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FEATURE GEOMETRY AND PALATALIZATION

The paper examines palatalization data from English, Polish and Croatian in the framework of Feature Geometry. It is shown that palatalization in the discussed data results in a number of phonologically diverse outputs, which cannot be accounted for by using one unique palatalization feature. Instead it is argued that palatalization can be represented by the spreading of either of two independent place specifications of the vowel, or of their combination. This approach implies a threefold typology of palatalization processes.

1. Introduction

In this paper I will examine palatalization data from – among others – English, Polish, and Croatian. Whereas the assimilatory nature of palatalization has been broadly recognized, it has been a topic of much discussion within the framework of feature geometry since the representation of place of articulation for vowels, unlike for consonants, is not a straightforward issue. In this paper, it will be shown that palatalization may be accounted for if one assumes that it is triggered by two features, which may either spread independently or spread as a unit. This finding requires a reevaluation of the assumptions regarding the representation of front vowels.

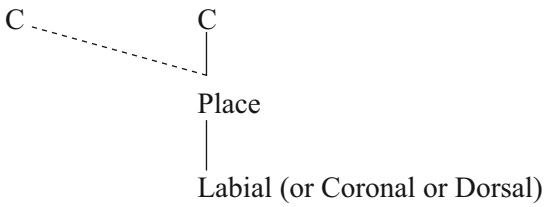
The paper is organized in the following way. First, in section 2, the two most influential earlier proposals regarding the featural make-up of front vowels will be briefly presented and it will be illustrated how palatalization is represented in these approaches. Section 3 will try to apply these frameworks to a number of palatalization processes in Polish. It will be argued that the palatal-

ization processes in Polish cannot be straightforwardly captured assuming earlier proposals. In section 4, an alternative approach will be offered and earlier data will be reanalyzed, and section 5 draws data from Croatian to support the proposal. Section 6 will address some outstanding questions, i.e., affrication of palatalized consonants, and the relative rarity of alveopalatal sounds as an output of palatalization.

2. Previous theories of feature geometry with respect to palatalization

Feature geometry (Clements 1985, Sagey 1986/1990, Hume 1992/1994, Halle 1995, Clements and Hume 1995) has originated from autosegmental phonology (Goldsmith 1990), where the independence of some features within a segment is represented by locating the independently acting feature on a separate tier. Feature geometry assumes additionally that if two or more features act together in phonology, this is represented in theory by grouping these features under a common organizational node. For example, virtually all approaches agree that different place features ([labial], [coronal], [dorsal]) form a larger organizational unit, the Place node, since many languages have processes of place assimilation where segments assimilate irrespective of whether the source is labial, coronal, or velar, whereas no other features of a given segment are assimilated. Thus, the rule of place assimilation refers directly to the Place node, and the spreading of Place implies the spreading of any feature that is arrayed under this node.

(1) Place assimilation in feature geometry

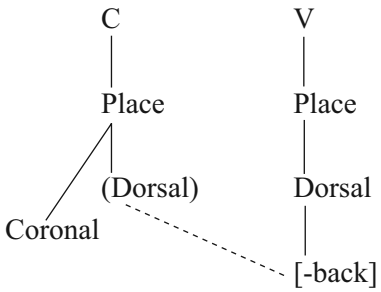


In the following sections, I will focus on the vowel-consonant assimilation processes, and review the necessary assumptions concerning the representation of the vowels involved in the interaction with consonants from the point of view of two competing models.

1.1. Articulatory model

Sagey (1986, 1990) and Halle (1995) assume that all vowels have in their representation the Dorsal node because vowels are articulated with the active involvement of the back part of the tongue. In front vowels, the back part of the tongue is supposed to initiate the forward movement (feature [– back]), whereas there is no such movement for back vowels (feature [+back]). Thus, palatalization is represented in Sagey (1986, 1990) as the spreading of feature [– back] from the vowel onto the consonant (with an automatic insertion of Dorsal node in the consonant).

(2) Palatalization of a coronal consonant in Sagey's (1986/1990) approach



A consonant with an additional Dorsal node (and attached [-back] feature) represents a consonant with a secondary palatalization. So, this model can account for processes such as, for instance, in Russian, where the result of palatalization is a consonant with a secondary palatalization.

(3) Palatalization in Russian with secondary palatalized consonants as output

(a)	vdo[v]+a	vdo[v^{j}]+e	'widow'
(b)	rı[b]+a	rı[b^{j}]+e	'fish'
(c)	flo[t]+a	flo[t^{j}]+e	'fleet'

However, it is very often that, apart from the additional secondary articulation, palatalization changes the main place of articulation of the consonant to coronal producing anything from dental, over alveolar, post-alveolar, and prepalatal to palatal sounds. For example, palatalization in English produces pala-

toalveolars [ʃ, ʒ, ʧ, ʤ], both in a lexicalized process as well as a result of a fast speech rule, as in examples below:

