Feature Geometry from the Perspective of Polish, Russian, and Ukrainian

Jerzy Rubach

This article looks at two current models of feature geometry, the Halle-Sagey model as modified by Halle (2005) and the Clements-Hume model, from the perspective of palatalization and related processes in Polish, Russian, and Ukrainian. The Halle-Sagey model predicts that palatalization should be analyzed by assuming derivational levels and is thus at odds with the tenet of strict parallelism in Optimality Theory. In contrast, the Clements-Hume model appears to be able to achieve the same goal without recourse to derivational stages because it is based on the assumption that, in the ways relevant for palatalization, vowels and consonants are characterized by the same features. However, analysis of palatalization and related processes shows that this assumption is incorrect. The consequence is that derivational stages cannot be avoided and that the tenet of strict parallelism must be rejected.

Keywords: Optimality Theory, features, Polish phonology, Russian phonology, Ukrainian phonology

It has long been recognized that phonological generalizations are best stated in terms of features.[1] In the past twenty years, the debate has focused primarily on two issues: first, the choice of features that are relevant in phonology and, second, the nature of hierarchical relationships between features. Both of these issues are united in their pursuit of a single goal: the construction of a formal framework of feature geometry that can express phonological generalizations in an insightful way.

In this article, I look at two current theories of feature geometry: the Halle-Sagey theory (modified in Halle 2005), called the *AT model*, and the Clements-Hume theory, called the *UFT model*.[2] I discuss these models from the perspective of palatalization and related processes in Polish, Russian, and Ukrainian. My focus is on theoretical issues and not on developing a complete

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[1] Halle (1992) attributes this discovery to Jakobson (1928, 1929) and Trubetzkoy (1929).

[2] I adopt these names from Halle, Vaux, and Wolfe 2000. *AT* stands for *Articulator Theory* and *UFT* for *Unified Feature Theory*.

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grammar of palatalization for these languages. In particular, I look at the processes triggered by the front vowel *i*. The discussion is set in the framework of Optimality Theory (OT; Prince and Smolensky 1993, McCarthy and Prince 1995) and centers around the issue of strict parallelism, an OT principle that prohibits derivational stages in phonological analysis.

It might appear that the model of feature geometry and the principle of strict parallelism are unrelated issues, but this judgment is incorrect. The sentiment of the researchers working within mainstream OT seems to lie with the UFT model. For example, Zoll (1997) assumes this model without discussion in her treatment of mimetic palatalization in Japanese.

From the point of view of this article, the attraction of the UFT model is that it appears to carry the promise of strictly parallel analysis for the palatalization of velars with concomitant retraction of the front vowel, for instance, //x + i// → [ʃɨ].[3] The change of velars to posterior coronals is analyzed in one fell swoop as coronalization, whereby the [coronal] feature of //i// is promoted to the C-Place node of the consonant, yielding the change in place of articulation from velar to coronal and the change from //i// to [ɨ]. (I discuss the details of this process in section 3.) This result cannot be obtained in the AT model, which requires that velar palatalization and vowel retraction be analyzed in two stages. Consequently, the AT model is at odds with the principle of strict parallelism. I argue that it is not the AT model but the principle of strict parallelism that must be rejected. I also show that the AT model is superior to the UFT model. The argument is that the AT model, but not the UFT model, can capture the phonological conspiracy governing palatalization, and capturing phonological conspiracies is the founding evidence for OT.

This article is organized as follows. Section 1 presents the relevant assumptions of the AT and UFT models. Section 2 addresses surface palatalization and introduces the mechanics of dealing with palatalization in OT. Section 3 looks at coronalization. An excursus in section 4 considers the unresolved status of the feature [−anterior] in its function of inducing posteriority. Section 5 presents an argument for derivational stages in OT. The consequences of this argument are pursued in sections 6 and 7, which analyze postlexical surface palatalization, vowel retraction, and vowel fronting, showing that the UFT model leads to analytical complications. Section 8 looks at depalatalization and argues that the UFT model is inadequate. The most important conclusions are summarized in section 9.

1 The AT Model and the UFT Model: Relevant Assumptions

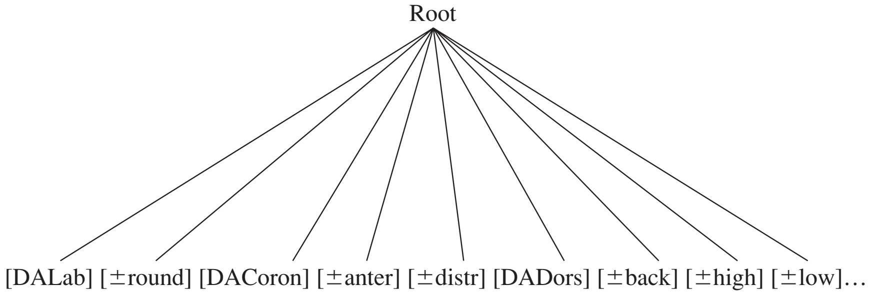
Since the seminal article by Clements (1985), it has been widely accepted that features are organized in the geometric fashion of a tree format. The debate centers on how this tree should be

[3] I will use double slashes for underlying representations, single slashes for intermediate stages, and square brackets for phonetic representations.

structured and what features should be employed. These questions are answered differently in the AT model and in the UFT model. In what follows, I focus on the fragment of feature-geometric representation that is relevant to the treatment of palatalization and related issues.

The AT model, developed in Sagey 1986, Halle 1992, 1995, 2005, and Halle, Vaux, and Wolfe 2000, uses different features to represent consonants and vowels and assumes that some features directly represent the designated articulators (DA features) that produce a given segment: lips (labial articulator), the tongue blade (coronal articulator), and the tongue body (dorsal articulator). DA features (here: [DALabial], [DACoronal], and [DADorsal]) are unary and hence different from most other features, which are binary. The most recent version of the AT model, that proposed by Halle (2005), departs radically from the earlier versions and from Clements 1985 in that it assumes a ''bottle brush'' organization of features, with every feature occupying an autosegmental tier of its own. The tree has no internal structure with nodes or features mediating between the terminal features and the Root node.[4] (For reasons of space, the tree in (1) does not represent the full set of features.)

(1) *AT model*

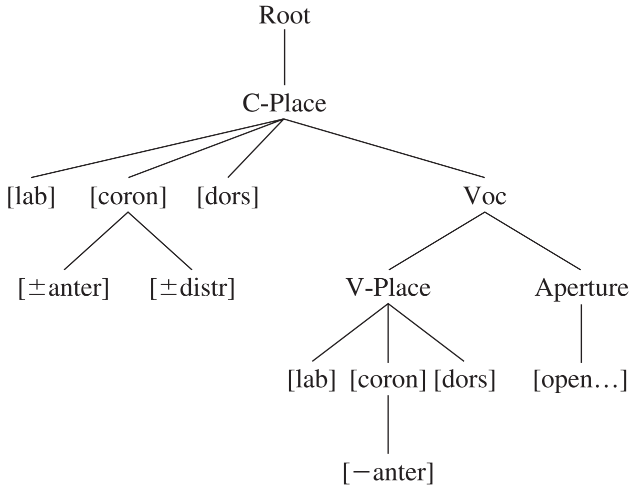


All vowels bear the feature [DADorsal], but front vowels are also [DACoronal] (Halle 2005).

The UFT model is different with regard to both the features used and the structure of the tree (Clements 1989, Hume 1992, 1996, Clements and Hume 1995). First, it employs the same features for both consonants and vowels and, second, vowels are characterized by nodes and features that are dependents of the Vocalic node, which itself is placed under the Consonantal-Place node. The fragment of the tree that is relevant from the perspective of this article is shown in (2).

[4] Halle (2005) assumes that simultaneous spreading of more than one feature expressed in the earlier versions of AT by reference to nodes is governed by special constraints on feature spreading and should not be reflected in the structure of the tree.

(2) *UFT model*



Some differences between (1) and (2) are not relevant from the perspective of palatalization and hence will be ignored. For example, the feature [open] under the Aperture node in (2) characterizes height and can be multivalued. The relevant differences are of three types. First, in the AT model, secondary articulation is expressed by the features [±back] and [±high] directly under the Root node. In the UFT model, it is expressed by the features under the V-Place node. Second, [coronal] and [dorsal] are privative features in the UFT model.[5] As dependents of the V-Place node, they correspond to the [−back] and [+back] specifications, respectively, in the AT diagram. Third, the features [coronal, −anterior] define both posterior coronal consonants and front vowels in the UFT model, which appears to mean that this model is better poised than the AT model for making sweeping generalizations regarding instances of palatalization in which velars turn into posterior coronals (see section 3).

Let us pause for a moment and consider the replacement of [±back] by the privative [coronal] and [dorsal] in the UFT model. This move raises the question of how the UFT model is able to account in a straightforward way for processes that spread both values of [back], as is often the case in vowel harmony languages such as Turkish.[6] The problem is how to avoid the complication of spreading [−back] and [+back] (i.e., [coronal] and [dorsal]) by separate rules. The UFT proposal is to introduce an intermediate node called Lingual that dominates [coronal] and [dorsal] in vowels and consonants.[7] However, Halle, Vaux, and Wolfe (2000) show that the evidence for

[5] [labial] is also a privative feature, but it plays no role in the analysis of palatalization that I pursue in this article.

[6] A related question is how the UFT model accounts for blocking effects when a palatal or velar consonant inhibits the spread of [±back], that is, [coronal] and [dorsal] in the UFT model. See Halle, Vaux, and Wolfe 2000 for discussion.

[7] As noted by Halle, Vaux, and Wolfe (2000), the UFT model's commitment to the Lingual node is unclear because the node is omitted in the feature tree that Clements and Hume (1995:292) finally adopt.

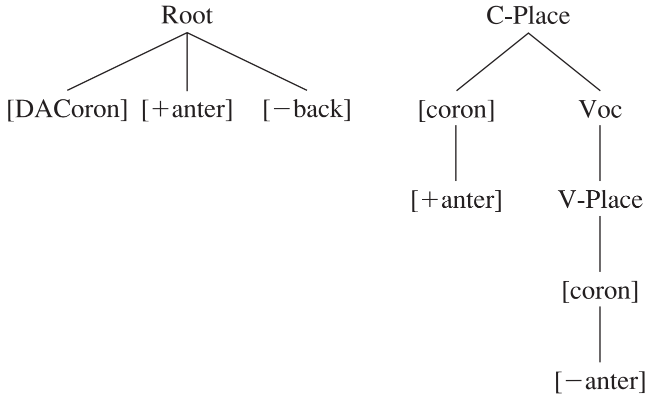
Lingual is illusory because the supporting examples can be either dismissed or reanalyzed (see the discussion on pp. 402–405). This contention is strengthened further by the observation that the Slovak *æ*-Backing process can also be reanalyzed. (This process is cited by Clements and Hume (1995:291, based on Rubach 1993) as evidence for Lingual, and the argument is not addressed by Halle, Vaux, and Wolfe (2000).)

In Rubach 1993, I observe that in Slovak //æ// is backed to [a] after coronals and velars but not after labials: for instance, //ʒæb + a// → [ʒaba] 'frog', //ɔ + kæd + i + t'// → [ɔkad'it'] 'to incense', but //pæt + a// → [pæta] 'heel'. It appears that such forms provide evidence for grouping coronals and velars under the Lingual node, as then *æ*-Backing can be stated by defining Lingual as the environment of the process. However, this argument has lost force in OT. In Rubach 2000b, I show that *æ*-Backing is a matter of two constraints: a markedness constraint prohibiting [æ], *[æ] (''Do not be [æ]''), and an identity constraint requiring the preservation of //æ// after labials, IDENT(Labæ). With the ranking IDENT(Labæ) ≫ *[æ], [æ] can occur after labials. In all other contexts, *[æ] induces a default repair to [a]. The Lingual node plays no role in this operation.

Essential for the purposes of this article is the representation of secondary articulations in AT and UFT: palatalization and velarization. I exemplify the difference between the two models by looking at the representation of a palatalized lateral in (3) and a velarized lateral in (4). The diagrams show the relevant part of the tree.[8]

(3) *Palatalized [l']*

a. AT model b. UFT model



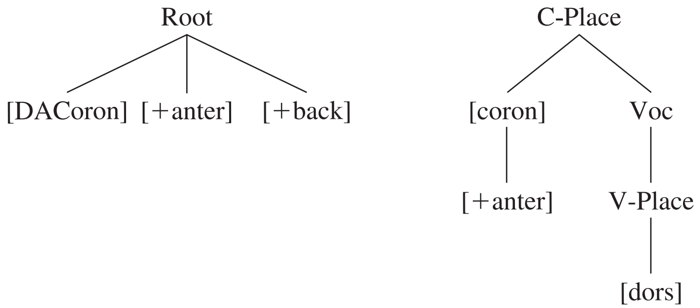
Velarization has never been explained in the literature proposing the UFT model, but I assume that it would be represented as the feature [dorsal] under V-Place, which makes it a mirror image of palatalization.

[8] Palatalized and velarized consonants are [+high], but I simplify representations by omitting this specification.

(4) *Velarized [ł]*

a. AT model

b. UFT model



2 Surface Palatalization

This section presents the treatment of palatalization in OT and pursues the mechanics of the analysis by introducing the relevant constraints and showing how these constraints interact. The focus is on palatalization as secondary articulation that does not affect places of articulation, a process that I call *surface palatalization*. The data for this part of the analysis are drawn from Russian.

Russian, like Polish and Ukrainian, has a surface inventory of six vowels: the high vowels [i ɨ u], of which [ɨ] and [u] are classified phonologically as [+back] (with [−round] versus [+round] being responsible for the contrast), the mid vowels [ɛ ɔ], and the low vowel [a]. The consonantal system exhibits the opposition of velarization versus palatalization as secondary articulation (Sweet 1879, Broch 1911, Halle 1959, Avanesov 1968). In the Slavic tradition that I adopt here, velarized consonants are called ''hard'' and palatalized consonants are called ''soft.'' The bifurcation of consonants into hard and soft cuts across the whole system, producing contrasts such as [z] – [z'] and [t] – [t'] in words such as *zad* [zat] 'back' versus *z'at'* [z'at'] 'son-in-law'.[9]

Front vowels trigger surface palatalization both inside morphemes and across morpheme boundaries.

(5) *Russian surface palatalization*
sto*l* [l] 'table' – sto*l*+*e* [l'ɛ] (loc.sg.), sto*l*+*i*k [l'i] (dimin.)
slo*n* [n] 'elephant' – slo*n*+*e* [n'ɛ] (loc.sg.), slo*n*+*i*k [n'i] (dimin.)
no*s* [s] 'nose' – no*s*+*e* [s'ɛ] (loc.sg.), no*s*+*i*k [s'i] (dimin.)
vo*z* [s] 'cart' – vo*z*+*e* [z'ɛ] (loc.sg.), vo*z*+*i*k [z'i] (dimin.)
bra*t* [t] 'brother' – bra*t*+*e* [t'ɛ] (loc.sg.), bra*t*+*i*k [t'i] (dimin.)
do*m* [m] 'house' – do*m*+*e* [m'ɛ] (loc.sg.), do*m*+*i*k [m'i] (dimin.)
*dire*ktor [d'ir'ɛ] 'director', *le*to [l'ɛ] 'summer', *si*ra [s'i] 'sulphur', *ki*no [k'i] 'cinema'

[9] However, [ʃ ʒ ts] are always hard while [ʧ] is always soft, hence [ʧ'].

Palatalization in OT is driven by constraints that mandate agreement between the consonant and the vowel. A theory using the AT model states these constraints as agreement in backness (Rubach 2000a).

(6) *AT model*[10]
 a. PAL-*i*
  A consonant and a following high vowel must agree in backness.
 b. PAL-*e*
  A consonant and a following mid vowel must agree in backness.

The evidence adduced in Rubach 2000a in support of PAL-*i* and PAL-*e* as separate constraints includes an argument that a language may exhibit palatalization before //i// but not before //ɛ//.[11] For example, Polish postlexical palatalization is found before *i* but not before *e*,[12] as in *kot Ireny* [t'#i] 'Irene's cat' versus *kot Ewy* [t#ɛ] 'Ewa's cat'.

Returning to the Russian data, the examples in (5) show that the agreement in backness between the consonant and the vowel is achieved at the expense of the unfaithful mapping of the consonant: the input hard consonant changes into an output soft consonant, which violates IDENT-C([+back]).

(7) *IDENT-C([+back])*
 Input [+back] on a consonant must be preserved in an output correspondent of that consonant.

