Posterior stridents in Korean and Russian

Jerzy Rubach
(University of Iowa/University of Warsaw)

Rubach, Jerzy. 2004. Posterior stridents in Korean and Russian. *Studies in Phonetics, Phonology and Morphology*. 10.1. 145–167. Derived posterior stridents are similar, though not identical, in Korean and Russian but they have different sources in the underlying representation. They come from dentals in Korean and from velars in Russian. Posterior stridents are a combined effect of Palatalization and segment inventory constraints. The latter are responsible for the fact that posterior stridents differ from their source segments in place and, in the case of stops, manner of articulation. Inventory constraints determine the type of admissible palatalized segments. The Korean system of derived posterior stridents is simpler than the Russian system and, counter to G.-R. Kim (2002), does not provide an argument for level distinctions in Optimality Theory. Such argument exists in Russian because posterior fricatives act in an ambiguous way: they behave as palatalized segments with vis-a-vis some processes and as velarized segments vis-a-vis some other processes. This contradiction is solved by postulating a distinction between the word level and the phrase level. Crucially, segment inventory constraints are ranked differently at each level. **(University of Iowa/University of Warsaw)**

Keywords: Korean phonology, Russian phonology, palatalization, strident consonants, Derivational Optimality Theory.

Korean and Russian are similar in the sense that they have a posterior (that is, [-anter]) coronal affricate *č* in their phonological systems.[*] The *č* is palatalized, which means that it is [-back, +high], a fact that will be represented in the transcription as a superscript [j], hence [č^{j}].[1] A further parallel is that, on the one hand, *č^{j}* has the status of an underlying segment in both languages and, on the other hand, it can also be a derived segment. *č^{j}* is an underlying segment because it occurs in environments that do not warrant palatalization: before a back vowel or a word boundary (1a). When occurring before [i], *č^{j}* is a derived segment since, first, the environment warrants palatalization and, second, there are alternations between *č^{j}* and non-palatalized segments (1b). Furthermore, [č^{j}] that comes from a non- palatalized segment is restricted to derived

[*] I would like to express my gratitude to Sang-Cheol Ahn and Elena Gavruseva for their advice and help with the Korean and the Russian data, respectively.

[1] The facts of Korean, including all the examples, are cited from Ahn (1985) and (2002), unless otherwise indicated. The earlier sources cited by Ahn (1985 and 2002) include a number of fundamental works in Korean phonology, for example, C.-W. Kim (1968 and 1972), C.-M. Lee (1972), and Kim-Renaud (1974).

environments (Kiparsky 1973) because segments that would normally be the source of the [čʲ] before front vowels occur before *i*, unaffected by palatalization, when they are morpheme-internal (1c). Note that Korean affricates are voiced between voiced segments, consequently, we find the [ǰʲ] rather than [čʲ] in these contexts.

(1) a. Korean: cu-(ta) [čʲu] 'to give', cam [čʲam] 'sleeping'
Russian: čas [čʲas] 'time', doč [dɔčʲ] 'daughter'
b. Korean: mat [mat][2] 'old' - maᴄ+i [maǰʲ+i] 'eldest'
kat^{h} [kat] 'some' - kac^{h}+i [kaǰʲ +i] 'together'
Russian: krʲuk [krʲuk] 'hook' - krʲuč+i+tʲ [krʲučʲ+i+tʲ] 'to bend (a hook)'
rozluk+a [rʌzluk+a] 'separation' (*a* is the feminine nom.sg. ending) – rozluč+i+tʲ [rʌzlučʲ+i+tʲ] 'to separate'
c. Korean: mati [madi] 'knot', t^{h}i [t^{h}i] 'dust', titi-(ta) [tidi] 'to step on'
Russian: kino [kʲinɔ][3] 'theater', kip'atok [kʲipʲʌtɔk] 'boiling water', [kʲilɔ] 'kilogram'

On the one hand, the data in (1) testify to the phonological similarity between Korean and Russian but, on the other hand, they point to a significant difference: Korean *čʲ* (phonetic [ǰʲ] by allophonic voicing) alternates with an alveolar stop while Russian *čʲ* alternates with a velar stop (1b).

The disparity between Korean and Russian is greater than it appears to be when we consider posterior fricatives. First, Korean [šʲ] is palatalized, a parallel to [čʲ]. Russian [š] is velarized, a contrast to [čʲ], because velarized consonants are [+back] (as well as [+high]) while palatalized consonants are [-back]. Second, Korean [šʲ] is an allophone of *s* in the sense that it is fully predictable and occurs exclusively before *i*. In contrast, Russian *š* is both an underlying and a derived segment (see section 2), a parallel to *čʲ*. Third, Russian derived *š* is limited to to occurrences across morpheme boundaries (a derived environment effect), because [x], its underlying source segment, may occur before front vowels morpheme-internally, for example, *xitr+yj* 'smart'. Fourth, Russian *š* triggers Vowel Retraction, *i* → ɨ an assimilatory process that spreads [+back] from the consonant to the vowel (see section 2). Fifth, Russian has [ž], which is velarized, like [š]. The status and the behavior

[2] Korean has a coda neutralization process that turns all stops into plain unreleased consonants.
[3] Actually, the *k* is palatalized here in an allophonic way (see Surface Palatalization in Rubach 2000a). The point is that it is not [èʲ], the segment derived from *k* by Velar Palatalization shown in (1b).

of [ž] are parallel to the status and the behavior of [š]: [ž] is both an underlying and a derived segment. Derived [ž], which invariably comes from an underlying //g//,[4] is restricted to morpheme boundaries as morpheme-internally we may have [g] before a front vowel, for example, *po+gib+nu+t'* 'perish'. Finally, [ž], like [š], triggers Vowel Retraction (see section 2). In sum, the differences between Korean and Russian are far greater than the examples in (1) might suggest. Furthermore, the Russian system, unlike the Korean system, seems to be internally incoherent: [č^{j}] is palatalized while [š] and [ž] are velarized and yet all the three segments are an effect of Velar Palatalization.

The goal of this article is to explore the question of how the similarities and the differences between Korean and Russian posterior stridents as well as the internal contradictions within the Russian system can be analyzed in the framework of Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1995). Section 1 develops a system of constraints that can account for the basic pattern of alternations between non-palatalized consonants and their posterior strident counterparts. Section 2 deepens the analysis by solving the internal contradictions in the Russian system and pointing out that standard Optimality Theory (OT henceforth) needs to be modified to admit derivational levels. Section 3 is a summary of the conclusions.