(4) Palatalization in English

(a)	[s] — [ʃ]	impress — impre[ʃ]n	
(b)	[z] — [ʒ]	diffuse — diffu[ʒ]n	
(c)	[t] — [tʃ]	Christ — chris[tʃ]n	
(d)	[t] — [ʃ]	opt — op[ʃ]n	protect — protec[ʃ]n
(e)	[d] — [ʒ]	invade — inva[ʒ]n	collide — colli[ʒ]n
(f)	[d] — [dʒ]	grade — gra[ʤ]ual	proceed— proce[ʤ]re
(g)	[s] — [ʒ]	Paris — Pari[ʒ]n	Caucasus— Cauca[ʒ]n
(h)	[s] – [ʃ]	I miss it - I mi[ʃ] you	
(i)	[z] – [ʒ]	I supervi[z]e it — I supervi[ʒ]e your project	
(j)	[t] – [ʧ]	I hate it — I ha[ʧ]e you	
(k)	[d] – [ʤ]	I nee[d] it — I nee[ʤ] you	

If we assume that the source of the assimilation, the vowel, is Dorsal (and not Coronal), the change of the target to Coronal is arbitrary. Contrary to intuition, palatalization with the change to coronal place of major articulation cannot be seen as an assimilatory process under this approach. An option would be to postulate that the change to the coronal place of articulation is a two-stage process (see 5), first changing the sounds to secondary palatalized ones (5a), than changing secondary palatalized sounds to Coronal (5b).

(5) Palatalization with the major change of the articulation place

(a)	Stage 1:	C --> C Dorsal[-back] / V Dorsal[-back]
(b)	Stage 2:	C Dorsal [-back] --> Coronal

The notation above states that secondary palatalized consonants become additionally coronal. Whereas one can design a notation to express this kind of a change, the change is still arbitrary and there is no theory-internal motivation behind it, i.e. the theory neither predicts nor explains it. Also, in English, there is no trace of the intermediate stage. Yet, instead of a simple straightforward notation, we are forced in this approach to postulate otherwise unmotivated stages

in the derivation. The criticism of this approach will also be that by definition it is incompatible with the main stream Optimality Theoretic approaches (Prince and Smolensky 1993, McCarthy and Prince 1986, McCarthy 2002), where we cannot refer to intermediate derivational stages and the final result of a phonological computation must be delivered in one step.

In the following section I will review an alternative theory which treats front vowels as coronal.

1.2. Constriction model

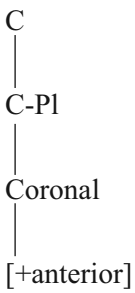
Clements (1985) pointed out the inadequacy of the assumption that all vowels are dorsal with respect to palatalization processes. If front vowels trigger the change to the coronal place of articulation in consonants, it would be logical to assume that front vowels contain a feature or node Coronal. This argumentation has been adopted by Hume (1992), Clements and Hume (1995), and many others. In this approach, the nodes are defined as identifying not the active articulator but the place of maximal constriction. Back vowels are Dorsal and front vowels have a Coronal node in their representation because the most radical constriction during the production of the vowel is located over the coronal area. Additionaly, Hume (1994) assumes that front vowels are inherently [– anterior][1].

This approach is problematic for the account of vowel harmony processes in many languages. Assuming that the Coronal specification of consonants and the Coronal specification of vowels is the same would be problematic because most of the time consonants do not intervene in vowel harmony processes. In order to accommodate for the facts of vowel harmony, Coronal specification in vowels occupies a different tier than in consonants, as in (6) below; cf. Clements and Hume (1995). Coronal node in vowels is represented under the V-Place node, and the Coronal node of the consonant is arrayed under the C-Place.

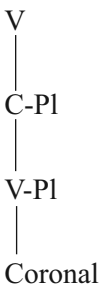
[1] This assumption might be problematic for the palatalization processes producing an alveolar fricative or affricate, as in Polish or Japanese. Yet, in Polish the alveolar [+anterior] sound is an output in a very limited lexicalized alternation being an effect of the whole chain of historical changes. In Japanese, on the other hand, the alveolar sound appears in the context of all high vowels but not all front vowels, thus, one might claim that the alternation is triggered by feature [+high] and thus is a different process than those discussed here.

(6) Representation of a consonant and a front vowel in the constriction model

(a) an alveolar consonant

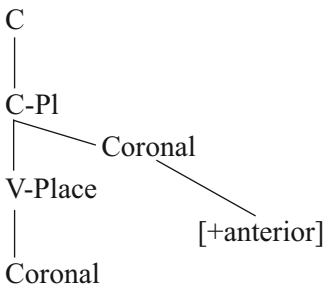


(b) a front vowel



Consonants may also have a V-Place specification meant to represent the secondary articulation of consonants, as represented schematically in (7).