The vowels in (5) are not affected under palatalization. For instance, *stol+ik* //stɔl+ik// 'table' (dimin.) surfaces as [stɔl'ik] rather than as [stɔlɨk], where the input //i// has changed into [ɨ] in order to achieve the agreement in backness between the consonant and the vowel. The incorrect output *[stɔlɨk] is eliminated by a constraint that mandates the faithful mapping of front vowels.[13]

(8) *IDENT-V([−back])*
 Input [−back] on a vowel must be preserved in an output correspondent of that vowel.

[10] Here and throughout this article, I will use the shorthand phrasing ''the AT model'' and ''the UFT model'' for what would be better expressed as ''a theory using the AT model/the UFT model.'' That is, I do not mean to imply that my interpretation of these models and/or my analysis are necessarily in agreement with the views of the proponents of the AT model and the UFT model. Halle (2002; see also Bromberger and Halle 1989) criticizes OT on the grounds that it cannot accommodate the opacity that is inherent in phonology. Clements (2000) is also skeptical about standard OT in general and argues that, in order to be a viable framework, OT must be derivational, a point I also make in this article and have made on several other occasions (see Rubach 1997, 2000a,b, 2003).

[11] In the same vein, PAL-*æ* is a constraint mandating agreement in backness before low vowels. Palatalization triggered by //æ// is found in Slovak (see Rubach 1993). Likewise, PAL-*j* accounts for palatalization before *j* (see Rubach 2000a).

[12] Lexically (i.e., in the domain of words), palatalization is triggered by both *i* and *e*. See Rubach 1984a and the discussion in section 3 below.

[13] Actually, vowel retraction, //i// → [ɨ], is an attested process in Russian, but it occurs postlexically, as in *stol Ivana* [stɔl ɨvana]. I discuss this process in section 6.

Given the constraints in (6)–(8), palatalization is an effect of the ranking schema in (9).

(9) *Palatalization*
PAL-*i* ≫ PAL-*e*[14] ≫ IDENT-V([−back]) ≫ IDENT-C([+back])

Further, we need to make sure that consonants do not change their place of articulation under palatalization. This is taken care of by the faithfulness constraints that mandate the preservation of the input place features in the output, for example, IDENT([+anter]) and IDENT([DADors]). I assume the widely accepted tenet that [±anterior] as a feature is valid for coronal segments.

(10) a. *IDENT([+anter])*
Input [+anterior] on a consonant must be preserved in an output correspondent of that consonant.
b. *IDENT([DADors])*
Input [DADorsal] on a consonant must be preserved in an output correspondent of that consonant.

There is yet another outstanding issue: we need to make sure that coronal inputs are not affricated in the output, which is an important concern because Russian as well as Polish and Ukrainian have affricates in their inventory of both underlying and phonetic segments. That is, [±strident] is a distinctive feature for coronals.[15] The constraint barring affrication, for example, the putative /t/ → [ts], is IDENT([−strid]).

(11) *IDENT([−strid])*
Input [−strident] on a consonant must be preserved in an output correspondent of that consonant.

The interaction of the constraints developed thus far is illustrated in tableau (12), where I look at the relevant fragment of the word *brat+ik* 'brother' (dimin.). The underscore under the *t* in candidate (12e) denotes a posterior place of articulation.

[14] The ranking PAL-*i* ≫ PAL-*e* expresses the implicational generalization that a language that has palatalization before *e* must also have it before *i* (see Chen 1973).
[15] This observation plays a role in the analysis of velar palatalization in section 3.

(12) AT model: //t+i// → [t'i][16]

	ID([−strid])	ID([+anter])	PAL-✻	ID-V([−bk])	ID-C([+bk])
☞ a. t'i					*
b. ti			*!		
c. tɨ				*!	
d. ts'i	*!				*
e. t̠'i		*!			*

A UFT analysis of the Russian data is comparably successful. Given the differences in the feature diagrams between the AT model and the UFT model (see (1)–(3)), the PAL constraints in (6) are restated as follows:

(13) *UFT model*
a. PAL-*i*
A consonant and a following high vowel must agree in [coronal, −anterior].
b. PAL-*e*
A consonant and a following mid vowel must agree in [coronal, −anterior].

Since, apart from the terminological replacement of [−back] by [coronal], the IDENT constraints are the same in the UFT model as in the AT model, the analysis of Russian surface palatalization is essentially the same as in (12) and hence will not be repeated.[17]

In preparation for the later discussion, I wish to return to the evaluation in (12) and look at the candidates [ts'i] in (12d) and [t̠'i] in (12e). Both of these outputs are attested in the Slavic languages.

The soft dental affricates [ts'] and [dz'] are found in Vilnius Polish (Turska 1983), a dialect of Polish spoken in Lithuania. They are an effect of palatalization operating on //t d//.

[16] My consultant who speaks a Moscow dialect has an affricated soft dental rather than the plain soft dental. The other consultants, who are from St. Petersburg, have a nonaffricated [t']. In their speech, I hear no difference between the [t'i] in *bratik* 'brother' (dimin.) and the [t'i] in my own pronunciation of the Polish phrase *brat Ireny* (see Wierzchowska 1971).

[17] A difference between the two models is found in the treatment of //ɨ//, a point that I discuss at length in the following sections.

(14) *Vilnius Polish*
//t d// → [ts' dz'] before front vowels
Szko*t* [t] (nom.sg.) Szko*c* + *i* [ts'i] (nom.pl.) Szko*ci* + *e* [ts'ɛ] (loc.sg.)
Szwe*d* [t] (nom.sg.) Szwe*dz* + *i* [dz'i] (nom.pl.) Szwe*dzi* + *e* [dz'ɛ] (loc.sg.)
Note: [t] in *Szwed* is due to Final Devoicing.

The point of interest is that stops become affricates under palatalization, a generalization that I state in (15).

(15) *Soft Stridency (Soft-Strid)*
No palatalized nonstrident coronals.[18]

The difference between Russian //t d// → [t' d'] and Vilnius //t d// → [ts' dz'] is a matter of how Ident([−strid]) and Soft-Strid are ranked vis-à-vis each other. In Russian, the ranking is Ident([−strid]) ≫ Soft-Strid; in Vilnius Polish, this ranking is reversed.

(16) AT model: Vilnius Polish //t+i// → [ts'i]

	Soft-Strid	Id([+anter])	Pal-*i*	Id-V([−bk])	Id-C([+bk])	Id([−strid])
a. t'i	*				*	
b. ti			*!			
c. tɨ				*!		
☞ d. ts'i					*	*
e. t̠'i	*!	*			*	

The output [t̠'i] in (16e), where [t̠'] is a posterior soft stop, is attested in Slovak (see Rubach 1993). It is an effect of palatalization operating on //t d//, as in *advokát* 'lawyer' – *advokát* + *i* (nom.pl.) and *hrad* 'castle' – *hrad* + *e* (loc.sg.). The observation is that anterior stops become posterior under palatalization, a generalization that I call *Soft Posterior*.

(17) *Soft Posterior (Soft-Post)*
No palatalized anterior coronals.

The difference between Russian and Vilnius Polish, on the one hand, and Slovak, on the other hand, is the ranking of Ident([+anter]) and Soft-Post. In Russian and Vilnius Polish, the ranking is Ident([+anter]) ≫ Soft-Post, so Soft-Post has no force. In Slovak, this ranking is reversed, so the posterior soft [t̠' d̠'] are the optimal outputs.

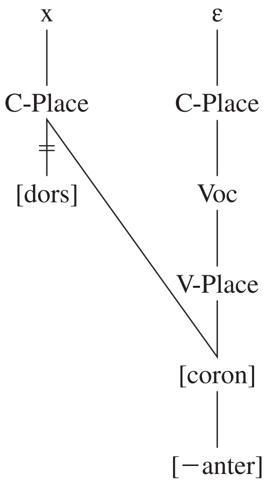
[18] A separate constraint prohibits strident sonorants.

3 Coronalization

The treatment of velar palatalization, //k g x// → [ʧ ʤ ʃ] before front vowels, appears to provide strong evidence in favor of the UFT model. The argument is that [coronal, −anterior], which is a property of front vowels in this model, is spread to velars, inducing coronalization. For instance, the input //x + ɛ// turns into [ʃɛ] by promoting the [coronal, −anterior] of the vowel to the C-Place node of the consonant (see (18)). If, as is the case in the Slavic languages, dorso-coronals are not well-formed segments, the delinking of [dorsal] in the input //x// follows from segment inventory constraints.

(18) *UFT model*

//x+ɛ// → [ʃɛ]



A spectacular effect of the UFT model is the ability to turn //x + i// into [ʃɨ] in one fell swoop. (And, likewise, //k + i// → [ʧɨ] and //g + i// → [ʤɨ].) This is exactly what is needed in Polish.

Polish is similar to Russian in that it does not have plain consonants (Wierzchowska 1963): consonants are either hard (velarized) or soft (palatalized). This bifurcation cuts across the whole consonantal system, including velars. The opposition hard – soft is contrastive with the exception of coronal stridents, [ts dz ʃ ʒ ʧ ʤ], which are hard in the phonetic representation.[19]

[19] As I point out later, these stridents can in fact be palatalized, but their palatalization occurs regularly only at word boundaries when they are followed by a word beginning with *i* or *j*.

(19) *pia*st + a [p'a][20] 'nave' – *pa*st + a 'toothpaste'
*mio*tł + a [m'ɔ] 'broom' – *mo*tłoch [mɔ] 'mob'
*kie*lni + a [k'ɛ] 'trowel' – *ke*lner [kɛ] 'waiter'[21]
*gie*rmek [g'ɛ] 'henchman' – *ge*niusz [gɛ] 'genius'
*ca*ł + y [tsa] 'whole', *dzwon* [dzvɔn] 'bell', *sza*r + y [ʃa] 'gray', *ża*r [ʒa] 'heat', *cza*s [ʧa] 'time', *dżu*ngl + a [ʤu] 'jungle'[22]

The vowel system of Polish is the same as that of Russian, and it includes [ɨ].[23]

Velar palatalization applies in derived environments, and it turns //x k g// into [ʃ ʧ ʤ] before front vowels. There are two special facts that need to be noted. First, the outputs of velar palatalization are hard (velarized) rather than soft (palatalized) consonants, which accords with the fact that Polish [ts dz ʃ ʒ ʧ ʤ] are hard, as in (19). Second, the front vowel //i// that triggers palatalization surfaces as [ɨ], which is [+ back] in the AT model. There is no doubt that the hardness of [ts dz ʃ ʒ ʧ ʤ] and the change of //i// into [ɨ] are related facts. Polish, like Russian, does not permit the cooccurrence of hard consonants and [i]; that is, [Ci] is an impossible output. The only admissible concatenations are [C'i], where the consonant is [− back] and the vowel is front, and [Cɨ], where the consonant is [+ back] and the vowel is back. (I discuss these restrictions further in sections 6 and 7.)

(20) *Palatalization before* e *and* i *in Polish*
a. Palatalization before *e*
maco*ch* + a [x] 'stepmother' – maco*sz* + *e* [ʃɛ] (dat.sg.)
Koza*k* [k] 'Cossack' – Koza*cz* + *e* [ʧɛ] (voc.sg.)
mózg [k] (due to Final Devoicing) 'brain' – móż*dż* + *e*k [ʤɛ] (dimin.)
b. Palatalization before *i*, where underlying //i// is documented by its occurrence in contexts other than those involving [ts dz ʃ ʒ ʧ ʤ], for instance, *dym* 'smoke' – *dym* + *i* + *ć* 'to smoke'
stra*ch* [x] 'fright' – stra*sz* + *y* + ć [ʃɨ] 'to frighten'
kro*k* [k] 'step' – kro*cz* + *y* + ć [ʧɨ] 'to step'
miaz*g* + a [g] 'pulp' – miaż*dz* + *y* + ć [ʤɨ] 'to crush'

The alternations in (20b) show that underlying velars change into posterior consonants with a simultaneous replacement of //i// by [ɨ]: for example, *strasz* + *y* + *ć* 'to frighten', //x + i// → [ʃɨ].

[20] The pronunciation [p'a] occurs in eastern Polish. In standard Polish, palatalized labials fission into a labial followed by [j]. See Rubach 2003 for an analysis.

[21] Notice that this pair of examples and the one below show that velars contrast in backness at the underlying level, hence the oppositions //k// – //k'// and //g// – //g'//.

[22] Palatalized dentals change their place of articulation from dental to prepalatal: for example, *wagon* [n] 'carriage' – *wagon* + *ik* [ɲ] (dimin.) and *głos* [s] 'voice' – *głos* + *ik* [ɕ] (dimin.); see Rubach 1984a. I will not discuss this process here.

[23] Phonetically, Polish [ɨ] is fronter than Russian [ɨ]. Careful studies describe it as a fronted central vowel (Biedrzycki 1974). Phonologically, [ɨ], which is spelled *y*, is a [+ back] vowel (for evidence, see Rubach 1984a), and it differs from [u] by being [− round].

What we witness is two processes: palatalization, //x// → [ʃ], and vowel retraction, //i// → [ɨ]. It seems that these two processes cannot be analyzed in parallel because palatalization requires the presence of a front vowel and retraction removes the front vowel. Consequently, //x + i// cannot change into [ʃɨ]. Rather, we would expect //x + i// to change into /ʃ'i/ or /ʃi/ at derivational level 1, an effect of palatalization, and /ʃ'i/ or /ʃi/ to turn into [ʃɨ] at derivational level 2, an effect of vowel retraction prohibiting [i] after [ʃ]. However, this scenario is unacceptable from the point of view of standard OT because it offends the principle of strict parallelism that prohibits derivational stages.

Analysis of velar palatalization in the UFT model carries the promise of avoiding a derivational step because front vowels are [coronal, −anterior], so this property can spread from the vowel to the velar consonant, yielding the desired posterior [ʃ ʧ ʤ]. Furthermore, the mapping of the input //i// to [ɨ], as in //x + i// → [ʃɨ], can also occur directly, as I detail below. This is then an attractive analysis and one to which standard OT must commit itself in order to uphold strict parallelism.

The assumption that front vowels carry the features [coronal, −anterior] leads to a sweeping generalization with regard to the Pal constraints: these constraints, stated in (13), are satisfied by agreement in [coronal, −anterior], regardless of whether this configuration of features is a dependent of V-Place (secondary articulation) or C-Place (primary articulation). The former case, a V-Place[coron, −anter] agreement between the consonant and the vowel, is in all essential ways equivalent to the AT agreement in [−back] and drives the change //Ci// → [C'i] analyzed in section 2. The latter case, an agreement in [coronal, −anterior] under C-Place of the consonant and V-Place of the vowel, is a new insight. Below, I incorporate this insight into an analysis of velar palatalization.

As shown in (18), the input //xɛ// can be transformed directly into [ʃɛ] by assuming that [coronal, −anterior] of //ɛ// is spread to the C-Place node of //x// with concomitant delinking of [dorsal]. But the input //x + i// looks problematic. The question is how to induce the change from //i// in (20b) to [ɨ], so that //x + i// can be mapped directly to [ʃɨ].

The key to the solution of the //xi// → [ʃɨ] problem lies with the UFT representation of central vowels. These are represented as placeless (Clements and Hume 1995); that is, they are neither [coronal] nor [dorsal]. Sidestepping the specification for height, the representation of [ɨ] in the UFT model is the tree in (21).

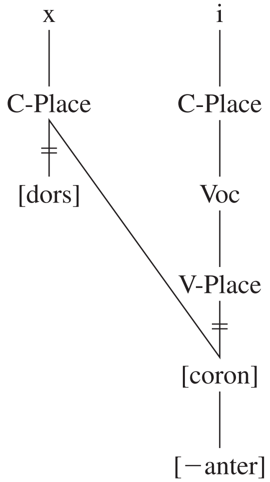
(21) *UFT model*

```
  ɨ
  |
C-Place
  |
 Voc
  |
V-Place
```

The transformation of the input //xi// into the output [ʃɨ] in the UFT model is a matter of spreading [coronal, −anterior] from the //i// onto the //x//, with concomitant delinking from the V-Place node. As in (18), the [dorsal] on the //x// is delinked as well.

(22) *UFT model*

//x+i// → [ʃɨ]



All that is required now is to discover the relevant constraints that can effect the changes in (22). The delinking of [dorsal] is not a problem. It is due to an undominated constraint that prohibits dorso-coronals, so I will ignore this constraint in the tableaux. The spreading of [coronal, −anterior] with the concomitant delinking from the V-Place node must be characterized in terms of Max([coron, −anter]) rather than in terms of Ident([coron, −anter]). The latter mandates that [coronal, −anterior] be preserved in an output segment that corresponds to the input segment containing [coronal, −anterior]. But this is not the case in (22) because the [coronal, −anterior] of the input //i// is not retained in the corresponding [ɨ]. Rather, the [coronal, −anterior] of //i// has moved to the consonant. We need to make sure that [coronal, −anterior] is not simply deleted, an assurance that is provided by Max([coron, −anter]).