1. Analysis

The focus of this section is on providing a system of constraints that account for the alternations between non-palatalized consonants and their strident counterparts in Korean and Russian. The discussion of the complex pattern of [š ž] derived from their velar sources //x g// is postponed till section 2.

Korean palatalization before *i* is straightforward in the sense that the attested outputs are [-back, +high], which is exactly what we would expect of a palatalization process. Russian follows suit here, but only for the derived [č^{j}]. That is, the Korean palatalization and the Russian palatalization yielding [č^{j}] are phonetically transparent because the properties of the triggering vowel, the [-back, +high] features of //i//, are spread onto the preceding consonant. The relevant data given in (1) are broadened by the Korean examples in (2) that include [š^{j}ɲ ʎ]that are derived from //s n l// (Ahn 1985).

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

(2) os+i //os+i// → [oš^{j}+i] ‘cloth’ (nom.)
san+i //san+i//→ [saɲ+i] ‘mountain’ (nom.)
el+li //el+li// → [eʎ+ʎi] ‘to make something frozen’

A similarly transparent pattern is attested in Russian, where a non-palatalized //k// surfaces as a palatalized [č^{j}] before *i*, as shown in (1b).

The alternations between non-palatalized and palatalized consonants in Korean and Russian suggest that OT must include a palatalization constraint that enforces an agreement in backness between the consonant and the following *i*. The relevant constraint is PAL-*i* that I cite after Rubach (2000a).[5]

(3) PAL-*i*: A consonant and a following high vowel must agree in backness.[6]

As section 2 will show, PAL-*i* intentionally leaves open the possibility of how the enforcement of the agreement in backness is actually executed.[7] Notice that this execution can take two completely different paths. First, the output candidate from the input //C+i//, in which the *C* and the *i* disagree in backness, can satisfy PAL-*i* by having a palatalized consonant: [C^{j}+i], where the consonant and the vowel share the feature [-back]. Second, PAL-*i* can also be satisfied by the output which has a velarized consonant and a back vowel: [C^{ɤ}+H], where the superscript [ɤ] denotes velarization.[8] The satisfaction of PAL-*i* is then in favor of [+back] because velarized consonants and [H] are [+back]. Korean exploits the first option: palatalization. Russian follows both scenarios and has [C^{j}+i] as well as [C+ɪ] as the optimal outputs from //C+i//. I postpone the discussion of the Russian [C+ɪ] outputs till section 2.

Returning to the data in (2), notice that PAL-*i* is unable to account for the fact that palatalized consonants are [-anter]. All that PAL-*i* requires is that the consonant be [-back], which means that palatalized dentals [s^{j} n^{j} l^{j}] should be the optimal outputs in (2). A change from input dentals to output posteriors is suboptimal because it violates a faithfulness constraint demanding the retention of the input feature [+anter].

---

[5] Rubach (2000a) is an analysis of Surface Palatalization, $C \rightarrow C^{j}$, and not of Velar Palatalization, *k g x* → *č ž š* (see Lightner 1972), that I address here.

[6] The understanding here is that the consonant and the vowel must share the same value for the feature [±back].

[7] Making sure that palatalized consonants are not only [-back] but also [+high] is the job of a segment inventory constraint mandating that palatalized consonants be [+high].

[8] In the remainder of the text, I will not mark velarization but the understanding is that a consonant of Russian that has not been transcribed as palatalized, that is, a consonant that has no superscript [j], is velarized.

(4) IDENT([+anter]): [+anter] on the input segment must be preserved on that segment in the output.

The occurrence of posterior consonants in (2) must therefore be an effect of a constraint that overrides IDENT([+anter]). The relevant constraint that I call POSTERIOR prohibits palatalized dentals.

(5) POSTERIOR: No palatalized dentals.

With the ranking POSTERIOR >> IDENT([+anter]), the candidates with palatalized dentals [s^j n^j l^j] become suboptimal. In order to satisfy POSTERIOR, the *s, n, l* before *i* must change their place of articulation. The option of turning dentals into labials (for example, *n*→*m*) or velars (for example, *n*→ŋ) is closed by an undominated IDENT-Coron.

(6) IDENT-Coron: CORONAL on the input segment must be preserved on that segment in the output.

Given the pressure from POSTERIOR, on the one hand, and from IDENT-Coron, on the other, the only option available to s^j, n^j, l^j is to move to the [-anter] place of articulation. This is the desired result, as shown by tableau (7), which looks at *os*+*i* 'cloth' (nom.).

(7) //os+i// → [os^j+i][9]

	PAL-*i*	POSTERIOR	IDENT([+anter])
☞a. o$š^j$i			*
b. osi	*!		
c. os^ji		*!	

Korean is not alone in moving anteriors to posteriors under palatalization. Exactly the same is true in Slovak (Sabol 1989) and Czech (Travnièek 1948), as documented by the data in (8). Note: prepalatal stops are transcribed [$\underline{t}^j$ $\underline{d}^j$].

(8) a. Slovak: plo*t* [t] 'fence' – plô*t*+ik [$\underline{t}^j$]
(diminutive, abbreviated as dimin. henceforth)
scho*d* [t] 'step' – scho*d*+ík [$\underline{d}^j$] (dimin.)
b. Czech: návra*t* [t] 'return' (noun) – vrá*t*+iti [$\underline{t}^j$] 'to return'
cho*d* [t] 'walk' (noun) – cho*d*+iti [$\underline{d}^j$] 'to walk'

[9] I do not consider candidates such as [opi] since they grossly offend faithfulness and have no chance of winning with other candidates. Notice that the candidate [opi] violates IDENT- Coron, IDENT([+contin]) and IDENT([+strid]).

Given this system of constraints, a question may be asked how we derive palatalized dentals that are known to occur in a number of languages. For example, Russian has [s^j n^j l^j] amongst other outputs of its Surface Palatalization (see Avanesov 1968 and Rubach 2000a).

(9) Russian: nos [nɔs] 'nose' – nos+ik [nɔs^j+ik] (dimin.)
slon [slɔn] 'elephant' – slon+ik [slɔn^j+ik] (dimin.)
stol [stɔl] 'table' – stol+ik [stɔl^j+ik] (dimin.)

The answer is straightforward: IDENT([+anter]) is ranked above POSTERIOR in Russian and, consequently, [nɔs^j+ik], the output corresponding to (7c) above, wins the race.