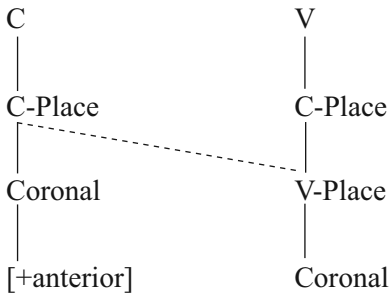
(7) Secondary palatalization in constriction model



Palatalization in this approach is viewed as a place assimilation with Coronal spreading from the vowel. A spreading with a resulting secondary palatalization is represented in (8) below[2].

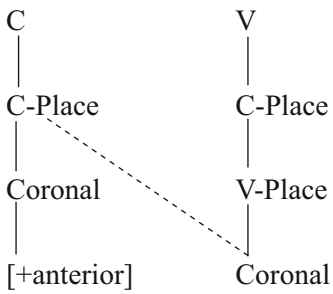
[2] Hume (1994:121) assumes that, although front vowels are inherently [– anterior], when vocalic Coronal spreads to a [+anterior] consonant, both the consonant and the vowel are realized as [+anterior]. On the other hand, the presence of [– anterior] specification is crucial in the assimilation involving velar consonants, where [– anterior] value of the resulting consonant comes from the vowel.

(8) Secondary palatalization in the constriction-based approach



The palatalization process resulting in a segment with a coronal major place of articulation is clearly an assimilatory process. However, in order to account for this type of palatalization, it would be necessary to allow an inter-planar spreading, which is not possible for any other features. Here, we have to specify when inter-planar spreading is allowed and when not, and when it actually does occur and when it does not occur although it is not banned.

(9) Palatalization with the change of the primary place of articulation, e.g., English



Change of constriction status: yes

There are some formal objections to (9). Accepting a spreading between planes just for this one particular feature weakens the theory. A feature geometry without inter-planar spreading is a more restrictive and formally more elegant theory. Also, the parameter regarding the change of the constriction status, which in Hume's model must be included in the statement of the rule in order to account for the spreading either to the Place linked under the Consonantal node or to the Place linked under the Vocalic node, is otherwise unmotivated.

3. Palatalization in Polish

Hume's analysis seems to account for the English palatalization data at this point as far as the change of the place of articulation is concerned. However, the theory should be such as to be able to express all possible palatalization processes and exclude all unattested possibilities. In what follows, the data from Polish is discussed and the conclusion will be that we need to propose another geometry of the palatalization features than the one assumed in Sagey (1986, 1990) and Halle (1995), or Hume (1992, 1994) and Clements and Hume (1995).

In Polish, we can talk about three different regular results of palatalization processes. 2nd Velar Palatalization (cf. Rubach 1984) takes underlying velars /k, g, x/ to surface post-alveolar retroflex-like[3] [tš, dž/ž, š], as in (10) below:

(10) 2nd Velar Palatalization

(a)	[k] – [tš]	kro[k] 'step'	kro[tš]yć	'to step'
(b)	[g] – [dž]	móz[g] 'brain'	wymóž[dž]yć	'to make stupid'
(c)	[g] – [ž]	wa[g]a 'scales'	wa[ž]yć	'to weigh'
(d)	[x] – [š]	ru[x] 'movement'	ru[š]yć	'to move'

One is tempted to assume that Velar Palatalization can be analyzed in the same way as the English data with the change of major place of articulation, as in (9) in the previous section. However, in a moment it will be shown that in Polish this approach is problematic.

Another regular palatalization process is Velar Fronting; cf. e.g. Rubach (1984). Velar stops /k, g/ are fronted to pre-velar [k^j, g^j] (and in a less regular fashion: [x] to [x^j]), as illustrated in (11):

(11) Velar Palatalization

(a)	ro[k] 'year' Nom.Sg.	ro[k^j]+em Inst.Sg.
(b)	blog 'blog' Nom.Sg.	blo[g^j]+em Inst.Sg.

[3] Although some researchers count the post-alveolar sounds of Polish among retroflexes (e.g. Hamann 2003), it is important to remember that they are articulatorily quite different from the typical retroflexes like in Dravidian languages. Polish post-alveolars are articulated without the characteristic raising and bunching back of the tip of the tongue. For this reason, they can be also phonetically secondarily palatalized, which often assumed to be impossible for 'real' retroflexes.

(c)	rak ‘crab’ Nom.Sg.	ra[k^{j}]+i Nom.Pl.
(d)	dłu[g]+a ‘long’ Nom.Sg.Fem.	dłu[g^{j}]+i Nom.Sg.Masc.
(e)	ma[x]+ać ‘to wave’	wyma[x^{j}]+iwać ‘to wave’ Iterative

Again, without looking at the whole system of palatalization processes in Polish, Velar Palatalization might potentially be accounted for as a spreading of the Coronal specification arrayed under the V-Place; cf. (8).

Finally, Coronal Palatalization (cf. Rubach 1984) needs to be mentioned, where dental stops and fricatives [t, d, s, z] (but not affricates), as well as the dental nasal [n], alternate with prepalatals [t͡ɕ,d͡ʑ, ɕ, ʑ, ɲ][4].