(23) *Max([coron, −anter])*
[coronal, −anterior] of the input must be preserved in the output.

Crucially, it does not matter for (23) whether [coronal, −anterior] is retained in the segment that corresponds to the source segment in the input or whether it surfaces on some other segment.[24]

[24] This property of Max(Feature) constraints is a source of potential trouble (see Rubach 2000b) because we must be able to determine the locus for the docking of a given feature. Currently, there is no mechanism in OT to deliver this result. However, I will not pursue a critique of the UFT model along these lines because, as I show in the following sections, the analysis is flawed for independent reasons.

The next question is what drives the delinking of [coronal, −anterior] from the V-Place node. Probably the reason is that [ɨ], being placeless, is a better vowel than [i], which has the place specification, that is, *[i] ≫ *[ɨ].[25] Finally, we must exclude the possibility that //x + i// has [x'i] as its optimal output. This is achieved by a segment inventory constraint that prohibits *[x' k' g'], which I call **Soft-Dors*. The evaluation is now as shown in (24).

(24) UFT model: //x+i// → [ʃɨ]

	Pal-*i*	*Soft-Dors	Max([coron,−anter])	*[i]	*[ɨ]	Id([dors])
☞ a. ʃɨ					*	*
b. xi	*!			*		
c. xɨ			*!		*	
d. x'i		*!		*		
e. ʃi				*!		*
f. ʃ'i				*!		*
g. s'i				*!		*
h. si	*!			*		*

Some comments are in order. The ranking *[i] ≫ *[ɨ] gives preference to [ʃɨ], candidate (24a), over [ʃi], [ʃ'i], and [s'i], candidates (24e–g). Pal-*i* is not satisfied by [xi] and [si], candidates (24b) and (24h), because the consonant is neither palatalized nor posterior. Candidate (24c), [xɨ], violates Max([coron, − anter]), a crucial constraint in this analysis, because [coronal, −anterior] does not exist in the output string: it is found neither on the consonant, which is a velar, nor on the vowel, which is placeless. Candidate (24f), [ʃ'i], parallels candidate (24e), [ʃi], but it overshoots on satisfying Max([coron, − anter]) and Pal-*i* because [ʃ'] is [coronal, −anterior] at both the C-Place node and the V-Place node. Such overshooting is penalized by *[coron, − anter], a low-ranked constraint not shown in (24). In fact, [ʃ'i] violates this constraint three times: first for the [i], which has V-Place[coron, − anter]; second for the posteriority of [ʃ], which has C-Place[coron, − anter]; and third for the secondary palatalization in [ʃ'], which is encoded as V-

[25] This ranking raises the question of why it is not the case that all instances of //i// change into [ɨ]. For consonant-plus-*i* configurations, this question is answered in section 7, where I show that [C'ɨ] is ill formed. Other configurations, such as *V* + *i* (exemplified by *mao* + *izm* 'Maoism'), might be analyzed in terms of segment inventory constraints: if *i* passes its [coronal, −anterior] to the preceding *o* (assuming the locality of feature transfer), then we derive the front vowel *ö*. However, *ö* is unattested in Polish, which means that the segment inventory constraint *[ö] is undominated.

Place[coron, − anter]. The candidates in (24a–e) and (24g–h) violate *[coron, − anter] either once or twice, so they fare better than [ʃ'i] vis-à-vis this constraint.

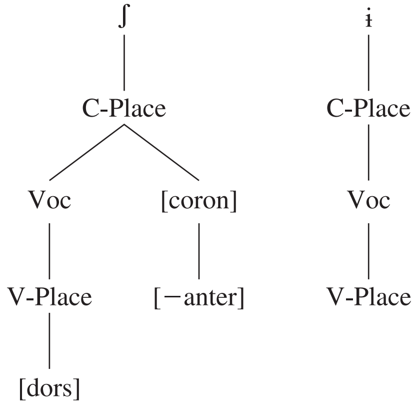
Missed in evaluation (24) is the answer to the question of how dorsal inputs //x k g// acquire stridency, since the correct outputs are the [+ strident] segments [ʃ ʧ ʤ]. Soft-Strid (15) is not active here because the outputs are the hard consonants [ʃ ʧ ʤ]. The problem is solved by postulating a constraint that requires posterior segments to be strident.

(25) *Posterior Stridency (Post-Strid)*
No posterior nonstrident coronals.

Finally, attention should be drawn to the feature configuration in [ʃɨ], the desired winner in (24a). Given the UFT model, the [ʃ] carries [coronal, − anterior] under the C-Place node while the [ɨ] has no specification for place features. Since [ʃ] is velarized, it is also specified for [dorsal] under the V-Place node.

(26) *UFT model*

[ʃɨ]



For this configuration to satisfy Pal-*i* (the UFT version in (13a)), it must be assumed that two nodes agree if they are not distinct.[26] That is, the nodes agree by the absence of disagreement, specifically, by the absence of place features on the vowel.[27] I will dub such configurations *agreement in absentia*. It is a separate question, and one that I will not pursue here, whether assimilatory processes, such as palatalization, should admit agreement in absentia.

Recasting the UFT analysis of velar palatalization in the AT model is problematic in two fundamental ways. First, in the AT model central vowels align themselves with [+ back] vowels.

[26] This is not the standard understanding of agreement. See, for example, Pulleyblank 1997.

[27] In contrast, palatalization induced by Pal-*e*, //x + ɛ// → [ʃɛ], results in a typical configuration, with features of the vowel linked to the tree of the consonant. Feature transfer of the kind shown in (26) is blocked by *[ə], because Polish does not admit schwa as a member of its vocalic inventory. In effect, then, the UFT model produces an asymmetry between the representations enforced by Pal-*e* and those enforced by Pal-*i*.

Therefore, the change from //x + i// to [ʃɨ] cannot be analyzed as a consequence of the fact that the input //i// has transferred its features to the consonant, yielding [ɨ], as is the case in the UFT model. Second, an AT analysis requires a derivational step, hence is at odds with the principle of strict parallelism.

The most recent version of AT, that proposed by Halle (2005), assumes that front vowels bear two designated articulator features: [DADorsal] and [DACoronal]. The view that front vowels are coronal, adopted from the UFT model, affords an analysis of velar palatalization that treats the change of //x// to [ʃ] as coronalization, a spread of [DACoronal] from the front vowel to the consonant. This is captured as the following constraint:

(27) *CORONALIZATION (CORONALIZ)*
A consonant and a following front vowel must agree in [DACoronal].

CORONALIZ is independent from the PAL constraints because palatalization need not accord with the change of the DA feature. For instance, //k// → [k'] is an effect of PAL, with CORONALIZ being blocked by the dominant IDENT([DADors]), stated in (10b). The fact that CORONALIZ and PAL are distinct is a liability of the AT model because, given the analysis so far, this distinction is not required in the UFT model. As noted earlier, this model is able to express coronalization and palatalization as a single generalization by appealing to the properties [coronal, −anterior], regardless of whether they are dependents of C-Place or V-Place (see (13)).

There is yet another type of liability that the AT model entails: the change from //x + i// to [ʃɨ] must go through an intermediate stage at which the output vowel is /i/ and not /ɨ/, so the analysis is derivational and hence incompatible with strict parallelism.

The intermediate stage is required because otherwise CORONALIZ, which refers to the presence of a front vowel, cannot have an effect. Actually, the system of constraints developed thus far predicts that the optimal output at level 1 is /ʃ'i/, with a soft /ʃ'/. In (28), I look at the input //x + i//, as in *strasz + y + ć* 'to frighten'. Notice that, in order to be active, CORONALIZ must outrank IDENT([DADors]), which protects dorsals from losing their dorsal place of articulation. The ranking IDENT-V([−back]) ≫ IDENT-C([+back]) follows from the observation that Polish exhibits palatalization with inputs other than velars: for example, *dym* [m] 'smoke' – *dym + i + ć* [m'] 'to smoke', //m + i// → [m'i].[28] That is, the violation of PAL-*i* in *C + i* strings, where the consonant is [+back] and the vowel is [−back], is resolved by palatalizing the consonant and leaving the vowel intact: //C + i// → [C'i] and not //C + i// → [Cɨ]. Since both [C'i] and [Cɨ] satisfy PAL-*i* because the consonant and the vowel are either uniformly [−back] or [+back], the choice of the way in which PAL-*i* is satisfied is a matter of how IDENT-V([−back]) and IDENT-C([+back]) are ranked.

[28] CORONALIZ is blocked here by the dominant IDENT([DALab]).

The evaluation of *strasz+y+ć* 'to frighten' is as shown in (28) (irrelevant constraints omitted).[29]

(28) AT model, level 1: //x+i// → [ʃ'i]

	Coronaliz	Soft-Post	Pal-*i*	Id-V([−bk])	Id-C([+bk])	Id([DADors])
a. xi	*!		*			
b. x'i	*!				*	
c. xɨ				*!		
☞ d. ʃ'i					*	*
e. ʃi			*!			*
f. ʃɨ				*!		*
g. s'i		*!			*	*
h. si			*!			*

Notice that Ident-V([−back]) plays an important role here since the undesired output [xɨ] in (28c) could not be eliminated by *[ɨ] (''Don't be [ɨ]'') because this constraint is not active in Polish. Not only that, Polish has /ɨ/ at both the underlying level and the phonetic level (as in the attested output of *strasz+y+ć* [ʃɨ]), and what is more, the [ɨ] occurs in words with the same root as in (28). The root is *strach* //strax// 'fright', and it appears in the verb *strasz+y+ć* 'frighten' analyzed in (28). This verb has been formed by appending the verbalizing suffix //i// (as in *dym* 'smoke' – *dym+i+ć* 'to smoke') plus the infinitive suffix *ć*. The point is that the plural of *strach* is *strach+y* [straxɨ], where the plural suffix //ɨ// (as in *dym* 'smoke' – *dym+y*) appears phonetically as [ɨ].

Since, as shown in (28), the AT model derives /ʃ'i/ from //xi//, there must be a later derivational level at which the attested phonetic output is generated: /ʃ'i/ → [ʃɨ]. We also need a constraint that mandates the hardening of stridents: soft /ʃ'/ → hard [ʃ].

An inspection of the typology of stridents in the Slavic languages unveils a rich system of variants.

(29) a. *Polish*
Hard [ts dz ʃ ʒ ʧ ʤ] (see (19))

[29] I simplify the presentation further by omitting Soft-Strid. In the case of velar stop inputs, Soft-Strid distinguishes between the desired winners /ʧ' ʤ'/ from //k g// and the undesired candidates /t̠' d̠'/, which are palatalized posterior stops rather than palatalized posterior affricates. Note also that Ident([−strid]) is mute on velar inputs to palatalization in the Slavic languages because these languages do not exhibit a stridency contrast in dorsals.

b. *Russian*
Hard [ts ʃ ʒ] but soft [ʧ']. Note: [dz] and [ʤ] do not occur because they are spirantized to [z] and [ʒ], respectively, as in *c*ar' [ts] 'emperor', *š*apka [ʃ] 'hat', *ż*yt' [ʒ] 'live' vs. *č*as [ʧ'] 'time'.

c. *Upper Sorbian* (de Bray 1980, Schuster-Šewc 1996, Schaarschmidt 2002, and my fieldwork)
Hard [ts][30] but soft [ʃ' ʒ' ʧ' ʤ']: pě*c* [ts] 'oven' vs. du*š*a [ʃ'] 'soul', *ż*aba [ʒ'] 'frog', *č*oło [ʧ'] 'forehead', *j*azz [ʤ'] 'jazz'

The picture is complicated further by the fact that Ukrainian has soft [ts' dz'], as in *lanc'ux* [ts'] 'chain', *palec*' [ts'] 'finger' and *dz*'*ob* [dz'] 'beak', *gedz*' [dz'] 'gadfly'.

These strident inventories are generated by a set of hardening constraints, listed in (30).

(30) a. *Hard Dental Affricates* (active in Polish, Russian, and Upper Sorbian but not in Ukrainian)
Dental affricates must be [+back].

b. *Hard Posterior Affricates* (active in Polish and Ukrainian but not in Russian and Upper Sorbian)
Posterior affricates must be [+back].

c. *Hard Posterior Fricatives* (active in Polish, Russian, and Ukrainian but not in Upper Sorbian)
Posterior fricatives must be [+back].

Since Polish exhibits the operation of all of these constraints, I will refer to them collectively as the Hard constraint.

The derivation of [ʃ ʧ ʤ] from //x k g// can now be completed: /ʃ' ʧ' ʤ'/ → [ʃ ʧ ʤ] at level 2 owing to the high-ranking Hard. This hardening at level 2 has an interesting consequence for /ʃ'i ʧ'i ʤ'i/ inputs. The hard (i.e., [+back]) [ʃ ʧ ʤ] cannot be followed by *i* any longer because *[ʃi ʧi ʤi] violate Pal-*i*. Recall that in the AT version of the Pal constraints, the consonant and the following vowel must agree in backness. At level 1, this requirement is fulfilled by the softness of the consonant: /ʃ'i ʧ'i ʤ'i/ agree in [−back]. With the undominated Hard at level 2 (specifically, ranked above Ident-V([−back])), the consonant must be [+back] and hence the following *i* would lead to disagreement in [±back]. It is therefore predicted that the input /i/ at level 2 must retract to [ɨ] in the optimal candidate, so that [ʃɨ ʧɨ ʤɨ] satisfy Pal-*i* because both the consonant and the vowel are [+back].

The derivation of *strasz* + *y* + *ć* 'frighten' that has /ʃ'i/ as the winner from level 1 in (28) is continued at level 2 in (31). Here, I focus only on the active constraints and assume that faithfulness constraints, such as Ident([−anter]) and Ident([+strid]), do not permit /ʃ'/ to change its place or manner of articulation.

[30] Soft [ts'] is a product of assimilation; [dz] is not attested in the standard dialect because it spirantizes to [z].

(31) AT model, level 2: /ʃ’i/ → [ʃɨ]

	PAL-*i*	HARD	ID-V([−bk])
☞ a. ʃɨ			*
b. ʃ’i		*!	
c. ʃi	*!		

The fact that HARD exists as a constraint and, as I will show in section 5, is motivated independently of velar palatalization raises the question of whether the intermediate step /ʃ’i/ in the //x + i// → [ʃɨ] mapping could not be eliminated by judicious ranking of HARD vis-à-vis other constraints. The answer is that indeed, /ʃ’i/ can be eliminated as an intermediate representation, but this move does not obviate the need for level distinction.

The ranking of HARD above PAL-*i* leads to the selection of /ʃi/ as the optimal output from //x + i//, which violates PAL-*i* since /ʃ/ is [+ back] and /i/ is [− back]. The candidate /ʃ’i/ is excluded because it violates HARD. In addition, in order to obtain /ʃi/ as the winner, IDENT-V([− back]) must be ranked above PAL-*i*; otherwise, the undesired candidate /xɨ/ would win. However, selecting /ʃi/ as the optimal output does not solve the problem of avoiding a derivational step since [ʃɨ] and not [ʃi] is the attested surface form. As noted earlier in connection with (28), for CORONALIZ to have an effect, the output must contain a front vowel, so /i/ instead of the desired [ɨ] cannot be avoided.

The evaluation in (32) unveils a problem: candidates (32b) and (32d) tie. (For reasons of space, IDENT([DADors]) is not shown in the tableau.)

(32) AT model, level 1: //x+i// → /ʃi/ (failed evaluation)

	CORONALIZ	SOFT-POST	HARD	ID-V([−bk])	PAL-*i*	ID-C([+bk])
a. xi	*!				*	
b. x’i	*!					*
c. xɨ				*!		
d. ʃ’i			*!			*
☜ e. ʃi					*	
f. ʃɨ				*!		
g. s’i		*!				*
☜ h. si					*	

The tie in (32) can be disambiguated in favor of /ʃi/ if we assume the ranking *[+anter] ≫ *[−anter] that I call *Posterior Shift*. These constraints must be dominated by respective Ident constraints, so that underlying anteriors and posteriors are not affected: Ident([+anter]) ≫ *[+anter] and Ident([−anter]) ≫ *[−anter]. As noted earlier, Ident([+anter]) and Ident-([−anter]) are mute on outputs from the input containing a dorsal, here //x//, so they play no role in (32).