In sum, our analysis can account for the alternations between dentals and posteriors shown in (2): palatalized posteriors are a combined effect of PAL-*i*, IDENT-Coron and POSTERIOR. Further, it is predicted that dental stops will move to the posterior place of articulation under palatalization. This is insufficient however. The attested alternation is between dental stops and posterior affricates: //mat+i// → [ma $\underline{\text{j}}^{\text{j}}$+i] 'eldest'. (Recall that the voicing of the affricate is a predictable allophonic process; see Ahn 1985.) We need a constraint that will enforce affrication.

The Korean data ($t \rightarrow \underline{j}^j$) and the Russian data ($k \rightarrow \check{c}^j$) converge on the observation that palatalized coronal stops are spelled out as affricates. Forerunning the discussion in section 2 that deals with the Russian [š] and [ž], this observation is generalized to all coronals. The relevant constraint that I call STRIDENCY is stated in (10).

(10) STRIDENCY (STRID): No [-strid] palatalized coronals.

One may wonder whether the statement of STRIDENCY should not be limited to posterior coronals. The answer is that this would be a false step. Vilnus Polish, a dialect of Polish spoken in Lithuania, shows an effect of STRIDENCY on [+anter] consonants. Dental stops alternate with dental affricates under palatalization (Turska 1983).

(11) Vilnus Polish:
drut [drut] 'wire' – druc+ik [druts^j+ik] (dimin.)
sk^{3}ad [sklat] 'store' (Final Devoicing) – sk^{3}adz+ik [skladz^j+ik] (dimin.)

The effect of STRIDENCY coupled with PAL-*i* and POSTERIOR is to force Korean //t+i// to turn into /č^j+i/. The change from //t//, which is [-strid], to [č^j], which is [+strid], violates IDENT([-strid]). Following

Rubach (1994), I assume that [±strid] is a dependent of CORONAL in a feature-geometric tree representation.[10]

(12) IDENT([-strid]): [-strid] on the input segment must be preserved on that segment in the output.

The details of the evaluation for //mat+i// are laid out in (13), where [d^{j}] stands for a posterior palatalized stop, as in Slovak. I assume that allophonic voicing is regulated by an undominated constraint not shown in (13).

(13) //mat+i// → [maǰ^{j}+i]

	PAL-*i*	POSTERIOR	STRID	IDENT ([-strid])	IDENT ([+anter])
☞ a.maǰ^{j}i				*	*
b. madi	*!				
c. mad^{j}i		*!			
d. maḏ^{j}i			*!		*

Stated for all palatalized coronals as in (10), STRIDENCY overshoots in the sense that it enforces strident outputs not only from obstruents, the correct result, but also from sonorants, the wrong result. Specifically, the inputs //n// and //l// do not change into stridents under palatalization (see the data in (2)). The key to the solution of this problem lies with the observation that input sonorants preserve their sonorancy in the output, an effect of an undominated IDENT([+sonor]) constraint.

(14) IDENT([+sonor]): [+sonor] on the input segment must be preserved on that segment in the output.

IDENT([+sonor]) militates against changes such as *n* → *t*.

With sonorancy being retained in the output, STRIDENCY is blocked by a segment inventory constraint in (15).

(15) *SONORSTRID: No [+strid] sonorants.

In all probability, sonorants are never [+strid] in any of the world's languages. If this is correct, then (15) is a constraint on GEN rather than a member of the EVAL function of OT. The net effect then is that strident sonorants are not submitted by GEN for evaluation.

[10] I assume Sagey's (1986) model of feature geometry.

If (15) is a constraint on GEN, a question may be asked whether STRIDENCY should not be a constraint on GEN as well. The answer is negative. STRIDENCY is violable, so it is a constraint in the EVAL function. The evidence comes from Russian, where dental stops palatalize without concomitant affrication.

(16) Russian: soldat [sʌldat] 'soldier'– soldat+ik [suldatʲ+ik] (dimin.)
zavod [zʌvɔt] 'factory' (Final Devoicing) – zʌvod+ik [zʌvɔdʲ+ik]

These data do not pose a problem: the ouputs [tʲ dʲ] are selected as optimal because Russian, in contrast to Korean, ranks IDENT([-strid]) above STRIDENCY. As remarked earlier, POSTERIOR is made ineffective on dental inputs by an undominated IDENT([+anter]). The evaluation of *brat+ik* 'brother' (dimin.) is as follows.

(17) //brat+ik// → [bratʲ+ik]

	PAL-*i*	IDENT ([-strid])	IDENT ([+anter])	POSTERIOR	STRID
☞a. bratʲik				*	*
b. bratik	*!				
c. bratsʲik		*!		*	
d. bračʲik		*!	*		
e. bra̱tʲik			*!		*

Given the evaluation in (17) that effectively prohibits affrication and posteriority, how is it possible that Russian //k+i// surfaces as [čʲ+i]? The answer follows from feature geometry. Specifically, velars are not within the purview of IDENT([+anter]) and IDENT([-strid]) because [±anter] and [±strid] are dependents of CORONAL and not of DORSAL (Rubach 1994).[11] Therefore these constraints are mute on velar inputs.

A problem with the Russian palatalization *k* → *čʲ* lies somewhere else. Evidently, the simplest way of satisfying PAL-*i* on //k+i// inputs is to palatalize the //k// to [kʲ] since [kʲ] is a more faithful output from //k// than [čʲ]. For example, the latter violates IDENT-Dorsal while the former does not.

(18) IDENT-Dorsal (IDENT-Dor): DORSAL on the input segment must be preserved on that segment in the output.

[11] Should [±strid] be moved up the feature-geometric tree so that it would dominate DORSAL, the IDENT([-strid]) constraint in (17) would have to be restricted to anteriors.

The option that PAL-*i* is satisfied on inputs //k+i// by palatalizing //k// to [kʲ] is closed by an undominated *SOFTDORSAL constraint (Zubritskaya 1995).

(19) *SOFTDORSAL (*SOFTDOR): No palatalized dorsals.[12]

If both [k+i] and [kʲ+i] are eliminated as optimal outputs by PAL-*i* and *SOFTDOR, respectively, the winning candidate must be either labial or coronal. The luck is with a coronal output because, universally, coronals are preferred to labials: *LAB >> *CORON[13] (Prince and Smolensky 1993). The remaining part of the evaluation is now clear: POSTERIOR penalizes [+anter] outputs and STRIDENCY enforces affrication. This reasoning is displayed in tableau (20). IDENT-Coron, IDENT([+anter]) and IDENT([-strid]) are omitted in (20) because they are mute on dorsal inputs. We look at //k+i// that is the relevant fragment of the examples in (1b). Recall that [t̲ʲ] is a posterior palatalized stop, as in Slovak.