(12) Coronal Palatalization

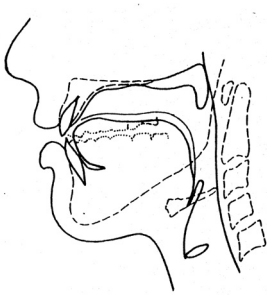
(a)	masa ‘mass’	ma[ɕ]+e Dat./Loc.Sg.
(b)	brąz ‘brown color’	bra[ʑ]+e Loc./Voc.Sg.
(c)	brat ‘brother’	bra[t͡ɕ]+e Loc./Voc.Sg.
(d)	moda ‘fashion’	mo[d͡ʑ]+e Dat./Loc.Sg.
(e)	Jan proper name	Ja[ɲ]+e Loc./Voc.Sg.

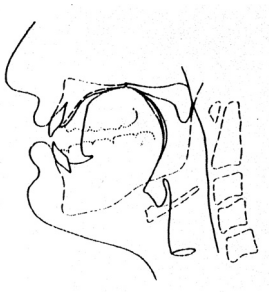
At first sight, one could be tempted to analyze Coronal Palatalization as the spreading of Coronal to the C-Place of the consonant. However, then the prediction would be that the output of Coronal Palatalization should not be different from the output of 1st Velar Palatalization. In fact, both the post-alveolar results of 1st Velar ([š, ž, tš, dž]), and the prepalatal effects of Coronal Palatalization ([t͡ɕ,d͡ʑ, ɕ, ʑ, ɲ]) are coronal, non-anterior. Yet they differ in that prepalatals are ‘inherently palatalized’ (cf. Keating 1991, Halle and Stevens 1989), that is, the mid part of the tongue behind the blade is raised towards the hard palate, the configuration that is particular for every secondary palatalized segment. Post-alveolars are also coronal, non-anterior, so the major place of articulation is the same, but in their articulation the tongue lies flat in the mouth cavity.

[4] The alternation of liquids, i.e., [r] changing to [ž] in the context of a front vowel, as well as [w] alternating with [l] is often treated with the change resulting in prepalatals. I do not discuss these alternations here because they need an independent account under any framework; cf. Ćavar (2004).

(13) Post-alveolars and prepalatals (after Wierzchowska 1967, 1980)

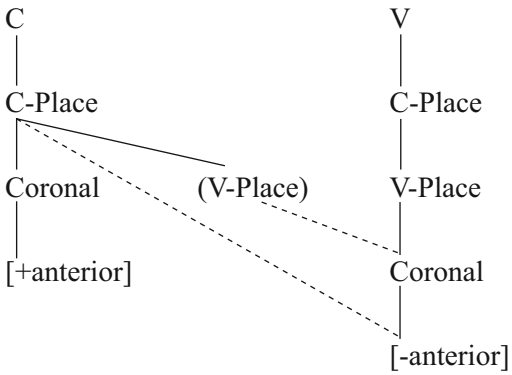
(a) post-alveolar [š, ž, tš, dž] (b) prepalatal [tɕ, dʑ, ɕ, ʑ, ɲ]





In terms of the constriction-based model, prepalatals have two Coronal specifications: one under the C-node, and another under the V-node. As a consequence, adopting the representation of the front vowel as in Clements and Hume (1995) would require that the Polish Coronal Palatalization is regarded as spreading of the Coronal node at the same time to the C-Place and the V-Place of the consonant, that is, it would require two independent operations at the same time.

(14) Coronal palatalization as a double spreading.



Thus, we end up again postulating a two-step solution. The data from Polish indicates that in order to distinguish between the different types of processes in Polish we actually need two 'palatalization features' to spread from the vowel, and a common node to dominate them for the cases when the two features act together.

4. Proposal

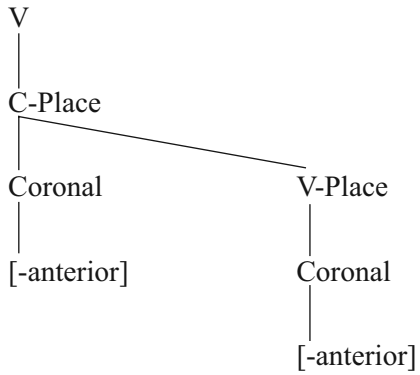
In order to express this idea that prepalatals originate from the spreading of two 'palatalization' features, we would have to modify either the Articulator model or the Constriction model with regard to the featural make-up of front vowels.

Within the Articulator model, we would need to assume that front vowels are both Dorsal [-back] and Coronal [-anterior]. A similar assumption has been adopted in Rubach (1993). In Rubach's analysis of Slovak it is assumed that front vowels are dorsal and

at a fairly early stage of derivation, before the application of palatalization rules, they are redundantly specified as [-anterior] at the Coronal node. Instead of assuming derivational steps, in principle one could assume that front vowels are both coronal[-anterior] and dorsal – by definition; cf. Cavar (1997). Yet this framework might be problematic for the exact same reasons why Clements and Hume (1995) assumed a division between the consonantal and vocalic place. This approach predicts that front vowels will interact with consonants in vowel harmonies. In fact, Hume (1992, 1994) described one such case in Maltese. Yet, it is more often that the major place of articulation of intervening consonants is transparent in vowel harmony processes, thus, there must be a theoretical tool to account for the distinction between consonantal and vocalic features.