With Posterior Shift now activated, the tie in (32) is resolved. Tableau (33) shows the relevant fragment of the evaluation.

(33) AT model, level 1: //x+i// → /ʃi/

	Coronaliz	*[+anter]	*[−anter]	Hard	Id-V([−bk])	Pal-*i*
☞ a. ʃi			*			*
b. si		*!				*

The success of the evaluation in (33) is little consolation because a derivational step has not been eliminated. The attested surface form [ʃɨ] is derived at level 2, where Ident([−anter]) is now active because the input has the posterior coronal /ʃ/. I assume that the faithfulness constraints (not shown in (34) below), including Ident([−anter]), hold /ʃ/ in check, so candidates exhibiting a different place or manner of articulation have no chance to win. The competition is among the candidates [ʃi], [ʃ'i], and [ʃɨ]. The attested surface form [ʃɨ] wins if Ident-V([−back]) is reranked below Pal-*i*. Tableau (34) focuses on the relevant constraints in this evaluation.

(34) AT model, level 2: /ʃi/ → [ʃɨ]

	Hard	Pal-*i*	Id-V([−bk])
☞ a. ʃɨ			*
b. ʃ'i	*!		
c. ʃi		*!	

To conclude, the AT analysis of velar palatalization in Polish is inferior to the UFT analysis in (24) in two ways, regardless of whether we adopt the scenario in (28) or (32). First, it calls for level distinction, thereby offending the principle of strict parallelism. In contrast, the UFT analysis obeys this principle, turning //x+i// into [ʃɨ] in one fell swoop. Second, the AT analysis postulates Coronaliz and Pal-*i* as separate constraints. In contrast, the UFT analysis treats coronalization and palatalization as a single generalization.[31] This follows from the assumption that the

[31] This is not the intention of Clements and Hume (1995), who treat these processes as separate, but the UFT model affords this possibility.

features [coronal, −anterior] are dependents of both the C-Place node and the V-Place node, so a single constraint PAL-*i* captures both coronalization and palatalization. I will resume the discussion of the inferiority of the AT model vis-à-vis the UFT model in section 5. In the next section, I look at some unresolved issues in both models.

4 Excursus: Unresolved Issues

The discussion in the previous section has identified two constraints that are responsible for turning nonstridents into stridents: SOFT-STRID and POST-STRID. The former is motivated independently of the latter by the affrication of dentals under palatalization, as in Vilnius Polish //t d// → [ts’ dz’] before front vowels (see (14)). POST-STRID was postulated as a corollary of CORONALIZ, the idea being that processes such as //x k g// → [ʃ ʧ ʤ] should not be required to go through a soft stage: *//x k g// → /ʃ’ ʧ’ ʤ’/ → [ʃ ʧ ʤ]. In sum, in order to become strident, coronals must be either soft or posterior (or both).

The derivation of softness from nonsoft inputs is straightforward for the types of processes considered in this article because the driver of alternations is palatalization. Since palatalization occurs before front vowels, [−back] can spread from the vowel, softening the consonant.

In contrast, the derivation of posteriority is not an obvious matter. We know that softness can be the reason for posteriority since both the AT and UFT models must recognize SOFT-POST, a constraint that is motivated by alternations such as those in Slovak: //t d// (dentals) → [t̠’ d̠’] (prepalatals) before front vowels (see (17)). The question is how to derive posteriority (and hence stridency) in instances in which //x k g// changing to [ʃ ʧ ʤ] are not assumed to go through a softness stage. The two models give different answers to this question.

The UFT model assumes that CORONALIZ and POST-SHIFT are inherently connected. They constitute a single operation because the feature [coronal] that characterizes front vowels has [−anterior] as its dependent, so it is impossible to spread [coronal] without spreading [−anterior]. In contrast, the AT model does not make this claim. Rather, the change of dorsals to posteriors under the nonsoft regime, //x k g// → [ʃ ʧ ʤ], is seen as two operations: CORONALIZ and POST-SHIFT (i.e., the ranking *[+anter] ≫ *[−anter] clarified in section 3). In effect, then, the UFT and AT models are comparably successful in accounting for the change of dorsals to posteriors without requiring an intermediate stage with soft consonants. Problematic for the AT model, but not for the UFT model, are instances of nonsoft anteriors turning into posteriors in palatalization contexts. The relevant example is found in English.

English has a palatalization process turning anterior obstruents into posterior stridents before *j* (e.g., Chomsky and Halle 1968, Rubach 1984b, Halle and Mohanan 1985). The change of interest here is //t d// → [ʧ ʤ], as in *habit* – *habitual* and *grade* – *gradual*. If front vowels and *j* (which is a melodic segment *i* not linked to the nucleus) are [−anterior], as put forward by the UFT model, the derivation of [ʧ ʤ] is straightforward, albeit a new constraint is needed. The constraint must mandate agreement in [−anterior] between coronal obstruents and the glide *j*, which enforces the spreading of [−anterior] from *j* to the obstruent. POST-STRID makes sure that the optimal output is an affricate rather than a stop. This analysis is not available in the AT model, which does not treat front vowels as [−anterior].

It appears that the AT model requires an intermediate stage at which the obstruents are soft: //t d// → /ʧ' ʤ'/ at level 1 by SOFT-STRID and SOFT-POST, and /ʧ' ʤ'/ → [ʧ ʤ] at level 2 by *[−back] operating on consonants. However, a different analysis is possible. The argument is prefaced by looking at some facts in Tswana.

The Bantu language Tswana, cited by Halle (2005, based on Cole 1969), exhibits palatalization of labials before the glide *w*. Thus, the *p* of *lop+a* 'request' and the *f* of *alaf+a* 'cure' appear as [ʧ] and [ʃ], respectively, before the passive suffix -*wa*: *lo*[ʧ]+*wa* and *ala*[ʃ]+*wa*. The question is how to turn labials into posteriors. (Once this is ensured, POST-STRID will spell out the consonants as stridents.) Since the trigger of //p// → [ʧ] is [w] and since back vowels and glides are not [−anterior] in any of the feature geometry theories, we need a new solution. Suppose the feature that spreads in *p+w* → *ʧw* is [+high]. That is, we posit a constraint, call it *AGREE-HIGH*, demanding agreement in [+high] between the consonant and the glide. A different constraint, call it *HIGH-POSTERIOR*, mandates that [+high] consonants must be posterior. Now POST-STRID ensures that they become strident. Incidentally, this scenario is not available in the UFT model.

As underscored by Zetterstrand (1996, 1998) and Halle, Vaux, and Wolfe (2000), the founding principle of the UFT model is constriction, which is realized differently in consonants and vowels. In consonants, constriction is expressed by [continuant]. In vowels, it is characterized by the multivalued feature [open]. These two features never intersect, so there is no sense in which consonants can bear [open] or vowels can bear [continuant]. Consequently, the constraint AGREE-HIGH that I have just proposed for the treatment of Tswana palatalization cannot be expressed in the UFT model.[32]

If the scenario outlined for Tswana is transferred to English, then a direct change of //t d// to [ʧ ʤ] need not require that front vowels and glides be [−anterior]. The palatalization is triggered by the front glide *j*, which is [+high], so AGREE-HIGH and HIGH-POSTERIOR can take their toll.[33]

Needless to say, more research is needed to determine whether there is further crosslinguistic evidence for the scenario with the spreading of [+high], so I leave this matter open. All I wish to observe at this point is that palatalization processes such as the English //t d// → [ʧ ʤ] before *j* do not provide conclusive evidence for the fact that front vowels and glides must be characterized as [−anterior]. In fact, there is evidence that this characterization can be undesirable.

[32] Zetterstrand (1996, 1998) presents compelling evidence from Turkana that argues against the UFT model and for the AT model. The argument is based on two observations. First, uvularization of consonants is triggered by nonhigh vowels, a generalization that is expressed as the spreading of [−high] from the vowel to the consonant. Second, high vowels cause the loss of uvularization whereby uvulars surface as velars, a generalization that is expressed as the spreading of [+high] from the vowel to the consonant. Both the spreading of [−high] and the spreading of [+high] from the vowel to the consonant fit the AT model because uvulars are [−high] and velars are [+high]. In contrast, the UFT model is unable to express these generalizations since, as noted in the text, the constriction features [continuant] and [open] for consonants and vowels cannot intersect.

[33] The addition of [+high] to consonants other than coronal obstruents can be blocked either by segment inventory constraints or by IDENT constraints.

Historically, Slavic is known to have undergone Second Velar Palatalization, which changed //k g x// to [ts' dz' s'], as in Common Slavic *cěna* [ts'] 'price', from Proto-Slavic **kaina*, Old Church Slavic *kъnig + a* [g] 'book' (nom.sg.) – *kniʒ + e* [dz'] (loc.sg.), and East Slavic *sěrъ* [s'] 'gray' (compare Germanic **haira*).[34] What we witness is CORONALIZ without the associated shift to posteriority. The process is readily analyzed if front vowels are not [−anterior]. CORONALIZ shifts dorsals to coronals, and the default ranking *[−anter] ≫ *[+anter] derives dental [ts' dz' s']. SOFT-STRID makes sure that the outputs are strident.

In sum, coronalization and posteriority are independent operations that are better stated if front vowels are not treated as [−anterior]. The evidence from dental palatalization of the English type, //t d// → [ʧ ʤ] before *j*, is inconclusive since an alternative analysis based on the spreading of [+high] is possible.

If front vowels are not [−anterior], then the expectation is that *e* causing palatalization of dentals accompanied by a shift to posteriors should produce soft segments because the spreading of [+high] is excluded. This expectation is borne out in the Slavic languages,[35] as documented by examples from Polish, Upper Sorbian, Slovak, and Czech.

(35) a. *Polish*
t d → ʨ ʥ (prepalatal affricates)
bra*t* [t] 'brother' – bra*ci + e* [ʨɛ] (loc.sg.)
sa*d* [t] 'orchard' – sa*dzi + e* [ʥɛ] (loc.sg.)

b. *Upper Sorbian*
t d → ʧ' ʤ' (postalveolar soft affricates)[36]
skó*t* [t] 'cattle' – skó*ć + e* [ʧ'ɛ] (loc.sg.)
su*d* [t] 'court' – su*dź + e* [ʤ'ɛ] (loc.sg.)

c. *Slovak*
t d → t̠' d̠' (prepalatal stops)
mies*t* + o [t] 'place' – mies*t + e* [t̠'] (loc.sg.)
vo*d* + a [d] 'water' – vo*d + e* [d̠'ɛ] (loc.sg.)

d. *Czech*
t d → t̠' d̠' (prepalatal stops)
plo*t* [t] 'fence' – plo*t + ě* [t̠'ɛ] (loc.sg.)
vo*d* + a [d] 'water' – vo*d + ě* [d̠'ɛ] (dat.sg.)

[34] The examples are from Bethin 1998. For broader background, see Shevelov 1965.

[35] A language that changes //t d// to nonsoft [ʧ ʤ] would be required to have an intermediate stage at which /ʧ ʤ/ are the palatalized /ʧ' ʤ'/. This is a complication, but not of the type that would make the analysis impossible if the assumed framework is that of Derivational OT. It can be claimed, for example, that at the lexical level the consonants are palatalized and that they lose palatalization at the postlexical level.

[36] The outputs of dental palatalization (just given) and velar palatalization (cited below in (54)) are the same.

To conclude, front vowels are better treated as not being [−anterior], but more research is necessary before this conclusion can be regarded as compelling.

5 Level Distinction: Soft Stridents

Recall that the discussion in section 3 ended with the conclusion that the AT model is inferior to the UFT model in two ways. First, it calls for level distinction, a complication that is avoided in the UFT model. Second, unlike the UFT model, it is unable to analyze coronalization and palatalization as effects of a single constraint. In this section, I address and develop the first of these observations. I show that the UFT model must also admit level distinction. The illustrative material is drawn from allomorph distribution in Polish. The second observation is discussed in section 6.

The nominative plural of masculine nouns in Polish is formed by adding either of the following two endings: -*y* [ɨ] or -*e* [ɛ]. Since there are no processes in the Polish phonology that could derive [ɨ] from //ɛ// or [ɛ] from //ɨ//, the two endings are established as separate underlying representations: //ɨ// and //ɛ//. That is, //ɨ// and //ɛ// are allomorphs of the masc. nom.pl.

Now the question is how these endings are distributed. The generalization is clear: //ɨ// is added after hard stems (i.e., stems that end in a hard consonant (36a)), and //ɛ// is added after soft stems (i.e., stems that end in a soft consonant (36b)).[37]

(36) a. ko*t* [t] 'cat' – ko*t* + *y* [tɨ]
gło*s* [s] 'voice' – gło*s* + *y* [sɨ]
kra*n* [n] 'faucet' – kra*n* + *y* [nɨ]
sta*w* [f] 'pond' – sta*w* + *y* [vɨ]
b. stru*ś* [ɕ] 'ostrich' – stru*si* + *e* [ɕɛ]
li*ść* [tɕ] 'leaf' – li*ści* + *e* [tɕɛ]
sło*ń* [ɲ] 'elephant' – sło*ni* + *e* [ɲɛ]
pa*w* [f] 'peacock' – pa*wi* + *e* [v'ɛ]
Notes: 1. [tɕ ɕ ɲ] are prepalatal [−back] consonants.
2. *Paw* has an underlying //v'// and not //v//, which is shown by the fact that [v'] appears before back vowels, as in *pawi* + *ami* [v' + a] (instr.pl.) versus *staw* – *staw* + *ami* [v + a], which is a hard stem ending in //v// (see Rubach 2003).

There are two different analyses that can account for the distribution of the endings in (36). First, the distribution can be trusted to word formation rules (WFRs). Second, it can be trusted to phonology.

[37] I discuss the behavior of [ts dz] later in this section.

In the first view, there are two independent WFRs that assign the nom.pl. ending, and both rules are sensitive to the phonological properties of the stem. One rule assigns *-y* if the stem is hard (i.e., ends in a [+ back] consonant). The other rule assigns *-e* if the stem is soft (i.e., ends in a [− back] consonant).

This analysis is problematic in two ways. First, the grammar of Polish is complicated by admitting two different and unrelated rules that have the same function: assignment of the nom.pl. ending. Second, the analysis misses the generalization that the distribution of the allomorphs is not accidental. The allomorph *-y*, a back vowel, is assigned to stems that end in a [+ back] consonant; and, conversely, the allomorph *-e*, a front vowel, is assigned to stems that end in a [− back] consonant. WFRs cannot capture this generalization because, from their point of view, the distributional restrictions could just as well be reversed, causing no complication in the statement of the rules. That is, one WFR could assign *-y* to soft stems and the other could assign *-e* to hard stems. Such a system would be just as simple as the system that is actually attested: *-y* after hard stems and *-e* after soft stems. I conclude that the analysis trusting the distribution of the allomorphs to WFRs is inadequate.

The alternative is to burden phonology with the task of making the correct choice of the underlying allomorph. In this analysis, the distribution is governed by generalizations (constraints) that exist independently in Polish phonology. The details are as follows.

There is one WFR (rather than two) that derives the nom.pl. by adding two allomorphs to the stem that is pluralized: //ɨ// and //ɛ//. The constraint system matches these allomorphs with the stem and selects the allomorph that fares best on constraint violation.[38] The choice of //ɨ// or //ɛ//, by definition, does not incur any violation of faithfulness because both //ɨ// and //ɛ// exist in the underlying representation.

The mechanics of the evaluation are illustrated by looking at the analysis of *kot* + *y*, the nom.pl. of *kot* 'cat'. Recall that the ranking IDENT-V([− back]) ≫ IDENT-C([+ back]) is required because the Polish response to the disagreement in backness between the consonant and the vowel is palatalization, so the consonant succumbs to the vowel rather than the other way round.[39] By default, PAL constraints, which act as drivers, are ranked above the faithfulness constraints controlling palatalization. Similarly, the ranking PAL-*i* ≫ PAL-*e* is regarded as unmarked because palatalization before *i* is more typical crosslinguistically than palatalization before *e* (see footnote 14).

[38] The treatment of allomorphy in OT has been investigated earlier, especially by Mascaró (1996), Kager (1996), and Rubach and Booij (2001). However, these writers have restricted their investigation to the role of syllable structure constraints in allomorph selection.

[39] The opposite response, where the vowel succumbs to the consonant, is found in Russian. For discussion, see section 6.