(20) //k+i// → [čʲ+i]

	PAL-*i*	POSTERIOR	STRID	*SOFT DOR	*LAB	*COR	IDENT-Dor
☞a. čʲi						*	*
b. ki	*!						
c. kʲi				*!			
d. či	*!					*	*
e. pʲi					*!		*
f. tʲi		*!	*			*	*
g. t̲ʲi			*!			*	*
h. tsʲi		*!				*	*

To summarize, Korean and Russian are similar in the sense that their palatalization processes produce [-back, -anter] consonants, a fact that is analyzed in OT in terms of PAL-*i* and POSTERIOR. Further, stops turn into affricates under palatalization, an effect of STRIDENCY being a high-ranked constraint. The sources of derived posteriors are different: in Korean posteriors come from underlying dentals whereas in Russian they

[12] *SOFTDOR is violated in the surface representation in Russian because [kʲ] is attested phonetically, as in *kozak+i* [kʲ+i] 'Cossacks'. This is not a problem however. The [i] of the plural ending is derived from //H// by Velar Fronting: *i* → *H* after velars (see Rubach 1984 for an analysis of a similar generalization in Polish).

[13] The constraints *LAB >> *CORON play no role in the case of labial and coronal inputs because these constraints are made ineffective by the higher ranked IDENT-Lab and IDENT-Coron that mandate the preservation of LAB and CORON in the output.

come from underlying velars. This distinction is a matter of how the relevant faithfulness constraints and the segment inventory constraints are ranked in these languages: IDENT-Coron, IDENT([+anter]), IDENT-Dor, and *SOFTDOR.

Further facts regarding the analysis of posterior stridents complicate the picture. In Korean, the palatalization of //t// is restricted to derived environments while the palatalization of //s// does not carry this restriction. In Russian, all posterior stridents derived from underlying velars are restricted to derived environments. The added difficulty is that the underlying //i// that triggers Velar Palatalization surfaces as [ɨ] after fricatives. An analysis of these complex facts is presented in the following section.

2. Level distinctions

It has long been known that Korean palatalization is phonemic for //t// and allophonic for //s// as well as for //n l// (see the references in footnote 1). Ahn (2002) points out that Korean speakers are unaware of the fact that they say [š^{j}]. Thus, they do not perceive the difference between the fricatives in *si* [š^{j}i] 'poem' and *sa* [sa] 'four'. Iverson (2002) observes that *s* → *š^{j}* causes interference when Koreans learn English. Consequently, *see* and *she* as well as *messing* and *meshing* are all pronounced with [š^{j}], an interference from palatalization applying before *i*.

The distinction between the phonemic palatalization of stops and the allophonic palatalization of the remaining coronals has been analyzed in Lexical Phonology (Kiparsky 1982) as a distinction between the lexical level and the postlexical level (Ahn 1985). Building on this result, G.-R. Kim (2002) makes a case for transferring this analysis into the framework of OT. Thereby she joins these researchers who believe that OT should be modified by admitting derivational levels (Kiparsky 1997 and 2000, Booij 1997, Rubach 1997, 2000a and 2000b, and others).

I think it is indeed true that Korean palatalization is best analyzed in terms of the lexical versus the postlexical levels. This assertion follows from my claim in Rubach (2000b) that, by default, languages distinguish between these two levels and this distinction must be an inherent part of the OT model. The point of interest is that, counter to her intentions, the two level analysis of Korean palatalization does not follow from G.-R. Kim's (2002) argument.

G.-R. Kim's argument is based on the observation established in the literature (notably, by Ahn 1985) that the palatalization of stops, but not of other coronals, is restricted to derived environments. Following Łubowicz (2002), G.-R. Kim assumes that the derived environment

restriction is expressed in OT as a conjunction of constraints, for the case in point – a conjunction of PAL and R-ANCHOR. The latter is violated if the rightmost segment of a stem in the input does not have a correspondent at the right edge of the syllable in the output (Łubowicz 2002). This means that R-ANCHOR is violated when the stem-final segment is syllabified with the vowel of the suffix to form an onset. Thus, *mat+i* //mat+i// 'eldest', syllabified as [ma.ʧʲ+i], violates R-ANCHOR but *mati* //mati// 'knot', syllabified as [ma.di], does not. In the latter case, the [d] is inside the stem rather than at at the stem edge because the [i] is not a suffix. The crucial point of the analysis is that the conjunction {PAL & R-ANCHOR}, specified as applicable to adjacent segments, forces palatalization in the event of a morpheme boundary as only then the stem-final segment syllabifies with the suffix and, consequently, violates R-ANCHOR. The candidate [ma.d+i] from //mat+i// that we wish to eliminate violates both PAL and R-ANCHOR (the conjoined constraint) and hence loses to the desired candidate [ma.ʧʲ+i] that violates R-ANCHOR but not PAL. This candidate passes on {PAL & R-ANCHOR} because a conjoined constraint is violated only when both conjuncts are violated at the same time, as in [ma.d+i].

G.-R. Kim observes that this analysis yields the desired result for *t*-palatalization, which is sensitive to derived environments, but not for the remaining coronals, which palatalize 'across-the-board', that is, both stem-internally and across morpheme boundaries. To put it differently, Łubowicz's (2002) conjoined constraint overshoots by restricting all palatalization to derived environments. Consequently, G.-R. Kim points out, the analysis predicts palatalization only across morpheme boundaries, which is incorrect for words such as *kasi* //kasi//, phonetic [ka.ɕʲi] 'thorn' (G.-R. Kim's example).

G.-R. Kim's solution to this problem is to assume two levels: the lexical level and the postlexical level. At the lexical level, the conjoined constraint forces palatalization in derived environments, hence //mat+i// → [ma.ʧʲ+i] 'eldest' and //kas+i// → [ka.ɕʲ+i] 'traditional hat' (nom.; G.-R. Kim's example). Stem-internal coronals plus *i*, as in //mati// 'knot' and //kasi// 'thorn' are unaffected. They cannot palatalize because IDENT([+anter]) dominates PAL. The conjoined constraint, which would otherwise have forced palatalization, is mute on such inputs. The reason is that there is no syllabification of the stem-final consonant with the suffix vowel as there is no suffix. Therefore R-ANCHOR is not violated, so the conjoined constraint has no force to override the blocking of palatalization effected by IDENT([+anter]) >> PAL. At the postlexical level, IDENT([+anter]) >> PAL is reranked to PAL >> IDENT([+anter]), the result being that palatalization applies across the board. Consequently,

the stem-internal *si* in //kasi// 'thorn' is now palatalized: [ka.šʲi], the correct result. There is a problem however. Given PAL >> IDENT ([+anter]) at level 2, this analysis predicts that not only //kasi// 'thorn' but also //mati// 'knot' will palatalize at level 2, which is incorrect for //mati//: the attested surface form is [ma.di] and not *[ma.ǰʲi]. The analysis needs to be revised. I propose the following scenario.