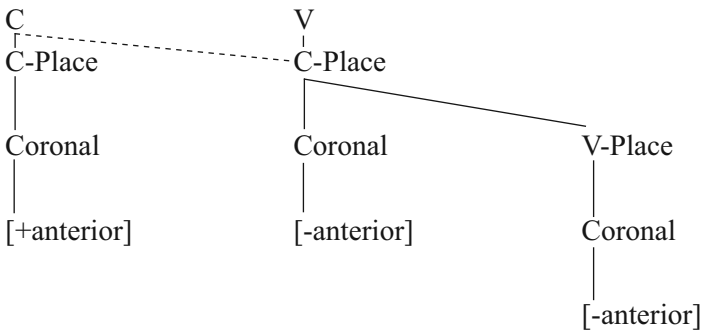
The option would be to adopt the constriction model with all the benefits of the distinction between vocalic and consonantal place features, and modify it in the way that front vowels are additionally specified as Coronal at C-Place (instead of having an empty C-Place).

(15) Front vowel in the modified model



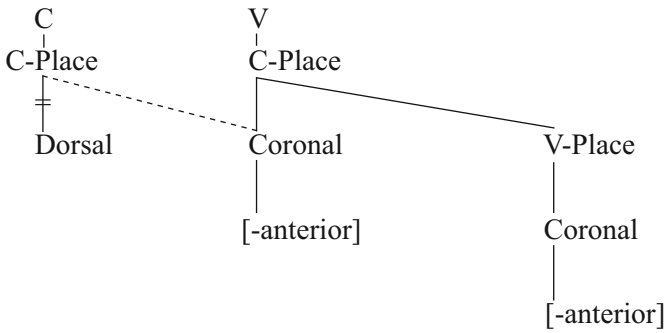
Within this approach we would analyze Coronal Palatalization as the spreading of the whole Place specification (including C-Place and V-Place) from the front vowel, as illustrated in (16):

(16) Coronal Palatalization



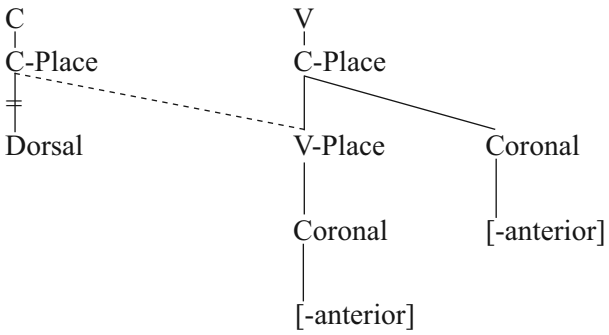
Further, 1st Velar Palatalization in Polish would be seen as a spreading of the Coronal node directly dominated by C-Place from the vowel alone.

(17) 1st Velar Palatalization



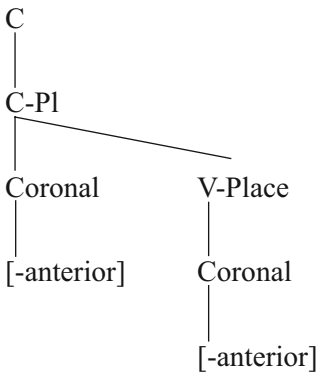
This proposal leaves room for the account of the secondary palatalization without the change of the major place of articulation, and explains processes such as the palatalization in Russian or Velar Fronting in Polish.

(18) Velar Fronting



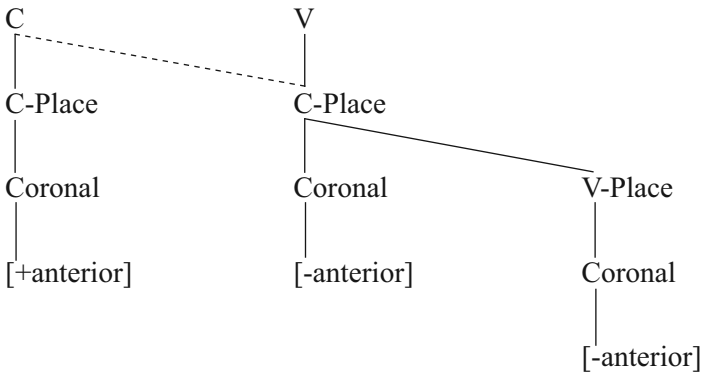
Finally, we would have to revise our approach to the palatalization in English. English palatoalveolars are articulated with the inherent raising of the tongue towards the hard palate, similarly like in prepalatals (though the displacement of the tongue from the rest position is less extreme than in prepalatals). Thus, more true would be to claim that the English palatoalveolars are represented with two coronal specifications, one for the place of articulation, and the other for the raising of the coronal part of the tongue towards the hard palate.