(37) AT model: //kɔt+{ɨ/ɛ}// → [kɔtɨ]

	PAL-*i*	PAL-*e*	ID-C([−bk])	ID-V([−bk])	ID-C([+bk])	ID-V([+bk])
☞ a. kɔtɨ (based on //kɔt+ɨ//)						
b. kɔt’i (based on //kɔt+ɨ//)					*!	*
c. kɔti (based on //kɔt+ɨ//)	*!					*
d. kɔtɛ (based on //kɔt+ɛ//)		*!				
e. kɔt’ɛ (based on //kɔt+ɛ//)					*!	
f. kɔtə (based on //kɔt+ɛ//)				*!		

Candidates select the allomorph arbitrarily. Thus, candidates (37a–c) have selected //ɨ// whereas the remaining candidates have selected //ɛ//. Candidate (37b) has changed //ɨ// to [i], thereby fatally violating IDENT-V([+back]). The same objection is true of candidate (37c), which, in addition, violates PAL-*i* because [t] is [+back] and [i] is [−back].[40] Candidate (37f) has selected //ɛ// and changed it to [ə], a violation of faithfulness penalized by IDENT-V([−back]). Candidate (37d) has selected //ɛ//, and [ɛ] occurs in the output representation, so IDENT-V([−back]) is satisfied. However, this candidate offends PAL-*e* because [kɔtɛ] has a hard consonant followed by the front vowel [ɛ]. Candidate (37e) obeys PAL-*e* since //t// has palatalized to [t’], but the soft [t’] offends IDENT-C([+back]) because the input has a hard //t//. Candidate (37a) has selected //ɨ//, and [ɨ] is found in the output, so IDENT-V([+back]) is satisfied. PAL-*i* is also satisfied since [t] and [ɨ] agree in backness: they are both [+back]. Thus, this candidate is a perfect match and wins the race, the correct result.

In what follows, I will simplify the evaluations by disregarding candidates that have transformed the vowel of the ending into some other vowel, such as [kɔti] based on //kɔt+ɨ// and [kɔtə] based on //kɔt+ɛ//. These candidates have no chance to win over the candidates that keep the input vowel intact in the output and hence do not violate faithfulness constraints.

The plural of *struś* [struɕ] ‘ostrich’ is *strusi+e* [struɕɛ]. The evaluation for this form is given in (38). I assume that the underlying representation of the surface prepalatal [ɕ] is //s’//, and I ignore the processes that turn //s’// into [ɕ] (but see Rubach 2003).

[40] CORONALIZ is disregarded in (37) and below because it is irrelevant. This is shown by stems such as *pawi+e* [pav’ɛ] ‘peacocks’: the stem-final //v’// selects *e* as the plural allomorph in spite of the fact that [pav’ɛ] violates CORONALIZ. The competitor [pav’ɨ] violates CORONALIZ as well, so the selection decision is passed on to PAL-*i*. In sum, CORONALIZ plays no role in the evaluation.

(38) AT model: //strus' + {ɨ, ε}// → [strus'ε]

	Pal-*i*	Pal-*e*	Id-C([−bk])	Id-V([−bk])	Id-C([+bk])	Id-V([+bk])
a. strus'ɨ	*!					
b. strusɨ			*!			
☞ c. strus'ε						
d. strusε		*!	*			

The intriguing question is how the coronal stridents [ʃ ʒ ʧ ʤ], discussed in section 3, behave vis-à-vis the allomorph selection process. We would expect that they take -*y* in the plural because they are hard rather than soft in the phonetic representation. Counter to this expectation, strident stems take -*e*, not -*y*.

(39) ko*sz* [ʃ] 'basket' – ko*sz* + *e* [ʃε]
gara*ż* [ʃ] 'garage' – gara*ż* + *e* [ʒε]
warko*cz* [ʧ] 'plait' – warko*cz* + *e* [ʧε]
bry*dż* [ʧ] 'bridge' – bry*dż* + *e* [ʤε]

The generalization is that strident stems align themselves with soft stems and not with hard stems. This is captured in the AT model by assuming that [ʃ ʒ ʧ ʤ] are represented as the soft //ʃ' ʒ' ʧ' ʤ'// at the underlying level. The surface [ʃ ʒ ʧ ʤ] are then an effect of Hard, a set of constraints that ban soft stridents (see (30)).

The evaluation of *kosz* + *e* 'baskets' is now as shown in (40).

(40) AT model: //kɔʃ' + {ɨ, ε}// → [kɔʃε] (failed evaluation)

	Pal-*i*	Pal-*e*	Id-C([−bk])	Hard	Id-V([−bk])	Id-C([+bk])	Id-V([+bk])
a. kɔʃ'ɨ	*!			*			
b. kɔʃɨ			*!				
☜ c. kɔʃ'ε				*			
☹ d. kɔʃε		*!	*				

Notice that Hard must be ranked below Ident-C([−back]) since otherwise the plural of *kosz* would be **kosz* + *y*, which is incorrect. This is demonstrated in (41), where Hard outranks Ident-C([−back]).

(41) AT model: //kɔʃ' + {ɨ, ɛ}// → [kɔʃɛ] (failed evaluation)

	PAL-*i*	PAL-*e*	HARD	ID-C([−bk])	ID-V([−bk])	ID-C([+bk])	ID-V([+bk])
a. kɔʃ'ɨ	*!		*				
☜ b. kɔʃɨ				*			
c. kɔʃ'ɛ			*!				
☹ d. kɔʃɛ		*!		*			

There is no ranking of constraints that can give preference to the attested surface form [kɔʃɛ] in (40d) over the undesired winner [kɔʃɨ] in (40b) because [kɔʃɛ] has a superset of the violations incurred by [kɔʃɨ].

The solution to the dilemma lies in level distinction. At level 1, the evaluation is exactly as given in (40). The optimal output from level 1, /kɔʃ'ɛ/, is hardened to [kɔʃɛ] at level 2, where PAL-*e* is reranked below the faithfulness constraints and hence is inactive. Tableau (42) shows the interaction of the relevant constraints. The input to level 2 is the representation /kɔʃ' + ɛ/, with /ɛ/ as the plural ending, because the selection of /ɛ/ over /ɨ/ was made at level 1.

(42) AT model, level 2: /kɔʃ' + ɛ/ → [kɔʃɛ]

	HARD	ID-C([−bk])	ID-V([−bk])	PAL-*e*
a. kɔʃ'ɛ	*!			
☞ b. kɔʃɛ		*		*
c. kɔʃə		*	*!	

I conclude that the AT analysis of the plural allomorphs strengthens the observation made in section 3 that, counter to the principle of strict parallelism, OT must admit derivational levels.

A reviewer asks whether the strict parallelism of standard OT could not be salvaged by appealing to sympathy theory (McCarthy 1999, 2002b). The answer is negative, as the following reasoning demonstrates.

McCarthy assumes that one of the faithfulness constraints acts as a selector (marked ✶) in the process of elevating a candidate to the status of the sympathetic base (marked ❀). By definition, a candidate that violates the selector cannot be the sympathetic base. Of the remaining candidates, the selector chooses the candidate that fares best on constraint violation. In (43), I repeat the tableau from (40), which now serves as a worksheet for the sympathy-theoretic analysis.

(43) AT model: //kɔʃ’ + {ɨ / ɛ}// → [kɔʃɛ] (worksheet)

	Pal-*i*	Pal-*e*	Id-C([−bk])	Hard	Id-V([−bk])	Id-C([+bk])	Id-V([+bk])
a. kɔʃ’ɨ	*!			*			
b. kɔʃɨ			*!				
☞ c. kɔʃ’ɛ				*			
☹ d. kɔʃɛ		*!	*				

Now we are looking for a selector among the faithfulness constraints in (43). Ident-V([−back]), Ident-C([+back]), and Ident-V([+back]) are useless since they are not violated by any of the candidates, so the search for the sympathetic base would yield the same winner as in (43), [kɔʃ’ɛ], because [kɔʃ’ɛ] fares best on constraint violation. Ident-C([−back]) is the only faithfulness constraint that is violated in (43) and hence becomes the selector. Now candidates (43b) and (43d) are excluded from the race for the status of the sympathetic base because they violate the selector. Of the remaining candidates, [kɔʃ’ɨ] in (43a) and [kɔʃ’ɛ] in (43c), the latter fares better than the former and thus becomes the sympathetic base ❀[kɔʃ’ɛ]. The result is the same as earlier: the candidate that wins in (43) without engaging sympathy theory is now reaffirmed by sympathy theory and granted the privileged status of the sympathetic base. This is odd, and the prospects for the success of the analysis do not look good.

Continuing the sympathy-theoretic reasoning, the constraint called ❀Sym requires that successful candidates accumulate the faithfulness violations of the sympathetic base; that is, they should have the same faithfulness violations as the sympathetic base and, possibly, some additional violations. Let me call this the *cumulativity test*. A candidate that fails this test receives the fatal mark ⊥ and is excluded from consideration. The candidates that have passed the test are then evaluated by ❀Sym on how similar they are to the sympathetic base. ❀Sym assigns the mark * for each faithfulness violation that makes a candidate less similar to the sympathetic base. I call this the *similarity test*.[41] This procedure is illustrated in (44), where I look at the familiar example *kosz* + *e* ‘baskets’. By definition, the sympathetic base passes on ❀Sym, so in order to lose in the competition, the sympathetic base must be eliminated by some other constraint. In (44), I rank ❀Sym below Hard in an attempt to eliminate ❀[kɔʃ’ɛ]. (For lack of space, Ident-C([+back]) and Ident-V([+back]), which are not violated by any candidates anyway, are not shown in (44).)

[41] In the published version of McCarthy 1999 (McCarthy 2002b), the cumulativity test and the similarity test are carried out by two independent constraints that replace ❀Sym: ❀Cumul and ❀Diff. The difference is technical, and I ignore it here.

(44) AT model: //kɔʃ’ + {ɨ, ɛ}// → [kɔʃɛ] (failed evaluation)

	Pal-*i*	Pal-*e*	✶Id-C([−bk])	Hard	❀Sym	Id-V([−bk])
a. kɔʃ’ɨ	*!			*		
b. kɔʃɨ			*!		*	
☞ c. ❀kɔʃ’ɛ				*		
☹ d. kɔʃɛ		*!	*		*	

Some clarification is in order. The sympathetic base ❀[kɔʃ’ɛ] incurs no faithfulness violations, so all the candidates pass the cumulativity test: they all share the faithfulness violations (which are zero) with [kɔʃ’ɛ]. Candidate (44a) does not incur any faithfulness violations and hence passes unscathed on ❀Sym. Candidates (44b) and (44d) each incur one faithfulness violation, as they fail on Ident-C([− back]): they receive the mark * on ❀Sym. The result is incorrect: [kɔʃ’ɛ], the undesired candidate, wins the race. The evaluation cannot be repaired by ranking ❀Sym in a different place because ❀Sym penalizes the desired winner [kɔʃɛ] in (44d) and the undesired candidate [kɔʃ’ɛ], which is the sympathetic base, by definition passes unscathed on ❀Sym. I conclude that McCarthy’s sympathy theory fails to deliver the correct result.

In an attempt to rescue the analysis, let us relax McCarthy’s theory by permitting markedness constraints to act as selectors, a suggestion due to Itô and Mester (1997). The choice of Pal-*i* or Pal-*e* as the selector leads to the same wrong result as earlier: of the candidates that do not violate the selector, [kɔʃ’ɛ] (43c) fares best and hence becomes the sympathetic base, which repeats the bad analysis in (43).

Appointing Hard as the selector opens a new perspective. Candidates (43a) and (43c) are excluded from the race for the status of the sympathetic base because they violate the selector. A comparison of the remaining candidates, [kɔʃɨ] in (43b) and [kɔʃɛ] in (43d), shows that (43b) fares better than (43d) and thus becomes the sympathetic base ❀[kɔʃɨ]. The evaluation is given in (45), where I ignore Ident-C([+ back]) and Ident-V([+ back]) since they are not violated by any candidates anyway. Arbitrarily, I rank ❀Sym above Pal-*e*.

(45) AT model: //kɔʃ’ + {ɨ, ɛ}// → [kɔʃɛ] (failed evaluation)

	Pal-*i*	❀Sym	Pal-*e*	Id-C([−bk])	✶Hard	Id-V([−bk])
a. kɔʃ’ɨ	*!	⊥			*	
☞ b. ❀kɔʃɨ				*		
c. kɔʃ’ɛ		⊥			*	
☹ d. kɔʃɛ			*!	*		

Candidates (45a) and (45c) receive the fatal mark ⊥ because they do not accumulate the faithfulness violations of ❀[kɔʃɨ]. Specifically, they do not violate IDENT-C([−back]). Candidate (45d), the desired winner, shares the IDENT-C([−back]) violation with ❀[kɔʃɨ] and, consequently, passes the cumulativity test. It has no other faithfulness violations and hence passes unscathed on ❀SYM. The winner is ❀[kɔʃɨ] because, by definition, it passes on ❀SYM, and it fares better than [kɔʃɛ] (45d) by avoiding a violation of PAL-*e*. However, [kɔʃɨ] is the wrong output. I conclude that the modified sympathy theory also delivers the wrong result.

A reviewer asks whether comparative markedness or targeted constraints can lead standard OT out of the derivational plight. The answer is negative, as the following discussion demonstrates.

Comparative markedness (McCarthy 2003) extends standard OT by doubling the number of markedness constraints because each of these constraints is now assumed to appear in two versions: $_{O}$M, which evaluates old markedness, and $_{N}$M, which evaluates new markedness. The distinction between $_{O}$M and $_{N}$M is made by comparing candidates to the FFC, a fully faithful candidate that is equivalent to the input representation but that has been enriched by adding predictable structure such as syllabification. A markedness violation that is found in the FFC is designated as ''old'' and is penalized by $_{O}$M. Markedness violations not found in the FFC are designated as ''new'' and are penalized by $_{N}$M. The evaluation of *kosz + e* 'baskets' from the perspective of comparative markedness is now as follows.

The worksheet in (43) shows three markedness constraints: PAL-*i*, PAL-*e*, and HARD. Each of them occurs in two guises: $_{O}$PAL-*i* and $_{N}$PAL-*i*, $_{O}$PAL-*e* and $_{N}$PAL-*e*, $_{O}$HARD and $_{N}$HARD. Since the input contains allomorphs for the nom.pl. ending, we have two FFCs: [kɔʃ' + ɨ], based on the //ɨ// allomorph, and [kɔʃ' + ɛ], based on the //ɛ// allomorph. Matching the FFCs with the PAL constraints appears to carry a promise of success because a distinction is made between the candidates [kɔʃ'ɨ], which violates PAL-*i* (or rather $_{O}$PAL-*i*), and [kɔʃ'ɛ], which does not violate PAL-*e* (or rather $_{O}$PAL-*e*). In contrast, recruiting $_{O}$HARD and $_{N}$HARD for the evaluation of *kosz + e* is pointless: only $_{O}$HARD is violated, because [ʃ'] occurs in both FFCs.[42] Therefore, I simply use HARD in (46), ignoring the ''old'' versus ''new'' distinction. I also suppress IDENT-V([−back]), which is irrelevant in this evaluation.

[42] $_{N}$HARD would be violated if the FFC contained a hard [ʃ] and if some candidate in the evaluation had a soft [ʃ'], but this is not the case here.

(46) AT model: //kɔʃ’+{ɨ, ɛ}// → [kɔʃɛ] (failed evaluation)

	$_{O}$PAL-*i*	$_{O}$PAL-*e*	ID-C([−bk])	HARD	$_{N}$PAL-*i*	$_{N}$PAL-*e*
a. kɔʃ’ɨ (FFC)	*!			*		
b. kɔʃɨ			*!			
☞ c. kɔʃ’ɛ (FFC)				*		
☹ d. kɔʃɛ			*!			*

The result is incorrect, and there is no ranking of constraints that can salvage the analysis because [kɔʃɛ], the desired winner, has a superset of the constraint violations incurred by [kɔʃɨ], (46b), so there is no scenario in which [kɔʃɛ] can win over [kɔʃɨ]. This failure of comparative markedness is beyond repair because the wrong output [kɔʃɨ] does not violate any markedness constraint, so making a distinction between old markedness and new markedness is to no avail.

Targeted constraints (Wilson 2001), like sympathy theory and comparative markedness theory, can be used to obviate the need for derivational stages. For ease of comparison, I use the data cited originally by Wilson (2001).