The difference between the behavior of *t*-palatalization, restricted to derived environments, and *s*-palatalization (as well as *n*-palatalization and *l*-palatalization), applying across the board, is due to the ranking of faithfulness constraints *vis-à-vis* PAL and the conjoined constraint. The relevant faithfulness constraint is the following.

(21) IDENT-Stop([+anter]): [+anter] on the input noncontinuant obstruent must be preserved on that obstruent in the output.

The general idea is that IDENT-Stop([+anter]) >> PAL blocks palatalization in //mati// 'knot' because the candidate [ma.ǰʲi] violates IDENT-Stop([+anter]). On the other hand, in //mat+i// 'eldest' palatalization is forced by the higher ranked conjoined constraint: {PAL & R-ANCHOR} >> IDENT-Stop([+anter]) >> PAL. The details of the analysis are as follows.

The constraint PAL used informally by Łubowicz (2002) and G.-R. Kim (2002) for palatalization involving changes in the place of articulation is inaccurate. In fact, as shown in section 1, we are looking here at three different constraints: PAL-*i*, POSTERIOR and STRIDENCY that interact with faithfulness constraints in a variety of ways.

Assuming with Łubowicz (2002) that the derived environment restriction is expressed as a conjoined constraint, the relevant conjunction here is {PAL-*i* & R-ANCHOR}. The input //mat+i// is forced to palatalize to [ma.ǰʲ+i] because the non-palatalized contender [ma.d+i] violates the conjoined constraint.

(22) //mat+i// → [ma.ǰʲ+i]

	{PAL-*I* &R-ANCHOR}	POSTERIOR	STRID	**IDENT**-STOP ([+ANTER])	PAL-*I*	IDENT ([+ANTER])
☞A.MA.J^{J}+I				*		*
B.MA.D+I	*!				*	
C.MA.D^{J}+I		*!	*			
D.MA.D^{J}+I			*!	*		*

Notice that it is not clear from (22) whether IDENT-Stop([+anter]),

PAL-*i* and IDENT-([+anter]) need to be ranked *vis-à-vis* each other. The ranking IDENT-Stop([+anter]) >> PAL-*i* is unveiled by the analysis of *mati*.

Recall that the morpheme-internal *ti* of //mati// does not violate the conjoined constraint in any of the viable candidates because *i* is not a suffix.

(23) //mati// → [ma.di]

	{PAL-*i* &R-ANCHOR}	POSTERIOR	STRID	IDENT-Stop([+anter])	PAL-*i*	IDENT ([+anter])
a. ma.$\underset{\sim}{\text{j}}$i				*!		*
☞b.ma.di					*	
c. ma.$\underset{\sim}{\text{d}}$i		*!	*			
d. ma.$\underline{\underset{\sim}{\text{d}}}$i			*!	*		*

The further ranking, PAL-*i* >> IDENT([+anter]), comes to light when we look at *s*-palatalization in non-derived environments (24b). Compare the derived environment //kas+i// 'traditional hat' (nom.) In (24a) and the non-derived environment //kasi// 'thorn' in (24b).

(24) a. //kas+i// → [ka.$\check{\text{s}}^{\text{j}}$+i]

	{PAL-*i* & R-ANCHOR}	POSTERIOR	STRID	IDENT-Stop([+anter])	PAL-*i*	IDENT ([+anter])
☞ a.ka.$\check{\text{s}}^{\text{j}}$+i						*
b.ka.s+i	*!				*	
c.ka.s$^{\text{j}}$+i		*!				

b. //kasi// → [ka.$\check{\text{s}}^{\text{j}}$i]

	{PAL-*i* & R-ANCHOR}	POSTERIOR	STRID	IDENT-Stop([+anter])	PAL-*i*	IDENT ([+anter])
☞a.ka.$\check{\text{s}}^{\text{j}}$i						*
b. ka.si					*!	
c. ka.s$^{\text{j}}$i		*!				

To summarize, POSTERIOR eliminates the candidates that have retained their dental place of articulation under palatalization: [ma.d$^{\text{j}}$+i], [ma.d$^{\text{j}}$i], [ka.s$^{\text{j}}$+i] and [ka.s$^{\text{j}}$i] in (22-24). IDENT-Stop([+anter]) wants to see dental stops as optimal outputs, hence [ma.di] is better than [ma.$\underset{\sim}{\text{j}}^{\text{j}}$i] in (23). In derived environments, the otherwise optimal output [ma.d+i] loses to [ma.j$^{\text{j}}$+i] because it violates the conjoined constraint in (22). IDENT-Stop ([+anter]) is mute on inputs with //s// (as well as with //n// and //l//) in (24). What matters now is the ranking PAL-*I* >> IDENT([+anter]) that

eliminates [ka.si] in favor of [ka.šʲi] in (24b). In (24a) the choice of [ka.šʲ+i] is additionally reaffirmed by the conjoined constraint but in fact this constraint is not essential here, given the PAL-*I* >> IDENT([+anter]) ranking motivated in (24b).

The conclusion is that Korean palatalization does not provide evidence for level distinctions in OT because the optimal outputs in (22-24) are correctly selected in fully parallel evaluations. However, given Rubach's (2000b) tenet that the distinction between the lexical level and the postlexical level is an inherent part of the OT model, it is the case that Korean palatalization is carried out at these two levels. At the lexical level, palatalization affects word-internal concatenations of a coronal followed by *i*, as shown in (22-24). At the postlexical level, palatalization extends its operation to contexts across word boundaries (Ahn 1985). This has an effect on the inputs containing //s// (as well as //n// and //l//) but not on the inputs containing //t//. In the latter case, palatalization is blocked by IDENT-Stop([+anter]) since, assuming that there is no resyllabification across word boundaries, such inputs are predicted to follow the pattern in (23), where {PAL-*i* & R-ANCHOR} is not activated. To conclude, the level distinction in Korean palatalization follows from the modified OT model but cannot be motivated internally for Korean by ranking paradoxes. Such paradoxes do not exist because the constraints are ranked in the same way at the lexical level and at the postlexical level.