(19) English palatoalveolars



The palatalization in English should be seen from this perspective as a spreading of the whole Place node of the vowel, because otherwise we should obtain sounds which are non-anterior but articulated without the 'inherent palatalization', i.e., comparable to Polish series [š, ž, tš, dž]:

(20) English palatalization



5. Palatalization in Croatian

One possible criticism of this approach is that Polish palatalization processes belong partly in the realm of morphophonology, that is, their application depends on the choice of the morphemes. The next step would be to claim that all the processes are actually lexicalized, and particular for Polish only, and there is no need to propose a theory to explain their potential output. I will now turn to the data from Croatian and show that the Croatian data also requires the assumption of two 'palatalization' features. Although Polish and Croatian are genetically related, the genesis of prepalatals in the two languages is independent (Dalewska-Greń 2002: 96ff). Thus, if two languages show independently the same behavior, we want to claim that the phonological theory needs to explain the emergence of the regular effect.

Croatian, like Polish, has both non-secondarily-palatalized post-alveolars [š, ž, tš, dž] and prepalatals [t͡ɕ, d͡ʑ] (see Miletić 1933 for the relevant x-ray tracings which help to verify the classification of sounds in terms of place of articulation). In the Croatian literature (e.g. Težak and Babić 1996), we will find sometimes classifications of [š, ž, tš, dž] as post-alveolar or prepalatal sounds and [t͡ɕ, d͡ʑ] are described as real palatals. Barić et al. (1990:25) describe both [š, ž, tš, dž] and [t͡ɕ, d͡ʑ] as palatal sounds, the former as apical, the latter as laminal. This use of labels only partly corresponds to the broadly accepted English terminology that is adopted in this article. Thus, we refer to [š, ž, tš, dž] as to post-alveolars (without specifying further), and to [t͡ɕ, d͡ʑ] as prepalatals (cf. e.g. Brozović 1991), since it seems that these terms in the best way correspond to the definitions of terms as they are used in the phonological English-speak-

ing literature. For the overview of the relevant terminology from the phonetic perspective, see Keating (1991) and, from the phonological perspective Hall (1997).

Prepalatals are a result of historical palatalization process, and post-alveoalars may be an output of a synchronic alternation, cf. also diachronically Mihaljević (1991). The Croatian synchronic alternation is parallel to Polish 1st Velar Palatalization; cf. (21).

(21) Croatian Velar Palatalization

juna[k] 'hero' Nom.Sg.	juna[tš]e Voc.Sg.
knji[g]a 'book' Nom.Sg.	knji[ž]ewni 'literary'
[du[x] 'ghost' Nom.Sg.	du[š]e Voc.Sg.

In Croatian, there is no parallel of Polish Coronal Palatalization, yet there are prepalatals [tɕ, dʑ], and the two groups of sounds clearly have different featural representation. Given their phonetic similarity to Polish sounds, one can safely assume that whereas [tš, dž, š, ž] are coronal [-anterior] under the C-Place, [tɕ, dʑ] additionally have a V-Place with a Coronal specification.

Croatian prepalatals historically originated from the sequences of proto-Slavic *tj, *dj, the change going back to Old Slavic. This is different from Polish, because the same original sequences are rendered in Modern Polish as [ts, dz]; see (22a). On the other hand, Polish prepalatals clearly have no Croatian prepalatal counterparts, as exemplified in (22b).

(22)	Croatian	Polish	gloss
(a)	no[tɕ]	no[ts]	'night' Nom.Sg.
	svije[tɕ]e	świe[ts]e	'candles' Nom.Pl.
	pre[dʑ]a	prze[dz]a	'yarn' Nom.Sg.
	izme[dʑ]u	mię[dz]y	'between'
(b)	[t]ijesto	[tɕ]asto	'dough' Nom.Sg.
	[dj]eca	[dʑ]eci	'children' Nom.Pl.
	ra[d]i	ra[dʑ]e	'advise' Dat.Sg.

Unlike Croatian, Polish prepalatals originated from secondarily palatalized dentals, and the change was completed by 16th century only (Klemensiewicz 1985).

The Croatian palatalization as in (21) should be viewed as a spreading of the Coronal node underneath the C-Place without the V-Place. If it were a spreading involving the V-Place alone, the result would be a secondary palatalized velar, and if the whole specification of the vowel spread, the outcome would be a prepalatal, which is not the case.

Croatian has to differentiate between the outputs of Velar Palatalization and the prepalatals, thus, a more complex representation of a front vowel than in Hume (1994), Sagey (1990), or Clements and Hume (1995) seems necessary.