Diola-Fogny simplifies a cluster of consonants C_1C_2 by deleting C_1, as in *let+ku+jaw* → *lekujaw* ‘they won’t go’. Wilson observes that standard OT cannot account for this deletion and motivates his contention as follows. From the point of view of syllable structure, the candidates [letujaw] and [lekujaw] are equally simple, so the selection of the winner is made by markedness constraints. These give preference to coronals over dorsals: *CORON ≫ *DORSAL. Consequently, [letujaw] wins over [lekujaw] because the former has a coronal while the latter has a dorsal, the wrong result.

Derivational OT has no difficulty solving this problem (Rubach 2004). At level 1, the cluster simplification constraint is not active, an effect of MAX(Seg) ≫ CLUSTER SIMPLIFICATION. Syllabification constraints make sure that /let.ku.jaw/ wins in the evaluation and becomes an input to level 2. The scenario is now clear: /k/ is in the onset and hence can be protected from deletion by the positional faithfulness constraint OnsetMAX(Seg), which is postulated by analogy to Root-MAX(Seg). This protection is not available to *t* because *t* is in the coda. The ranking MAX(Seg) ≫ CLUSTER SIMPLIFICATION from level 1 is reversed at level 2, yielding CLUSTER SIMPLIFICATION ≫ MAX(Seg), which bans the faithful candidate [let.ku.jaw]. The violation of CLUSTER SIMPLIFICATION is resolved in favor of [le.ku.jaw] because the deletion of *k* is thwarted by OnsetMAX(Seg). This analysis is not available to standard OT since syllable structure is not reliably present in the underlying representation and positing derivational levels offends the principle of strict parallelism.

Wilson (2001) avoids derivational levels by extending standard OT to include targeted constraints. Relevant here is his constraint →WEAK-C.

(47) →*Weak-C*

Let *x* be any candidate and α be any consonant in *x* that is not released by a vowel. If candidate *y* is exactly like *x* except that α has been removed, then *y* is more harmonic than *x* (i.e., *y* ≫ *x*).

The weak element in *letkujaw* is *t* because it is not released by a vowel. Targeted →Weak-C evaluates only the candidates that differ by the weak element, which means that it considers candidates (48a) and (48b) but not candidate (48c).

(48) //let+ku+jaw// → [lekujaw]

	→Weak-C	Max
a. letkujaw		
☞ b. lekujaw	lekujaw > letkujaw	letkujaw > lekujaw, letujaw
c. letujaw		
Harmonic ordering	lekujaw > letkujaw	lekujaw > letkujaw > letujaw

In Wilson's view (2001:159), only ''poorly cued elements'' are within the purview of targeted constraints. The poorly cued elements are those that occur in contexts that impair perception: before an obstruent or word-finally. The Diola-Fogny example in (48) fits this restriction: *t* is before an obstruent, so it is poorly cued. However, the allomorph selection dilemma in Polish shown in (43) is different. The problem is how to make sure that the candidate [kɔʃɛ] wins over [kɔʃ'ɛ] and [kɔʃɨ]. Targeted constraints have nothing to say about how the selection is made because neither of the competing candidates exhibits poor cuing. In fact, exactly the reverse is true: the cuing is excellent because [ʃ] is released into a vowel in the competing candidates. I conclude that targeted constraints cannot deliver the desired result.[43] The correct analysis is the one proposed earlier in (40) and (42), but this analysis relies on level distinction, an unacceptable assumption from the point of view of standard OT. Now the only hope for standard OT to avoid derivationalism is to work with the UFT model.

Recall that in the UFT model, Pal-*i* and Pal-*e* require agreement in [coronal, −anterior] between the consonant and the vowel (see (13)). Crucially, it does not matter whether [coronal, −anterior] is a dependent of the V-Place node or the C-Place node. It appears that this generalization is exactly what we need for the analysis of the plural allomorphs.

Hard stems such as *kot* 'cat', analyzed in (37), take -*y*: *kot*+*y*. This is clear because the contender **kot*+*e* violates Pal-*e*: the consonant is [coronal, +anterior] while the vowel is [coronal, −anterior]. Soft stems work correctly as well. The plural of *struś* //strus'// 'ostrich' is *strusi*+*e*

[43] Also, see McCarthy 2002a for decisive criticism of targeted constraints.

[strus'ɛ] because the candidate [strus'ɛ] is a perfect match: the consonant is palatalized and hence bears [coronal, −anterior], which is exactly what front vowels (here *e*) bear.

The troublesome stems in (39) that end in the stridents [ʃ ʒ ʧ ʤ] can be analyzed without recourse to a derivational step. This is possible because the desired winner, for instance, [kɔʃɛ] in (40), satisfies PAL-*e*: [ʃ] and [ɛ] agree in [coronal, −anterior], albeit the former carries these features under the C-Place node and the latter under the V-Place node.[44] Consequently, [ʃ ʒ ʧ ʤ] need not derive from //ʃ' ʒ' ʧ' ʤ'//, as in the AT analysis. Rather, the hard //ʃ ʒ ʧ ʤ// exist in the underlying representation and they surface as such in the phonetic representation: the analysis is fully parallel and no level distinction is necessary.

Inspection of further data shows that the UFT analysis is incorrect and that derivational levels cannot be avoided. The evidence comes from the behavior of stems that end in [ts dz]. Since [ts dz] are hard, we would expect that they should align themselves with hard stems and take -*y* in the plural, but this is not the case.

(49) ko*c* [ts] 'blanket' – ko*c* + *e* [tsɛ]
pie*c* [ts] 'oven' – pie*c* + *e* [tsɛ]
ry*dz* [ts] 'type of mushroom' – ry*dz* + *e* [dzɛ]
skorowi*dz* [ts] 'index' – skorowi*dz* + *e* [dzɛ]

The attested surface forms [tsɛ] and [dzɛ] violate PAL-*e* (13b) because [ts dz] are [+anterior] while [ɛ] is [−anterior].

To remedy the analysis, [ts dz] must be the soft //ts' dz'// at the underlying level. Then, PAL-*e* is satisfied in /ts'ɛ/ and /dz'ɛ/ by agreement in [coronal, −anterior] under the V-Place node for both the consonant and the vowel.

For this analysis to work, the output of the evaluation must retain the soft /ts' dz'/ in /ts'ɛ/ and /dz'ɛ/, exactly as in the analysis of *kosz* + *e* 'baskets' in (40). But then we need another level of evaluation at which /ts'ɛ/ and /dz'ɛ/ harden to the attested [tsɛ] and [dzɛ], exactly as in the analysis of *kosz* + *e* in (42). That is, the analysis of *kosz* + *e* 'baskets' and *koc* + *e* 'blankets' is the same: /kɔʃ'ɛ/ and /kɔts'ɛ/ are the winners at level 1, and they harden to [kɔʃɛ] and [kɔtsɛ] at level 2.

Similar evidence for derivational stages, but based on a totally different process, comes from Russian. Russian has a vowel reduction process known as ikanie that fronts and raises mid and low vowels to [i] when unstressed and preceded by a soft consonant (50a). If not raised to [i], the vowels reduce to [a], a generalization that is known as akanie (50b) (Jones 1923, Avanesov 1968).

[44] Problematic here and in other cases are the candidates with [ɨ], such as [kɔʃɨ]. I discuss them in section 8.

(50) *Vowel reduction in Russian (stress marked by an accent)*

a. sém [s'ɛm] 'seven', dés'at' [d'ɛs'it'] 'ten' – semdes'át' [s'imd'is'at'] 'seventy': //ɛ// → [i] and //a// → [i]

p'át [p'at'] 'five' – p'atí [p'it'i] 'of five': //a// → [i]

s'ól + a [s'ɔla] 'village' (nom.pl.) – s'ol + ó [s'ilɔ] (nom.sg.): //ɔ// → [i]

b. vóz [vɔs] 'cart' – voz + ámi [vazam'i] (instr.pl.)

kót [kɔt] 'cat' – kot + ámi [katam'i] (instr.pl.)

In the context of stridents, we witness ikanie rather than akanie. The vowel surfaces as [i] after *č* because *č* is soft and as [ɨ] after *š*, *ž* because *š*, *ž* are hard.

(51) čás [ʧ'as] 'time' (nom.sg.) – čas + ý [ʧ'isɨ] (nom.pl.)

žón [ʒɔn] 'wife' (gen.pl.) – žon + á [ʒɨna] (nom.sg.)

šést' [ʃɛs't'] 'six' – šest' + órka [ʃɨs't'ɔrka] 'six' (collective)

Pulling these facts together, we can say that ikanie applies in two contexts: after a soft consonant (50) and after a posterior coronal (51). These contexts constitute a single environment in the UFT model, the desired result, because ikanie is analyzed as being sensitive to the features [coronal, −anterior] and, crucially, it does not matter whether these features are dependents of the V-Place node (50) or the C-Place node (51). Thus, it is not necessary to assume that *š* and *ž* are soft in order to trigger ikanie (an assumption that is necessary in the AT model) and that they harden because of the constraints in (30) at a later derivational stage. In this way, the UFT model avoids positing a derivational step.

The UFT analysis runs into a problem with [ts]. Since [ts] is [+anterior], it does not constitute an environment for ikanie, yet ikanie takes place: *cén* [tsɛn] 'price' (gen.pl.) – *cená* [tsɨna] (nom.sg.). From the point of view of ikanie, *ts* must carry the features [coronal, −anterior] but, because [ts] is [+anterior] in its place of articulation, the configuration [coronal, −anterior] must be under the V-Place rather than the C-Place node. This means that the phonetically hard [ts] derives from the underlyingly soft //ts'//, which is exactly what the AT analysis would postulate. Assuming underlying //ts'// entails that the hardening //ts'// → [ts] must occur after ikanie has applied, so we need two derivational levels, with ikanie applying at level 1 and HARD taking its toll at level 2.

To summarize, counter to the conclusion in section 3, the UFT model cannot avoid a derivational step and therefore, in this regard, is exactly like the AT model: both models are at odds with the principle of strict parallelism. This observation will be strengthened in the following sections by much additional evidence, leading to the final conclusion that strict parallelism is incorrect and must be rejected.

6 Palatalization versus Coronalization

Recall the conclusion from section 3 that the AT model is inferior to the UFT model in two ways. First, it calls for level distinction and, second, it treats PAL constraints as distinct from CORONALIZ. The first objection was countered in the preceding section: both models require level distinction. The second objection is countered in this section.

Below, I adduce three types of evidence showing that PAL constraints must be separate from CORONALIZ, regardless of the feature geometry model: Polish surface palatalization, Upper Sorbian velar palatalization, and Russian vowel retraction.

All Polish word-final consonants palatalize when followed by a word beginning with *i* (52a). This palatalization does not spare posterior stridents (52b).

(52) a. bra*t* [t] 'brother' – bra*t I*wony [t'i] 'Ivonne's brother'
gło*s* [s] 'voice' – gło*s I*wony [s'i] 'Ivonne's voice'
ojcie*c* [ts] 'father' – ojcie*c I*wony [ts'i] 'Ivonne's father'
ba*r* [r] 'bar' – ba*r I*wony [r'i] 'Ivonne's bar'
skle*p* [p] 'store' – skle*p I*wony [p'i] 'Ivonne's store'
do*m* [m] 'house' – do*m I*wony [m'i] 'Ivonne's house'
wie*k* [k] 'age' – wie*k I*wony [k'i] 'Ivonne's age'
stra*ch* [x] 'fear' – stra*ch I*wony [x'i] 'Ivonne's fear'
b. kapelu*sz* [ʃ] 'hat' – kapelu*sz I*wony [ʃ'i] 'Ivonne's hat'
gara*ż* [ʃ] 'garage' – gara*ż I*wony [ʃ'i] 'Ivonne's garage', where [ʃ'] is due to Final Devoicing; compare *garaż + e* [ʒɛ] (nom.pl.)
warko*cz* [ʧ] 'plait' – warko*cz I*wony [ʧ'i] 'Ivonne's plait'
bry*dż* [ʧ] 'bridge' – bry*dż I*wony [ʧ'i] 'Ivonne's bridge', where [ʧ'] is due to Final Devoicing; compare *brydż + e* [ʤɛ] (nom.pl.)

PAL-*i* (13a) of the UFT model can successfully enforce palatalization in (52a) because the input structure in, for example, *brat Iwony* 'Ivonne's brother' has a hard /t/ followed by /i/, which violates PAL-*i*. Consequently, the /t/ must palatalize to [t'], yielding [t'i], the correct output.[45] The data in (52b) are a problem because inputs such as /ʃi/ satisfy PAL-*i*: both the consonant and the vowel carry [coronal, −anterior] (albeit linked to different nodes). So how is it possible that /ʃ/ palatalizes to [ʃ']? Evidently, PAL-*i* in (13a) asking for agreement in [coronal, −anterior], regardless of whether [coronal, −anterior] is under V-Place or C-Place, is insufficient. We need another constraint that I call *PAL*-i-*VOC*.

(53) *PAL*-i-*VOC*
A consonant and a following high vowel must agree in [coronal, −anterior] under the V-Place node.

Abstracting away from terminological and technical differences, PAL-*i*-VOC is equivalent to the AT PAL-*i* stated in (6a).

Incidentally, data such as *strach Iwony* 'Ivonne's fear', //x#i// → [x'i], in (52a), and *strasz + y + ć* 'to frighten', //x + i// → [ʃɨ], in (20b), provide further evidence for level distinction because the same input //x// followed by //i// yields different results. The mapping //x + i// → [ʃɨ] occurs at the lexical level, while the mapping //x#i// → [x'i] is postlexical.[46] The lexical

[45] The candidate [t'ɨ] loses to [t'i] because of fronting, which I discuss in section 7.

[46] Recall that //x + i// → [ʃɨ] goes through an intermediate stage /ʃ'i/ or /ʃi/ in the AT model. Hence, there are two lexical levels: the stem level and the word level. The distinction between stem level and word level has been argued for in the literature, notably in Kiparsky 2000 and Rubach 2003.

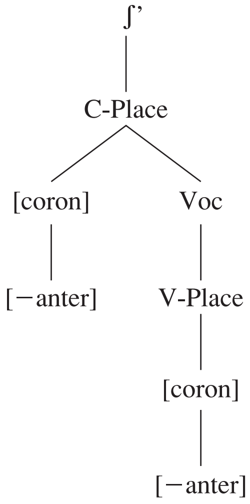
and postlexical levels differ with regard to the ranking of CORONALIZ and IDENT([DADors]). At the lexical level, CORONALIZ dominates IDENT([DADors]), so //x// loses its dorsal place of articulation. At the postlexical level, the ranking is reversed, IDENT([DADors]) ≫ CORONALIZ, so the dorsality of //x// is not affected.

A different piece of evidence showing that the UFT model must recognize palatalization constraints in addition to PAL-*i* and PAL-*e* listed in (13) comes from Upper Sorbian. The point of interest is that Upper Sorbian velar palatalization yields soft stridents.

(54) *Upper Sorbian*
//k ɣ x//[47] → [ʧ' ʒ' ʃ'] before front vowels
ru*k* + a [k] 'hand' – ru*č* + *i*čka [ʧ'i] (dimin.)
pje*k* + u [k] 'I bake' – pje*č* + *e*š [ʧ'ɛ] 'you bake'
Bo*h* + a [ɦ] 'God' (gen.sg.) – Bo*ž* + *i*čko [ʒ'i] (dimin.)
plu*h* + a [ɦ] 'plough' (gen.sg.) – plu*ž* + *e* [ʒ'ɛ] (loc.sg.)
mni*ch* [x] 'monk' – mni*š* + *i* [ʃ'i] (nom.pl.)
pro*ch* [x] 'dust' – pro*š* + *e* [ʃ'ɛ] (loc.sg.)

The outputs [ʧ' ʒ' ʃ'] have [coronal, −anterior] as a dependent of both the C-Place node and the V-Place node. For example, [ʃ'] is represented as in (55).

(55) *UFT model*
[ʃ']



Given the UFT model, the softness of the consonant is superfluous from the point of view of PAL constraints because these constraints are satisfied by the change in the place of articulation

[47] I assume that *h*, which is a voiced laryngeal [ɦ] in the phonetic representation, derives from the underlying voiced velar fricative.

from velar to coronal. As documented by candidate (24f), [ʃ'i], soft posterior coronals can never win over hard posterior coronals, hence over [ʃi] (24e), in the UFT model. The softness of posterior stridents must be enforced by PAL-*i*-VOC, as in the Polish surface palatalization shown in (49b). However, Upper Sorbian soft stridents, illustrated in (54), are derived not only before *i* but also before *e*. Consequently, we need the constraint in (56).

(56) *PAL*-e-*VOC*
A consonant and a following mid vowel must agree in [coronal, −anterior] under the V-Place node.