Motivating level distinctions by pointing to ranking paradoxes or language-internal contradictions is exceedingly difficult. The reason for this difficulty is that OT has developed a number of auxiliary theories that target opacity, notably, output-output theory (Benua 1997) and sympathy theory (McCarthy 1999 and 2002), both of which simulate derivational effects. Thus, as McCarthy (1999) points out, Booij's (1997) analysis of Dutch motivating the lexical and the postlexical levels disappears as an argument in sympathy theory. Similarly, Kiparsky's (2000) analysis of Arabic battles successfully output-output theory but yields to a reanalysis in terms of sympathy theory. The line of argumentation for derivational levels is therefore reduced to the debate of what constitutes a simpler grammar: OT enriched by derivational levels or OT enriched by output-output theory and sympathy theory. It is difficult for such a debate to be conclusive because different researchers have different convictions about what constitutes a simple grammar. To move this debate forward, we need to find evidence of the type that is not amenable to reanalysis in terms of output-output theory or sympathy theory. The Slavic languages provide exactly this type of evidence, as shown by Rubach (2000a) for Russian Surface Palatalization and Rubach (2000b) for glide and glottal stop insertion in Polish, Slovak and Czech. Russian Velar Palatalization

adds to this body of evidence, as I show below.

Velar Palatalization accounts for alternations between velar //k g x// and posterior [čʲ ž š], as shown in (25), where we look at the alternations in the context of //i//.

(25) a. muk+a [muk+a] 'torture' – muč+i+tʲ [mučʲ+i+tʲ] 'to torture'
b. dolg [dɔlk][14] 'debt' – o+dolž+y+tʲ [ʌdʌlž+ɨ+tʲ] 'lend'
c. pux [pux] 'fluff' – puš+y+tʲ [puš+ɨ+tʲ] 'to fluff'

The underlying representation of the verbalizing morpheme is //i//[15] (see, for example, Lightner 1972). The //i// surfaces transparently as [i] in (25a), where [čʲ], a result of palatalization, is a [-back] segment. Unexpectedly, the //i// surfaces as a back vowel [H] in (25b-c) and the posterior stridents are hard [+back] consonants. The concatenations [žɨ] and [šɨ] in (25b-c) agree in backness, albeit the agreement is in favor of both the consonant and the vowel being [+back]. Thus, PAL-*i* is satisfied, but how is it possible that the input velars //g// and //x// change into posterior stridents? Recall that the constraints responsible for deriving posterior stridents, POSTERIOR and STRIDENCY, are sensitive to the feature [-back] on coronal consonants. Before attempting to solve this dilemma, we need to look at some background facts of Russian phonology.

Relevant to the analysis is the observation that Russian does not admit plain consonants. That is, all consonants in the surface representation are either palatalized or velarized (Sweet 1879, Broch 1911, Halle 1959, Avanesov 1968, and others). In other words, the feature [±back] is a necessary property on a consonant, so consonants are either [-back] or [+back]. This opposition is found not only in the surface representation but also at the underlying level, as shown in (26).[16]

(26) putʲ //putʲ// 'journey' – brat //brat// 'brother'
nolʲ //nɔlʲ// 'zero' – stol //stɔl// 'table'

Rubach (2000a) points out that PAL-*i* has diverse effects, depending on whether the concatenation of a velarized consonant plus *i* occurs inside words or across word boundaries. In the former case, we witness palatalization (27a); in the latter case – vowel retraction (27b).

---

[14] [k] is an effect of Final Devoicing.
[15] The final [tʲ] is an infinitive morpheme.
[16] This is a standard assumption in the generative literature on Russian, see, for example, Halle (1959) and Lightner (1972).

(27) a. brat ‘brother’ - brat+ik (dimin.), //t+i// → [tʲ+i]: the spreading of [-back] from the vowel to the consonant.
b. brat ‘brother’ - brat i ‘brother and’, //t#i// → [t#ɨ]: the spreading of [+back] from the consonant to the vowel.

Since the operations in (27) are contradictory, they cannot be effected at one level. Rather, at the word level the strategy is to palatalize the consonant. This is achieved by ranking IDENT-V([-back]) above IDENT-C([+back]), the faithfulness constraints stated in (28) below. At the postlexical level, IDENT-C([+back]) is reranked above IDENT-V ([-back]), the effect being that now it is the vowel that assimilates to the consonant.

(28) a. IDENT-V([-back]): [-back] on the input vowel must be preserve on that vowel in the output.
b. IDENT-C([+back]): [+back] on the input consonant must be preserved on that consonant in the output.

Rubach’s (2000a) argument for level distinction deriving from the operation of PAL-*i* is strengthened by a process known as Akanie/Ikanie (see, for example, Jones 1923 and Avanesov 1968). The generalization is that unstressed non-high vowels reduce to [i] after a palatalized consonant and to [ʌ] after a velarized consonant. This is exemplified in (29), where we look at alternations involving an underlying //ɔ//. Stress is marked by an accent.

(29) a. Akanie, //ɔ// → [ʌ]:
dóm [dɔm] ‘house’ (nom.sg.) - dom+óv [dʌmɔf] (gen.pl.)
voz [vɔs] ‘cart’ (nom.sg.) - voz+óv [vʌzɔf] (gen.pl.)
zvon [zvɔn] ‘bell’ (nom.sg.) - zvon+í+tʲ [zvʌnʲitʲ] ‘to ring’
b. Ikanie, //ɔ// → [i]:
sčot [ɕʲčʲɔt] ‘bill’ – sčit+á+tʲ [ɕʲčʲitatʲ] ‘count’
čort [čʲɔrt] ‘devil’ – čort+á [čʲirta] (gen.sg.)
sʲól+a [sʲɔla] ‘village’ (nom.pl.) – sʲol+ó [sʲilɔ] (nom.sg.)

The question is how *š* and *č* behave *vis-à vis* Akanie/Ikanie. Since [š ž] are velarized in the surface representation, we would expect them to trigger Akanie, but this is not what happens.

(30) šolk [šɔlk] ‘silk’ (nom.sg.) – šolk+á [šɨlka] (nom.pl.), not *[šʌlka]
žon [žɔn] ‘wife’ (gen.pl.) – žon+á [žɨna] (nom.sg.), not *[žʌna]

What we see is an alternation between [ɔ] and [ɨ] rather than [ɔ] and

[ʌ]. The analysis is straightforward if we make an assumption that *š* and *ž* are palatalized at the underlying level, that is, they are //šʲ žʲ//. It is clear then that they trigger Ikanie because they are [-back]. An independently motivated Vowel Retraction, *i*→*ɨ*, exemplified in (27b), turns /i/ into [ɨ] after *š* and ž. However, in order to trigger Vowel Retraction, *š* and *ž* must be velarized rather than palatalized because Vowel Retraction spreads [+back] from the consonant to the vowel. Evidently, Russian has a segment inventory constraint that spells out //šʲ žʲ// as velarized [š ž], as indeed attested in the surface representation.