There are actually more languages which differentiate between two types of non-anterior coronals where one is articulated with the raising of the blade of the tongue towards the hard palate, and the other non-anterior sound does not have this 'inherent palatalization', and where at least one member of the pair is derived in the context of a front vowel. One more such example is Swedish. A prepalatal voiceless fricative [ɕ], a coronal [-anterior] sound, appears always in the context of a front vowel and contrasts with a retroflex sound, which is also coronal [-anterior]. Clearly, in order to get a prepalatal as an effect of palatalization, we need to explicitly specify that the outcome has additionally – apart from coronal [-anterior] specification under the C-Place node – also a coronal specification under the V-Place. Otherwise, it would be unclear why the output is a prepalatal and not a retroflex.

Summing up, Polish is not the only language where we would need to assume a representation of a front vowel with a double coronal specification, thus, the data problematic for the earlier theories cannot be dismissed as a idiosyncratic Polish phenomenon.

6. Residual problems

The spreading of any specification under the place node does not account for the fact that, whereas fricatives undergoing palatalization do not change the manner of articulation, stops alternate with affricates. In actual fact, feature geometry does not have theoretical tools to explain affrication.

The problem might find a formal solution if we assumed, following Lombardi (1990) and Sagey (1986), that affricates contain a double specification for the feature [continuant]: they are both [−continuant] and [+continuant]. Affrication in this case might be considered to be a spreading of [+continuant] from the vowel, as illustrated in (23).

(23) Affrication

However, the structural description of the rule is also met when the condition of the rule is a back vowel, yet the spreading does not occur from back vowels. Low or back vowels do not seem to have the tendency to affricate adjacent stops, and it is not clear why a spreading of continuancy should be limited only to the situations when the trigger is a front vowel. One cannot say, for instance, that front vowels are more continuant than back vowels.

Another approach was suggested by Padgett (Padgett 1995), who assumes that feature [continuant] is arrayed under place features. Thus, a spreading referring exclusively to Coronal would be impossible, and the prediction would actually be that if the place of articulation in the consonant changes to coronal, the manner of articulation must also change to an affricate or a fricative. This would motivate a concomitant mutation of Coronal and manner feature in palatalized consonants. The obvious problem in this approach would be of course the secondary palatalization, where manner of articulation does not change, i.e., the output of palatalization remains a stop. Bhat (1978) also reports palatalization with the change of the major place of articulation to a prepalatal stop (Bhat 1978, after Miller and Davis 1963). And last but not least, recent studies (e.g., Kim 2001) present arguments against feature [+continuant] in the representation of affricates altogether[5].

The two legitimate operations in feature geometry are a spreading of a feature (or a node) and a delinking of a feature. When talking about affrication in the context of a front vowel, we cannot regard it as a spreading from a front vowel because there is no 'affrication' or 'stridency' feature in the vowel, but rather it would have to be a feature insertion. There is in principle nothing wrong about feature insertion as long as it is phonetically motivated. Yet the question is then, providing affrication is a phonological effect, how phonology knows which feature insertion is phonetically motivated and which is not, consequently, how it can be distinguished between a phonetically legitimate insertion and the feature insertion which is not phonetically motivated. The problem of distinguishing between possible and impossible sound changes is supposed to be the core

[5] Earlier researchers assumed that affricates should be regarded as strident stops; cf., e.g., Rubach (1994).

of phonological theory, and should be formalized. Yet, the theory of feature geometry does not contain a sub-theory of possible feature insertion.

It is unquestionable that affrication of a consonant in the context of a front vowel "makes sense" phonetically. Lahiri and Evers (1991), cf. also Kim (2001), motivated the appearance of affricates instead of stops as a side-effect of the characteristic articulation of the palatalized consonant with an off-glide [j] release:

"Coronal consonants have relatively more energy in the higher frequencies than in the lower frequencies (Lahiri et al. 1984: 402). If, in addition, there is an off-glide [j] release for the [+high] palatalized coronal consonants, then there will be a greater increase in the higher frequencies, causing a concentration of energy in the high frequency range – a characteristic of strident segments." (Lahiri and Evers 1991:95)

This passage aptly explains the rise of stridency in phonetic terms. However, it is unclear how this account should be formalized within Feature Geometry, and how acoustic properties of the sound should influence the structure of a sound without prior assuming the existence of perceptual features. Another explanation, this time in terms of articulation, was hinted in Lahiri and Evers (1991). It has been proposed that stridency emerges because of the change to the palato-alveolar region, where the unmarked articulation of all obstruents is with stridency; cf. Lahiri and Blumstein (1984: 142). It is true that in languages of the world non-anterior obstruents tend to be affricates or fricatives. Yet, there are languages which have post-alveolar stops in their inventory (cf. Ladefoged and Maddieson 1996), and Bhat (1978) quotes one example of a language where palatalization produces a prepalatal stop, namely, Acoma (Bhat 1978 after Miller and Davis 1963). Thus, feature geometry cannot explain affrication.

Another problem is why it is so seldom that palatalization results in post-alveolar segments, relatively more seldom than the palatalization to a palatoalveolar or secondary palatalization. The answer to this question has to necessarily refer to the theory of inventories and the theory of markedness, feature geometry leaves this question unanswered.