In all relevant ways, this constraint is equivalent to the PAL-*e* constraint of the AT model stated in (6b).

A still different type of argument underscoring the need for PAL constraints in the UFT model that are distinct from the PAL constraints in (13) is offered by vowel retraction in Russian. This process is a perfect mirror image of Polish surface palatalization at the postlexical level. The Russian examples in (57) closely resemble the Polish examples in (52), but the effect is the reverse of what is found in Polish: instead of the consonant palatalizing, the vowel retracts.

(57) bra*t I*vana 'Ivan's brother': //ti// → [tɨ]
golo*s I*vana 'Ivan's voice': //si// → [sɨ]
ote*c I*vana 'Ivan's father': //tsi// → [tsɨ]
ba*r I*vana 'Ivan's bar': //ri// → [rɨ]
do*m I*vana 'Ivan's house': //mi// → [mɨ]
bo*k I*vana 'Ivan's side': //ki// → [kɨ]
karanda*š I*vana 'Ivan's pencil': //ʃi// → [ʃɨ]

The contention that retraction is an assimilatory process is strengthened by the observation that the input /i/ surfaces unscathed if the final consonant in the preceding word is soft.

(58) mes*t' I*vana 'Ivan's revenge': //t'i// → [t'i]
ry*s' I*vana 'Ivan's lynx': //s'i// → [s'i]
dve*r' I*vana 'Ivan's door': //r'i// → [r'i]
golu*b' I*vana 'Ivan's pigeon': //p'i// → [p'i]
do*č I*vana 'Ivan's daughter': //ʧ'i// → [ʧ'i]

These data prompt two observations. First, the word-final consonant in (58) is palatalized in the underlying representation, so it has no [+back] that could spread to the vowel. Second, there is no reason to alter the inputs in (58) because PAL-*i* is satisfied: palatalized consonants are [−back], so they agree in backness with [i], which is also [−back].

In contrast, the data in (57) show disagreement in backness because a hard consonant is followed by *i*. This conflict is resolved in favor of vowel retraction: //C#i// → [Cɨ]. We are looking at an assimilatory change, whereby [+back] from the consonant spreads to the vowel, a perfect mirror image of palatalization.

In terms of the AT model, retraction is an effect of the ranking in (59), which contrasts with the ranking given for palatalization in (9) by reversing Ident-V([−back]) ≫ Ident-C([+back]) to Ident-C([+back]) ≫ Ident-V([−back]).

(59) *Retraction*
Pal-*i* ≫ Ident-C([+back]) ≫ Ident-V([−back])

Thus, it is more important to be faithful to the [+back] property of the consonant than to the [−back] property of the vowel.

The evaluation for *brat Ivana* 'Ivan's brother' is given in (60), where I look at the relevant fragment of the phrase only and assume that faithfulness constraints keep dental *t* intact by not permitting it to change its place or manner of articulation.

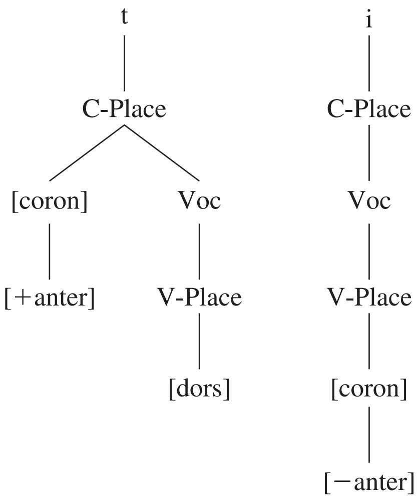
(60) AT model: /ti/ → [tɨ]

	Pal-*i*	Id-C([+bk])	Id-V([−bk])
☞ a. tɨ			*
b. ti	*!		
c. t'i		*!	

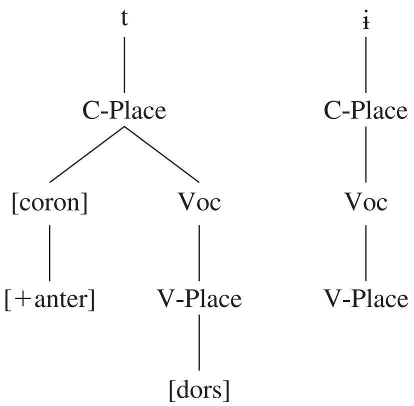
Recasting retraction in terms of the UFT model appears to be a simple matter. The input /ti/ and the output [tɨ] exhibit the feature trees in (61). As noted in section 1, I assume that velarization is represented as V-Place[dors].

(61) *UFT model*
[ti] versus [tɨ]

a.



b.



The change from /ti/ to [tɨ] means that [coronal, −anterior] on the vowel in (61a) must be deleted to yield the structure in (61b). The deletion is compelled by PAL-*i* (13a) because the input in (61a) does not exhibit agreement in [coronal, −anterior]. However, we need to make sure that the [coronal, −anterior] detached from /i/ under the pressure from PAL-*i* does not dock on the /t/, causing it to palatalize. This is not a problem, however. The UFT analysis can be assumed to have an equivalent of the IDENT-C([+back]) constraint found in the AT analysis.

(62) *IDENT-V-PLACE([dors])*
Input V-Place[dors] on a segment must be preserved in an output correspondent of that segment.

Further, the strayed [coronal, −anterior] from the /i/ could dock on the C-Place node, causing the consonant to alter its place of articulation from anterior to posterior. That is not a problem either, since the AT model and the UFT model both have IDENT([+anter]), stated in (10a), and the UFT analysis can use it to thwart the docking of [coronal, −anterior] on the /t/.

Finally, we need to disempower MAX([coron, −anter]), a constraint that the UFT analysis uses in order to reap the benefits of direct mapping in velar palatalization: //x + i// → [ʃɨ] in (24). The desired effect is achieved by the ranking IDENT-V-PLACE([dors]) ≫ MAX([coron, −anter]).

The evaluation of /ti/ → [tɨ] for *brat Ivana* 'Ivan's brother' is now as follows.[48] Recall that underlining denotes posteriority, so [t̠] is a [−anterior] stop.

[48] The candidate [t'ɨ], not included in (63), is discussed in the next section.

(63) UFT model: /ti/ → [tɨ]

	PAL-*i*	ID-V-PLACE([dors])	ID([+anter])	MAX([coron, −anter])
☞ a. tɨ				*
b. ti	*!			
c. t'i		*!		
d. t̠ɨ			*!	

Given the ranking in (63), candidate (63a) wins, the desired result. It avoids the violation of PAL-*i* by deleting [coronal, −anterior], as shown in (61b). Candidate (63b) violates PAL-*i* (13a) because [t] and [i] do not agree in [coronal, −anterior]. Candidate (63c) satisfies PAL-*i* because the consonant is palatalized but fatally violates IDENT-V-PLACE([dors]), which mandates the preservation of velarization in the output. Candidate (63d) has transferred [coronal, −anterior] from the vowel to the consonant, making the latter a posterior segment. This is a violation of IDENT-([+anter]), so (63d) loses to (63a).

Problematic for the UFT version of PAL-*i* in (13a) are inputs with posterior consonants. In (64), I look at *karandaš Ivana* 'Ivan's pencil', which retracts /i/ to [ɨ] after [ʃ]: /ʃi/ → [ʃɨ]. The place-of-articulation faithfulness constraint that is relevant here is IDENT([−anter]), which mandates the preservation of [−anterior] in the output.

(64) UFT model: /ʃi/ → [ʃɨ]

	PAL-*i*	ID-V-PLACE([dors])	ID([+anter])	MAX([coron, −anter])
☹ a. ʃɨ				*!
☜ b. ʃi				
c. ʃ'i		*!		
d. sɨ			*!	
e. si	*!		*	

The result is incorrect because the faithful candidate [ʃi] wins the competition. The problem is easily identified: [ʃi] satisfies PAL-*i* (13a) because [ʃ] is [coronal, −anterior] under the C-Place node. The analysis can be repaired in the same way as in the case of Polish postlexical surface palatalization: in addition to PAL-*i* (13a), we need to recognize another PAL-*i*-VOC (53) that looks at the agreement between the V-Place[coron, −anter] nodes and ignores [coronal, −anterior] under the C-Place node. If this constraint is ranked above MAX([coron, −anter]), then candidate (64b), [ʃi], is excluded and candidate (64a), [ʃɨ], wins the race, the correct result.

In sum, there is compelling evidence that the UFT model must recognize PAL-*i*-VOC (53) and PAL-*e*-VOC (56). These constraints are in all relevant ways parallel to PAL-*i* and PAL-*e* in the AT model. Therefore, the criticism in the conclusion of section 3 that the AT model is more complex than the UFT model is unfounded.

A still different conclusion emerges from the discussion of retraction: it is not true that adopting the UFT model for the purposes of OT can remove evidence against the principle of strict parallelism. A derivational step is necessary not only in the AT analysis (compare (9) and (59)) but also in the analysis envisaged by the UFT model. The point is that the retraction analysis discussed in this section is incompatible with the palatalization analysis shown for Russian in section 2. Accounting for the contrast between the palatalization in *brat* [t] 'brother' – *brat* + *ik* [t'i] (dimin.), we need to rank MAX([coron, − anter]) above IDENT-V-PLACE[dors], so that the desired candidate [brat'ik], showing palatalization, wins over the contender [bratɨk], showing retraction. Postlexically, this ranking must be reversed because *brat Ivana* calls for the retraction candidate [brat ɨvana] to be the winner, as shown in (63).

The ranking paradox is easily solved if we admit a derivational step. At the word level, Russian solves the conflict between the hard consonant and *i* by palatalization, //Ci// → [C'i], so the ranking of constraints favors the retention of the vowel features at the expense of the consonant features. At the postlexical level, the same conflict is solved by retracting the vowel, /Ci/ → [Cɨ], so the ranking of constraints must now favor the retention of the consonant features at the expense of the vowel features.[49]

7 Vowel Fronting

The AT analysis of vowel retraction in the preceding section did not consider candidates with a palatalized consonant and a placeless vowel: [C'ɨ]. If such candidates were included in the evaluation, they would win the race; for example, the candidate [t'ɨ] (not shown in (63)) from the input /ti/ would fare better than the desired winner [tɨ] because it obeys all the constraints in (63), including MAX([coron, − anter]), which is satisfied by the palatalization of the consonant. Since, according to Clements and Hume (1995), [ɨ] is placeless in the UFT model, PAL-*i*, regardless of the version, is satisfied by [t'ɨ]. But [t'ɨ] does not exist in any of the Slavic languages, so the analysis needs further elaboration.

The concatenation of an *underlying* palatalized consonant with the vowel //ɨ// is certainly attested. The violation of PAL in the input //C' + ɨ// is eliminated by the fronting of the vowel: //C' + ɨ// → [C'i]. This is amply documented in Russian.

The words on the left in (65) below have underlying soft consonants because these consonants can occur word-finally, where they could not be derived from hard consonants because they are not followed by a front vowel. Palatalized consonants in (65) trigger the fronting of the nom.pl. suffix //ɨ// to [i] in (65a). The data in (65b) show that the suffix is an underlying //ɨ//, because [ɨ] is indeed attested in the surface representations after nonpalatalized consonants. A reversed scenario—that //i// is underlying in (65b) and the surface [ɨ] is due to retraction—is unworkable. This is shown by (65c), where the same root palatalizes in the verbalized forms but not in the

[49] Retraction also occurs at the interface between the prefix and the stem; see Rubach 2000a for an analysis.

forms with the nom.pl. suffix. The presence versus the absence of palatalization must therefore be due to whether the suffix is an //i//, as in the verbs, or an //ɨ//, as in the pluralized nouns (65c).

(65) *Russian vowel fronting*

a. //C' + ɨ// → [C'i]

Nom.sg.	*Nom.pl.*
z'a*t*' [t'] 'son-in-law'	z'a*t* + *i* [t'i]
ry*s*' [s'] 'lynx'	ry*s* + *i* [s'i]
ca*r*' [r'] 'emperor'	ca*r* + *i* [r'i]
ko*n*' [n'] 'horse'	ko*n* + *i* [n'i]
bo*l*' [l'] 'pain'	bo*l* + *i* [l'i]
dro*b*' [p'] 'fraction'	dro*b* + *i* [b'i]

b. //C + ɨ// → [Cɨ] (no change)

Nom.sg.	*Nom.pl.*
ko*t* [t] 'cat'	ko*t* + *y* [tɨ]
dono*s* [s] 'report'	dono*s* + *y* [sɨ]
ba*r* [r] 'bar'	ba*r* + *y* [rɨ]
zako*n* [n] 'law'	zako*n* + *y* [nɨ]
vo*l* [l] 'ox'	vo*l* + *y* [lɨ]
du*b* [b] 'oak'	du*b* + *y* [bɨ]

c. Noun (nom.sg.) – noun (nom.pl.) – verb (inf.)

xva*t* [t] 'grab' – xva*t* + *y* [tɨ] – xva*t* + *i* + t' [t'i] 'to grab'
su*d* [t] 'court' – su*d* + *y* [dɨ] – su*d* + *i* + t' [d'i] 'to judge'
pa*r* [r] 'steam' – pa*r* + *y* [rɨ] – pa*r* + *i* + t' [r'i] 'to steam'
uko*l* [l] 'injection' – uko*l* + *y* [lɨ] – uko*l* + *i* + t' [l'i] 'to inject'

An AT analysis of the vowel fronting in (65) is straightforward. The desired change, //t' + ɨ// → [t'i], is generated by the interaction of the existing constraints. The crucial observation is that, in the AT model, [ɨ] is a [+back] vowel rather than a placeless vowel. Consequently, the faithful candidate [t'ɨ] from //t' + ɨ// violates PAL-*i* because the consonant is [−back] and the vowel is [+back]. This conflict is resolved in favor of the consonant at the expense of the vowel, a solution that follows from the ranking IDENT-C([−back]) ≫ IDENT-V([+back]), as shown in (66).

(66) AT model: //t' + ɨ// → [t'i]

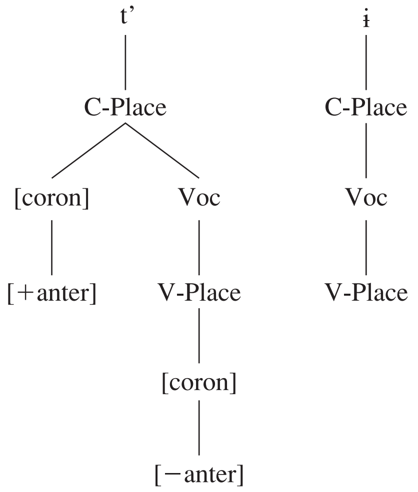
	PAL-*i*	ID-C([−bk])	ID-V([+bk])
☞ a. t'i			*
b. t'ɨ	*!		
c. tɨ		*!	

Candidate (66a), the winner, has spread the [−back] from the consonant to the vowel, a natural assimilatory change.

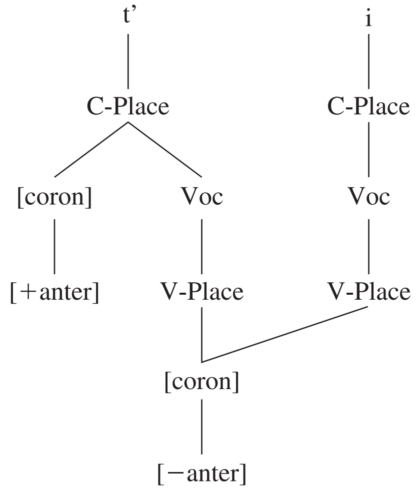
To understand the problem raised by vowel fronting in the UFT model, let us look at the input and output representations in (65a), for example, //t’ + ɨ// → [t’i] in *z’at + i* ‘sons-in-law’. Recall that [ɨ] is a placeless vowel in the UFT model. Fronting must then be an operation of spreading [coronal, −anterior] from the consonant to the vowel.

(67) *UFT model*

a. Input



b. Output



But what constraint compels the change from //t’ + ɨ// to [t’i]? It must be Pal-*i*-Voc. There is a problem, however. The configuration in (67a) satisfies both Pal-*i* (13a) and Pal-*i*-Voc (53) by agreement in absentia (see section 3), so vowel fronting cannot be compelled. The conclusion is obvious: agreement in absentia must be rejected as a legitimate configuration.[50] Now vowel fronting works as desired: the output in (67b) is enforced by the UFT version of Pal-*i* (or Pal-*i*-Voc) in order to avoid the ill-formed representation in (67a).[51]

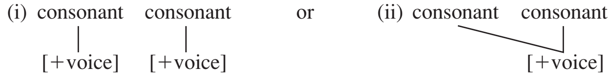
The success of this analysis comes at an unaffordable cost. By rejecting agreement in absentia, we have destroyed the UFT analysis of velar palatalization in section 3 (see (24) and (25)). This analysis was based on two assumptions: first, agreement in absentia is legitimate in OT and, second, central vowels are placeless. The first assumption has just fallen. The second assumption falls when we look at depalatalization, a process that I discuss in the following section.