(31) HARD FRICATIVE (HARD-FRIC): Posterior fricatives must be [+back].

Russian is not alone in providing evidence for HARD as a constraint. Other Slavic languages join suit but, interestingly, the inputs to HARD may vary from one language to another. Thus, Ukrainian has not only hard [š ž] but also [č ǰ] (Bilodid 1969). However, the dental affricates [tsʲ dzʲ] are soft, that is, palatalized. Upper Lusatian is a mirror image of Ukrainian: [ts] is hard while [šʲ žʲ čʲ ǰʲ] are soft (Schuster-Šewc 1996). In Polish, HARD has the widest range of inputs since both dental and posterior stridents are hard: [ts dz š ž č ǰ] (see Rubach 2003). These facts show that HARD is in fact a family of constraints. However, for the purposes of this analysis, the only relevant constraint is HARD-FRIC.

With this background we return to the analysis of Velar Palatalization for the //x// and /g// inputs shown in (25). Recall that these data raise two questions, first, how to obtain hard [š ž] in a process that involves palatalization and, second, how to account for the fact that an underlying //i// appears as [ɨ] in the surface representation. The analysis calls for an intermediate stage of evaluation at which POSTERIOR and STRIDENCY, both of which are sensitive to the [-back] property on a consonant, are activated. The necessary intermediate stage of evaluation is readily available: it is the distinction between word phonology (word level) and phrase phonology (postlexical level). This distinction is motivated internally for Russian by the data in (27) showing the contradictory outcomes of Surface Palatalization (*ti*→ *tʲi*) and Vowel Retraction (*t#i* → *t#ɨ*). The facts of Velar Palatalization, not discussed by Rubach (2000a), provide independent support to the view that Russian requires a two level analysis. The details are as follows.

At the word level, the analysis of //x+i// and //g+i// is the same as the analysis of //k+i// in (20). The optimal output of //x+i// in *puš+y+tʲ* 'to fluff', a verb from *pux* //pux// 'fluff', is /šʲ+i/, which makes the //x+i// evaluation parallel to the /k+i// evaluation in (20): //x+i//→/šʲ+i/ and //k+i//→/čʲ+i/. In (32) we look at the relevant fragment of //pux+i+tʲ//.

The constraints and their ranking are the same as in (20) but the evaluation is simplified by leaving out *LAB and *COR. On the other hand, we include HARD-FRIC that was irrelevant in (20).

(32) Word level //x+i// → [š^{j}+i]

	PAL-*i*	POSTERIOR	STRID	*SOFTDOR	IDENT-V([-bk])	IDENT-T-Dor	HARD-FRIC
☞ a. š^{j}i						*	*
b. xi	*!						
c. x^{j}i				*!			
d. s^{j}i		*!				*	
e. xɨ					*!		

The difference between //k+i// → [č^{j}+i] in (20) and //x+i// → /š^{j}+i/ in (32) is that in (20) the optimal output is the attested surface representation while in (32) it is not. The /š^{j}+i/ needs to be turned into [š+H], which is derived at the postlexical level. Now HARD-FRIC and IDENT-V ([-back]) change places, so that it is more optimal for the fricative to be velarized than for the /i/ to preserve its [-back] feature. IDENT-Dor is omitted in (33) because it is mute on the /š^{j}+i/ input that has no velar. Similarly, *SOFTDOR is irrelevant as IDENT-Coron, an undominated constraint, does not permit any diversion from the coronal place of articulation of the input /š^{j}/.

(33) Postlexical level //š^{j}+i// → [š+ɨ]

	PAL-*i*	POSTERIOR	STRID	HARD-FRIC	IDENT-V([-bk])
☞a. šɨ					*
b. š^{j}i				*!	
c. š^{j}ɨ	*!			*	*
d. s^{j}i		*!			
e. si	*!				

The evaluation of *odolž+y+t^{j}* 'lend', a verb from *dolg* 'debt' (25b), highlights two points. First, STRIDENCY becomes a relevant constraint and, second, we see the operation of Spirantization because the input has a stop while the attested output has a fricative: //g+i// → /ž^{j}+i/ at the word level (and further /ž^{j}+i/ → [ž+ɨ] at the postlexical level). Spirantization is a straightforward generalization since Russian does not have voiced affricates, that is *[ǰ] and *[dz] are not attested.[17]

[17] Actually, they may occur in the surface representation but only as an effect of Voice Assimilation acting on the inputs [č^{j}] and [ts], as in *m^{j}ačdetey* [m^{j}ač^{j} d^{j}it^{j}ej]

(34) SPIRANTIZATION (SPIR): No voiced affricates.

SPIRANTIZATION violates IDENT([-contin]) because the stop //g// is turned into a fricative.

(35) IDENT([-contin]): [-contin] on the input consonant must be preserved on that consonant in the output.

The evaluation of *odolž+y+t^{j}* is now as follows. At the word level, the optimal output is /ž^{j}+i/, a parallel to /š^{j}+i/ in (32). Recall that [d̲^{j}] is a posterior palatalized stop.

(36) Word level //g+i// → [ž^{j}+ɨ]

	PAL-*i*	**POSTERIOR**	STRID	*SOFTDOR	SPIR	ID-V ([-bk])	ID-Dor	ID([-cont])	HARD-FRIC
☞a. žʲi							*	*	*
b. gɨ	*!								
c. gʲi				*!					
d. gɨ						*!			
e. dʲi		*!	*				*		
f. d̲ʲi			*!				*		
g. džʲi					*!		*		

At the postlexical level, /ž^{j}i/ has [žɨ] as its optimal output, a parallel to /š^{j}+i/ → [š+ɨ] in (33). The constraints IDENT-Dor, *SOFTDOR, IDENT ([-contin]), and SPIRANTIZATION are now irrelevant (but see footnote 17), so they are not shown in (37).

(37) Postlexical level //ž^{j}+i// → [ž+ɨ]

	PAL-*i*	POSTERIOR	STRID	HARD-FRIC	IDENT-V([-bk])
☞a. žɨ					*
b. žʲi				*!	
c. žʲɨ	*!			*	*
d. zʲi		*!			
e. zi	*!				

