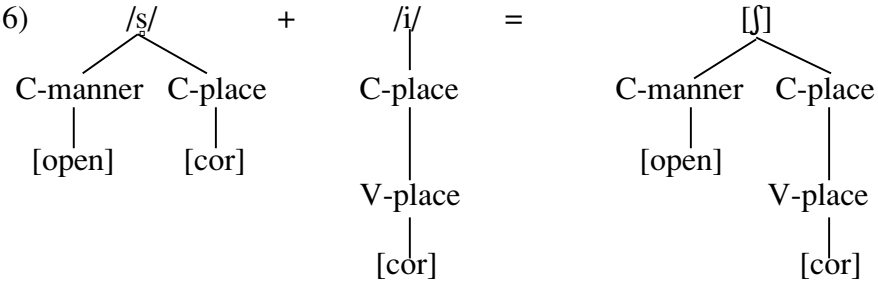
The laminal stop becomes a laminal palatal stop by keeping the C-manner[closed] of the stop, the V-place[cor] of the vowel and the C-place[cor]. The palatal place comes from the V-place[cor], but the laminality comes from the C-place[cor].

(35) /t̟/ + /i/ = [c̟]



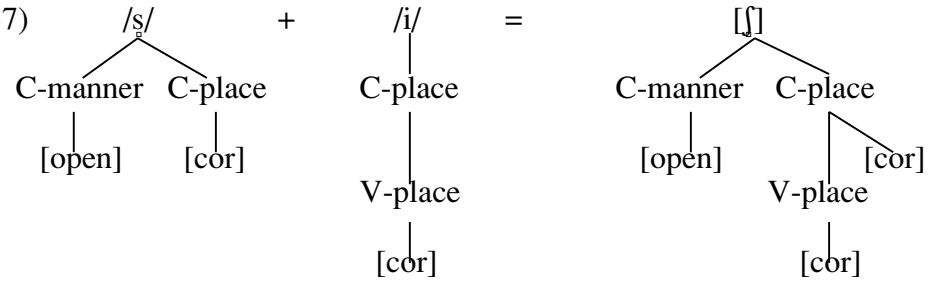
The laminal fricatives are interesting because it is unclear if they retain their C-place[cor] when they merge with the following iotizing segment. If the descriptions in the literature are correct, and they surface as non-laminal palatal fricatives, then they must keep the C-manner[open] of the fricative and the V-place[cor] of the vowel, but lose the C-place[cor]. Thus, they do not behave the same way their stop counterparts at the same place of articulation do. However, it is possible that the laminal fricatives become laminal palatal fricatives, thus behaving identically to the stops. Since this language does not distinguish between laminal and non-laminal palatal fricatives, native speakers would not necessarily hear a difference between them if they were both to surface in complementary distribution. This is an empirical issue that deserves careful phonetic research. However, both options are shown in (36) and (37).

(36)

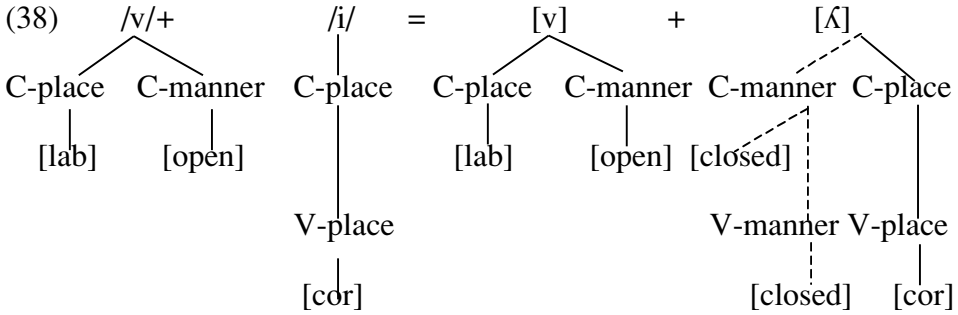


or

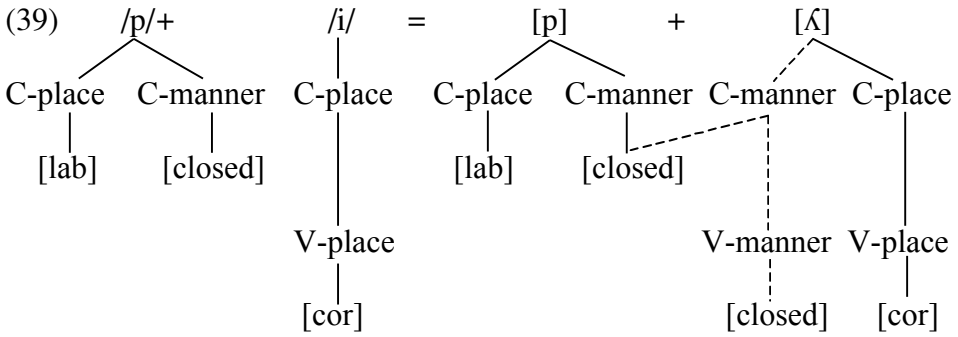
(37)