8 Depalatalization

The preceding section has shown that the violation of Pal-*i* with //C' + ɨ// inputs is solved in Russian by fronting the vowel: //C' + ɨ// → [C'i]. The AT statement of Pal-*i*, which requires agreement in backness between the consonant and the following vowel, opens the possibility that the violation contained in the //C' + ɨ// input may be solved in yet another way: the consonant can accommodate to the vowel by changing its [−back] feature to [+back], an instance of depalatalization. It is exactly this strategy that is used in Ukrainian,[52] an empirical generalization that has never been reported in the generative literature on the Slavic languages to date.

From the point of view of this article, for all practical purposes Ukrainian is exactly like Russian. Specifically, it contrasts velarized and palatalized consonants (68a) and has a distinction between [i] and [ɨ] (68b).[53]

[50] Enforcing the spreading in (67b) in a brute force manner by postulating a ''share'' type of constraint is not a good idea. The putative constraint would have to say that [coronal, −anterior] of the consonant must be shared with a following high vowel. The problem is that spreading is a predictable effect of feature markedness constraints that exist in OT anyway. For example, an assimilation process that voices consonants, as in //s + b// → [zb], is a natural result of an Agree constraint that prohibits clusters of voiceless and voiced obstruents. This constraint is satisfied by either of the following two configurations:



The spreading configuration in (ii) should not be stipulated in the statement of the Agree constraint because it follows from *[+ voice], a feature markedness constraint penalizing the occurrence of [+ voice]. This constraint is violated once in (ii) but twice in (i), so (i) is suboptimal. Naturally, *[+ voice] must be ranked below Ident([+ voice]), so that underlying voiced segments are not affected.

[51] Fronting does not affect //u//, which surfaces as [u] after soft consonants. This fact can be analyzed in either of the following two ways. First, an undominated segment inventory constraint *[ü] (''No front rounded vowels'') thwarts all fronting efforts. Second, *u* is unspecified for backness at level 1, where fronting is active. (It contrasts with /ɨ/ by being [+ round].) At level 2, /U/ defaults to [u] owing to a high-ranked segment inventory constraint that aligns rounded vowels with back vowels. This analysis can be adopted for Ukrainian, where *u* does not cause depalatalization (see section 8).

[52] The facts of Ukrainian are reported in many standard grammars, including Bilodid 1969, Zilyns'kyj 1979, Rusanovskyj et al. 1986, Chukina, Pochtarenko, and Mykolayivna 1998, and Ponomareva 2001. These data have been confirmed in my fieldwork.

[53] Ukrainian [ɨ] is described as a much fronter vowel than Russian [ɨ]. It is also lower than Russian [ɨ] but not low enough to be regarded as a mid vowel (Bilodid 1969). My fieldwork (see the acknowledgments) with speakers from western Ukraine (primarily from two regions: Tarnopil and Lviv) shows that there is some variation in the realization of

(68) *Ukrainian*
a. zad [zad] 'back' – z'at' [zat'] 'son-in-law'
dar [dar] 'gift' – d'ad'a [d'ad'a] 'uncle'
sud [sud] 'court' – s'udy [s'udɨ] 'here'
nanos [nanɔs] 'sediment' – n'an'a [n'an'a] 'nanny'
lono [lɔnɔ] 'lap' – l'on [l'ɔn] 'linen'
b. ly*s* + *y*j [sɨ] 'bald' – ly*s* + *i* + ty [s'i] 'get bald'
boro*d* + a [d] 'beard' – boro*d* + *y* [dɨ] (nom.pl.) – boro*d* + *i* [d'i] (dat.sg.)

Soft consonants depalatalize to hard consonants before suffixes that begin with *y* [ɨ].

(69) ry*s*' [s'] 'fast trot' – ry*s* + *y*styj [sɨ] (adj.)
oko*n*' [n'] 'perch' – oko*n* + *y*sko [nɨ] (augmentative)
kova*l*' [l'] 'blacksmith' – kova*l* + *y*k [lɨ] (dimin.)
– kova*l* + *y*xa [lɨ] 'team blacksmiths'
voho*n*' [n'] 'fire' – voh*n* + *y*k [nɨ] (dimin.)
– voh*n* + *y*styj [nɨ] (adj.)
– voh*n* + *y*s'ko [nɨ] 'bonfire'
– voh*n* + *y*šče [nɨ] 'big bonfire'
lo*s*' [s'] 'moose' – lo*s* + *y*k [sɨ] (dimin.)
– lo*s* + *y*sko [sɨ] (augmentative)
– lo*s* + *y*nyj [sɨ] (adj.)
– lo*s* + *y*na [sɨ] 'moose meat'
– lo*s* + *y*c'a [sɨ] 'she-moose'
čap*l*' + a [l'] 'heron' – čap*l* + *y*nyj [lɨ] (adj.)
– čap*l* + *y*n [lɨ] 'belonging to the heron'
– čap*l* + *y*na [lɨ] 'heron meat'
vedmi*d*' [d'] 'bear' – vedme*d* + *y*šče [dɨ] (augmentative)
– vedme*d* + *y*k [dɨ] (dimin.)
– vedme*d* + *y*ca [dɨ] 'she-bear'
– vedme*d* + *y*xa [dɨ] 'she-bear' (pejorative)
– vedme*d* + *y*na [dɨ] 'bear meat'

In the AT model, depalatalization is a simple spreading operation: [+ back] from the //ɨ// is spread onto the soft consonant, causing it to harden. A formal analysis of this process uses the

[ɨ]. Some educated speakers from Lviv have a rather back [ɨ], much as in Russian. More typical, however, is the pronunciation of [ɨ] that resembles or is identical to Polish [ɨ], which is a high fronted central vowel. In the speech of my consultants from Mikulynci, a village near Tarnopil, [ɨ] sounds exactly the same as in Polish. For instance, I do not hear any difference at all between the Polish and Ukrainian pronunciations of the word [tɨ], the pronoun *ty* 'you' that exists in both Polish and Ukrainian.

constraints that we have seen before: in palatalization, retraction, and fronting. Depalatalization is a matter of a different ranking of the familiar constraints: Pal-*i* ≫ Ident-V([+back]) ≫ Ident-C([−back]). Tableau (70) evaluates *los+ynyj*, an adjective from *los*' 'moose'. I assume that faithfulness constraints (not shown in the tableau) do not permit //s'// to change its place or manner of articulation.

(70) AT model: //s'+ɨ// → [sɨ]

	Pal-*i*	Id-V([+bk])	Id-C([−bk])
☞ a. sɨ			*
b. s'ɨ	*!		
c. s'i		*!	

The AT analysis in (70) cannot be recast in the UFT model. The reason is clear: if [ɨ] is a placeless vowel, which is what Clements and Hume (1995) claim, then it cannot be active in an assimilatory process because it has no features to spread. The consonant – vowel configuration in fronting (discussed in the previous section) and in depalatalization is the same: //C'+ɨ//. While fronting can ultimately be enforced (see section 7), depalatalization cannot: the palatalized consonant carries the necessary properties for fronting but the placeless vowel [ɨ] does not carry the necessary properties for depalatalization.[54]

The assumption that [ɨ] is placeless is incorrect from yet another perspective. As shown in section 5, one of the tasks of the constraint system is to select the correct allomorph when more than one variant exists in the underlying representation. Thus, the analysis in section 5 predicts correctly that the plural of *kosz* 'basket' is *kosz+e* [kɔʃɛ] and not *[kɔʃɨ]. The problem is that the incorrect variant *[kɔʃɨ] cannot be excluded in the UFT analysis because [ʃɨ] violates neither Pal-*i* (13a) nor Pal-*i*-Voc (53). The problem disappears if we reject the legitimacy of agreement in absentia (see section 7) and/or the tenet that [ɨ] is placeless. However, once this step is taken, the analysis of velar palatalization in section 3 falls because this analysis is crucially based on both of these assumptions. The consequence is that velar palatalization must be analyzed by drawing a derivational distinction between level 1 and level 2, a distinction that we hoped to avoid by setting the analysis in the UFT framework.

[54] A reviewer observes that, technically, the UFT model *can* state depalatalization by positing a special constraint that mandates the spreading of the empty V-Place node of /ɨ/ to the consonant and delinking the V-Place node of that consonant. The problem with this brute force stipulation is that, first, depalatalization cannot be regarded as an assimilatory change and, second, it cannot be related to Pal-*i*. This analysis misses a significant generalization that the AT model captures in an admirably adequate way. In fact, given Pal-*i*, the existence of depalatalization is expected as an effect of one of the ranking permutations of Pal-*i*, Ident-V([+back]), and Ident-C([−back]). See the discussion in section 9.

An outstanding question is whether the UFT model can be modified in order to accommodate depalatalization. An obvious step to take is to adopt the AT understanding that central vowels function as back vowels in phonology. Translated into specific features, this modification would entail that central vowels are characterized as V-Place[dors], which corresponds to [+back] in the AT model. However, this step cannot be taken in the current UFT model: Clements and Hume (1995) define [dorsal] in a way that makes it impossible for central vowels to be regarded as [dorsal], an intention that they explicitly state.

9 Conclusion

The analysis in the preceding sections leads to the conclusion that PAL-*i*, a constraint that mandates agreement in backness, heads a conspiracy: disparate processes engage in an effort to remove the violation of PAL-*i* in //C + i// and //C' + ɨ// strings.

(71) a. //C + i// → [C'i]: palatalization
b. //C + i// → [Cɨ]: retraction
c. //C' + ɨ// → [C'i]: fronting
d. //C' + ɨ// → [Cɨ]: depalatalization

This conspiracy is characterized in a simple way in the AT model: PAL-*i* is the driver constraint and the disparate outcomes in (71) are a matter of how the faithfulness constraints for preserving [±back] are ranked.

(72) *AT model*

a. Palatalization: //C+i// → [C'i]

	PAL-*i*	ID-V([−bk])	ID-C([+bk])
☞ a. C'i			*
b. Ci	*!		
c. Cɨ		*!	

b. Retraction: //C+i// → [Cɨ]

	PAL-*i*	ID-C([+bk])	ID-V([−bk])
a. C'i		*!	
b. Ci	*!		
☞ c. Cɨ			*

c. Fronting: //C' + ɨ// → [C'i]

	PAL-*i*	ID-C([−bk])	ID-V([+bk])
☞ a. C'i			*
b. Ci	*!	*	*
c. Cɨ		*!	

d. Depalatalization: //C' + ɨ// → [Cɨ]

	PAL-*i*	ID-V([+bk])	ID-C([−bk])
a. C'i		*!	
b. Ci	*!	*	*
☞ c. Cɨ			*

The UFT model has no way of accounting for the PAL-*i* conspiracy because it is unable to view the processes in (72) as driven by a single constraint. This objection holds true, even if the theory is modified in its basic assumption referring to the definition of [dorsal], so that [ɨ] can be regarded as a dorsal vowel. The problem persists because ''frontness'' and ''backness'' are defined by different features: [coronal, −anterior] and [dorsal], respectively. The function played by PAL-*i*, a single constraint in the AT model, must therefore be defined by two constraints: one mandating agreement in [coronal, −anterior] and the other mandating agreement in [dorsal]. The former can then act as the driver for palatalization (*Ci* → *C'i*) and fronting (*C'i* → *C'i*) and the latter as the driver for retraction (*Ci* → *Cɨ*) and depalatalization (*C'i* → *Cɨ*). What is missing is a single denominator uniting all of these processes as a conspiracy. Furthermore, the grouping of palatalization with fronting and retraction with depalatalization is uninsightful, as shown by the following example from Ukrainian.

While the strategy of resolving the //C'ɨ// conflict in Ukrainian is to depalatalize the consonant (see section 8), the procedure can be reversed by well-formedness demands that are independent of depalatalization. The data in (73) show that the same suffix, the adjectivizing //ɨn//, can either trigger depalatalization (73a) or undergo fronting (73b).

(73) a. Maru*s*' + a [s'] 'Mary' – Maru*s* + *y*n [sɨ]
Ko*l*' + a [l'] 'Alexander' – Ko*l* + *y*n [lɨ]
b. Marij + a 'Maria' – Mari*j* + *i*n [ji]
Sofij + a 'Sophie' – Sofi*j* + *i*n [ji]

The reversal from depalatalization to fronting is enforced by ONSET([u]), a constraint that prohibits

[w] in onsets, which is a common restriction in the Slavic languages (see Rubach 2000b). The evaluations for *Marus + yn* and *Marij + in* are shown in (74).[55]

(74) *AT model*

a. //s’ + ɨ// → [sɨ]

	ONSET([u])	PAL-*i*	ID-V([+bk])	ID-C([−bk])
☞ a. sɨ				*
b. s’ɨ		*!		
c. s’i			*!	

b. //j + ɨ// → [ji]

	ONSET([u])	PAL-*i*	ID-V([+bk])	ID-C([−bk])
a. wɨ	*!			
b. jɨ		*!		
☞ c. ji			*	

The dramatic change of strategy from depalatalization (74a) to fronting (74b) is straightforward in the AT model: the candidates [s’ɨ] and [jɨ] are eliminated by a single constraint: PAL-*i*. In the hypothetical UFT model that purports to account for the same facts, these candidates violate two constraints: one mandating agreement in [coronal, −anterior] and the other mandating agreement in [dorsal]. This fact is an unexpected accident because they are independent constraints. Furthermore, [ɨ] is neither [dorsal] nor [coronal], so there is no reason for Ukrainian to have different strategies in (74a) and (74b).

The idea that the UFT model could eliminate derivationalism turns out to be incorrect. The UFT model cannot account for the behavior of soft dental stridents, underlying //ts’ dz’//, in Polish and Russian in a way that would avoid a derivational step. Similarly, without derivation, it cannot reconcile the contradictory behavior of //Ci// inputs in Russian. Lexically, these inputs lead to palatalization, //Ci// → [C’i]; postlexically, they trigger retraction, //Ci// → [Cɨ]. Much the same difficulty occurs in the analysis of velar inputs in Polish. Lexically, //x + i// yields [ʃɨ]; postlexically, the same input has [x’i] as the optimal output (see sections 3 and 6).

55 PAL-*i* must be understood to include *j*; that is, it must refer to the prevocalic segment rather than to the segment that carries the feature [+consonantal].

As shown in section 3, the most attractive aspect of the analysis set in the UFT framework is the ability to analyze velar palatalization cum vowel retraction in one fell swoop: //x + i// → [ʃɨ]. The crucial assumptions of this analysis are that [ɨ] is a placeless vowel and that agreement in absentia is legitimate, but, as shown by fronting (section 7) and depalatalization (section 8), these assumptions are incorrect. The vowel [ɨ] must be [dorsal] in the UFT model, just as it is [+back] in the AT model. Velar palatalization cannot be analyzed as a process spreading [dorsal] since the input vowel is //i//, a [coronal, −anterior] segment. Actually, the feature [dorsal] *is* present in the input consonant //x//. However, it cannot be allowed to spread because then the optimal output candidate would be [xɨ], the wrong result. The change from //x// to [ʃ] in the desired output [ʃɨ] must therefore be driven by a PAL constraint mandating the spread of [coronal, −anterior]. But then [ʃɨ] can never be the optimal output because it does not obey the driver constraint: [ʃ] is [coronal, −anterior] but [ɨ] is [dorsal]. This analysis is easily repaired if /ʃ'i/ is the optimal output from //x + i//. Then, the attested surface form [ʃɨ] is derived at a later derivational level, exactly as in the AT model. I conclude that the UFT model and the AT model both require derivation in their analysis of velar palatalization and demonstrate that the OT principle of strict parallelism is incorrect.

The AT model is superior to the UFT model, even if the latter is modified to accommodate the observation that central vowels cannot be placeless. This conclusion follows from the fact that the AT model but not the UFT model can capture the disparate strategies for satisfying PAL constraints shown in (71), a conspiracy effect that is a central concept in OT.

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Department of Linguistics
University of Iowa
Iowa City, Iowa 52242

jerzy-rubach@uiowa.edu

Institut Anglistyki
University of Warsaw
ul. Novy Swiat 4
00-497 Warsaw
Poland

jerzy-rubach@uw.edu.pl