7. Conclusions

The analysis in the approach of Sagey, as it was proposed originally in 1986 (Sagey 1986, 1990), cannot adequately account for the data whenever we have a palatalization with the change of the major articulation place to coronal. The model would be able to express the assimilatory nature of the process only if

we adopted the amendments by Rubach (1993) or Ćavar (1997). The former approach cannot be adopted within an OT approach, the latter models would be problematic for the account of vowel harmony processes.

In this article a modification of Hume-Clements model has been proposed as to include a Coronal specification on the C-Place tier in the representation of the vowel. This model predicts three possible kinds of a spreading: the spreading of the Coronal node from the C-Place, the spreading of the Coronal from the V-Place node, and the spreading of the whole Place node. In the original Clements and Hume's approach, the front vowel may spread in one operation either to the vocalic or to the consonantal Place. The Clements-Hume model predicts that the changes in a natural language changing both the main articulation to coronal [-anterior] and adding the secondary palatalization are a pure coincidence, and as such should not reoccur cross-linguistically. This prediction is not borne out, as it has been demonstrated in earlier sections.

This paper does not propose a solution to other issues problematic for feature geometry, such as the affrication concomitant with the change of the place of articulation in palatalization, or the relative rarity of post-alveolars as an effect of palatalization. Instead, it is suggested that these problems need to be explained with reference to perception.

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Geometrija obilježja i palatalizacija

Sažetak

U članku se istražuje palatalizacija u poljskome, hrvatskome i engleskome jeziku u okviru geometrije obilježja. Raspravlja se o tome kako palatalizaciju možemo pojmiti kao širenje obilježja mjesta tvorbe izravno ispod konsonantskoga mjesnog čvora (*C-Place node*) ili kao širenje mjesta tvorbe ispod vokalnoga mjesnog čvora (*V-Place node*), odnosno njihovu kombinaciju.

Rasprava počinje kratkim pregledom dvaju najutjecajnijih pristupa palatalizaciji unutar geometrije obilježja: artikulacijskoga modela (*Articulatory Model*, Sagey 1986 i 1999, Halle 1995) i modela stezanja (*Constriction Model*, Hume 1992, 1994, Clements i Hume 1995). Potom slijedi prikaz podataka o palatalizaciji u poljskome jeziku. Dokazano je kako nijedan od modela nije u potpunosti primjenjiv pri analizi tih podataka. Artikulacijski model ne može predvidjeti pravilnu izmjenu mjesta artikulacije konsonanata u koronalni glas u okružju prednjih vokala. Model stezanja, s druge strane, predviđa dvije vrste rezultata tijekom procesa palatalizacije: sekundarno palatalizirane glasove (bez promjene glavnoga mjesta artikulacije) i promjenu glavnoga mjesta artikulacije koronalnih glasova (bez sekundarne palatalizacije). Model ne predviđa mješoviti učinak, a poljski prednjonepčani glasovi nastali palatalizacijom ipak su rezultat kombinacije dviju promjena, tj. promjene glavnoga mjesta artikulacijske promjene i dodavanja sekundarne palatalizacije. Stoga palatalizacija u poljskome jeziku predstavlja problem i u primjeni modela stezanja. Slični se problemi pojavljuju i kod analize palatalizacije u standardnome hrvatskom jeziku, što pokazuje da te promjene nisu tek pojedinačne osobitosti poljskoga ili hrvatskoga jezika, već su indikativne s obzirom na mehanizme koji utječu na palatalizaciju u pojedinim jezicima te ukazuju na potrebu za sustavnim rješenjem koje će biti primijenjeno na analizu primjera iz obaju jezika.

U članku se zagovara potpuno nov pristup. Dokazuje se da prednji vokal ima dvostruku koronalnu (prednju) specifikaciju mjesta tvorbe. Dio bi se palatalizacijskih procesa iz kojih proizlazi sekundarna palatalizacija konsonanata (primjerice, pomicanje jedrenika u poljskome) valjao pripisati širenju obilježja vokalnoga mjesnoga čvora dalje od vokala. Dio je palatalizacijskih procesa i stvaranja ne-prednjih koronalnih glasova koji se artikuliraju bez podizanja jezika prema tvrdome nepcu u poljskome i hrvatskome (primjerice prva velarna palatalizacija u poljskome i velarna palatalizacija u hrvatskome), uzrokovan širenjem koronalnoga (prednjeg) mjesta tvorbe ispod konsonantskoga mjesnog čvora pri artikulaciji vokala. Konačno, širenje cijeloga mjesnog čvora zahtijeva promjenu u koronalne i palatoalveolarne konsonante (koronalna palatalizacija u poljskome).

Rad na kraju donosi kratak pregled mogućih nerazriješenih pitanja o načinu predstavljanja palatalizacijskih procesa unutar pristupa geometrije obilježja.

Ključne riječi: fonologija, geometrija obilježja, palatalizacija, poljski jezik, hrvatski jezik, engleski jezik

Keywords: phonology, feature geometry, palatalization, Polish, Croatian, English