Finally, we must explain the iotization patterns of labial consonants. Interestingly, we do not see a change in the place or manner of articulation for these consonants. Rather, the iotizing segment gains a manner of articulation. This state of affairs is easily captured via two observations. First, it must be very important in this language for labial consonants to not lose their underlying [lab] specification. This is attested by the fact that velar obstruents lose their place feature and change to palatal, but labial consonants do not. Second, this language does not generally allow secondary place articulations, unlike its northern Slavic cousins. Therefore, realizing the iotizing vowel place as palatalization on the labial consonant is impossible. The result is a conflict between being faithful to underlying labial specification, being faithful to the manner-deficient underlying iotizing segment, and not allowing secondary articulations. To resolve this conflict, Serbian chooses to epenthesize manner features onto the iotizing segment to ensure that it can surface. Since the iotizing segment is syllabified as part of an onset cluster, the epenthetic manner features result in the least marked sonorant consonant - lateral. This is shown in (38) and (39).



As (39) demonstrates, it may be the case that labial stops share their consonant manner with the following lateral, thus minimizing the number of epenthetic features needed in this context.



8. Further Support from Consonant-driven Vowel Alternations

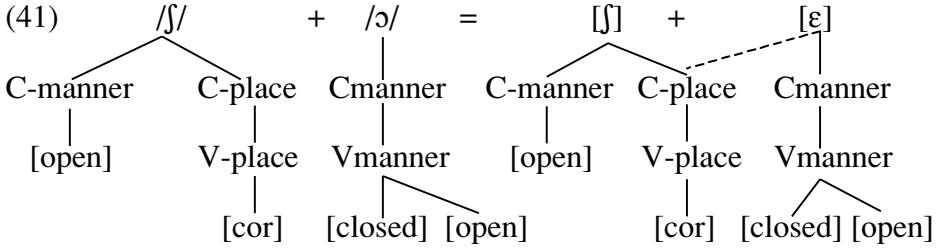
Finally, further support for the claim that palatal consonants have vowel place features comes from interactions between palatal consonants and mid vowels in particular morphological contexts. As the data in (40) show, underlying mid vowels become front following palatal consonants but not following non-palatal coronals.

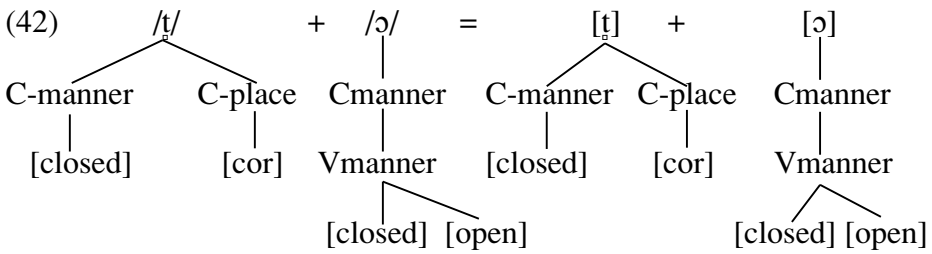
(40)	a. -o ~ -e	neuter noun		
		selo	[s̪ɛlɔ]	‘village
		polje	[pɔʎɛ]	‘field’
	b. –o ~ -e	nom./acc. neut. sing.		
		dobro	[d̪ɔbrɔ]	‘good’
		loše	[lɔʃɛ]	‘bad’

c. -om ~ -em dat./loc. sing.

dobrom	[d̪ɔb̪rɔm]	‘good’
lošem	[lɔʃɛm]	‘bad’

This is easily accounted for if underlyingly placeless mid vowels (see Section 5) assimilate to the vowel place of the preceding palatal consonant, as demonstrated in (41). However, (42) shows that mid vowels do not assimilate to preceding non-palatal consonants because the non-palatals do not have vowel place. This phenomenon is not so easily captured using traditional features or geometric structures.





9. Conclusion

This paper has provided a coherent and economical analysis of the segment inventory of Serbian that is couched in the Parallel Structures Model of feature geometry. The major results are a concrete proposal of the features and representations needed to explain the segment inventory, as well as a very straightforward account of several interesting, yet previously puzzling, aspects of the morpho-phonological phenomenon known as iotization. In addition, some interactions between the phonological representations and phonetic implementations of stops and affricates are discussed and analyzed, and the choice of which palatal affricate is lost in those dialects that only allow one is explained. Finally,

the morpho-phonological assimilation of mid vowels to preceding palatal consonants, but not to other coronals, is accounted for.

The specific claim of this paper is that Serbian non-palatal laminal consonants have a consonant coronal place feature, the apical palatal consonants have a vowel coronal place feature, and the laminal palatal consonants have both a consonant and a vowel coronal feature.

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