'children's ball' and *konec borby* [kunʲedz burbH] 'end of the battle'. Since Voice Assimilation acting on *čʲ* and *ts* is found in phrase phonology, these data show that Spirantization must be active at the word level. Postlexically, it is blocked by IDENT([-contin]) that is ranked above Spirantization. Thus, we have yet another piece of evidence motivating a level distinction: at the word level the ranking is SPIRANTIZATION >> IDENT([-contin]), at the postlexical level this ranking is reversed and we have IDENT([-contin]) >> SPIRANTIZATION.

To conclude, Velar Palatalization provides evidence for level distinctions by requiring that there should be an intermediate stage at which *š* and *ž* occur as palatalized /šʲ žʲ/.

3. Conclusion

Derived posterior stridents have different sources in Korean and Russian. In Korean, they come from //t s// while in Russian from //k g x//. Yet, the analysis is in many ways similar because it relies on the same three constraints: PAL-*i*, POSTERIOR and STRIDENCY. The differences are seen in the ranking of the faithfulness constraints and the segment inventory constraints. For example, in contrast to Russian, Korean does not change velars into posterior stridents, an effect of the undominated IDENT-Dor constraint. In Korean, [šʲi] is the attested output while in Russian it is [ši]. This difference is due to the ranking IDENT-V([-back]) >> HARD-FRIC in Korean and HARD-FRIC >> IDENT-V([-back]) in Russian. Russian, but not Korean, provides evidence for level distinctions. The evidence comes from the role that segment inventory constraints play at different depths of derivation. At the word level, the optimal output must be a palatalized consonant in order to activate POSTERIOR and STRIDENCY, with the consequence being that HARD-FRIC is violated for the outputs /šʲ/ and /žʲ/. At the postlexical level, HARD-FRIC is reranked to an undominated position, which means that the inputs /šʲi/ and /žʲi/ harden their fricatives and retract their vowel from [-back] to [+back]: /šʲi/ → [ši] and /žʲi/ → [ži]. In sum, the inventories of admissible output segments are different at the word level and at the postlexical level. Standard OT is unable to accommodate such generalizations because its auxiliary theories designed to handle opacity (output-output theory and sympathy theory) have nothing to say on what constitutes an admissible inventory of output segments. Standard OT must therefore be modified to permit an intermediate derivational level. By default, this level is at the interface between word phonology and phrase phonology, a generalization that is a prominent result of the pre-OT research in Lexical Phonology.

REFERENCES

AHN, SANG-CHEOL. 1985. *The Interplay of Phonology and Morphology in Korean*. Urbana-Champaigne: University of Illinois dissertation.

AHN, SANG-CHEOL. 2002. *An Introduction to Korean Phonology*. Seoul: Kyung Hee University, MS.

AVANESOV, RUBEN, I. 1968. *Russkoye literaturnoye proiznoshenie*. Moscow: Prosveshchenie.
BENUA, LAURA. 1997. *Transderivational Identity: Phonological Relations between Words.* Amherst, MA: University of Massachusetts dissertation.
BILODID, K. 1969. *Suchasna ukrains'ka literaturna mova.* Kiev: Naukova Dumka.
BOOIJ, GEERT E. 1997. Non-derivational phonology meets Lexical Phonology. *Derivations and Constraints in Phonology*, ed. by Iggy Roca, 261-288. Oxford: Oxford University Press.
BROCH, OLAF. 1911. *Slavische Phonetik*. Heilderberg: Carl Winter.
CLEMENTS, GEORGE N. 1985. The geometry of phonological features. *Phonology Yearbook* 2: 225-252.
HALLE, MORRIS. 1959. *The Sound Pattern of Russian*. Mouton: The Hague.
IVERSON, GREGORY K. 2002. On deriving the derived environment constraint in non-derivational phonology. *Proceedings of the Linguistic Society of Korea International Summer Conference*, volume II: 267-278. Seoul: Kyung Hee University.
JONES, DANIEL. 1923/1969. *The Phonetics of Russian.* Revised by Dennis Ward, 1969. Cambridge: Cambridge University Press.
KIM, CHIN-WOO. 1968. The vowel system of Korean. *Language* 44: 516-527.
KIM, CHIN-WOO. 1972. The two phonological notes, A-sharp and B-flat. *Contributions to Generative Phonology*, ed. by Michael K. Brame, 155-170. Austin, TX: University of Texas Press.
KIM-RENAUD, YOUNG-KEY. 1974. *Korean Consonantal Phonology*. Hawaii: University of Hawaii dissertation.
KIM, GYUNG-RAN. 2002. Korean palatalization in Optimality Theory: against the strict parallelism. *Studies in Phonetics, Phonology and Morphology* 8: 1-15.
KIPARSKY, PAUL. 1973. Abstractness, opacity, and global rules. *Three Dimensions in Linguistic Theory*, ed. by Osamu Fujimura, 57-86. Tokyo: TEC Company.
KIPARSKY, PAUL. 1982. From cyclic to lexical phonology. *The Structure of Phonological Representations*. Part 1, ed. by Harry van der Hulst and Norval Smith, 131-175. Dordrecht: Foris Publications.
KIPARSKY, PAUL. 1997. LP and OT. Handout: Cornell Linguistic Institute.
KIPARSKY, PAUL. 2000. Opacity and cyclicity. *The Linguistic Review* 17: 351-365.
LEE, CHUNG-MIN. 1972. Boundary phenomena in Korean revisited. *Papers in Linguistics* 5: 454-485.
LIGHTNER, THEODORE. M. 1972. Problems in the theory of phonology: *Russian Phonology and Turkish Phonology.* Edmonton, Alberta: Linguistic Research Inc.
ŁUBOWICZ, ANNA. 2002. Derived environment effects in Optimality Theory.

Lingua 112: 243-280.
MCCARTHY, JOHN J. 1999. Sympathy and phonological opacity. *Phonology* 16: 331-339.
MCCARTHY, JOHN J. 2002. Sympathy, cumulativity, and the Duke-of-York gambit. *The Optimal Syllable*, ed. by Caroline Féry and Ruben van de Vijver, 23-76. Cambridge: Cambridge University Press.
MCCARTHY, JOHN J., and ALAN PRINCE. 1995. Faithfulness and reduplicative identity. Papers in Optimality Theory. *University of Massachusetts Occasional Papers in Linguistics* 18, ed. by Jill N. Beckman, Laura W. Dickey, and Suzanne Urbanczyk, 249-384. Amherst, MA.: Graduate Linguistic Student Association.
PRINCE, ALAN, and PAUL SMOLENSKY. 1993. Optimality Theory: Constraint interaction in generative grammar. New Brunswick, NJ and Boulder, CO: Rutgers University and University of Colorado, MS.
RUBACH, JERZY. 1994. Affricates as strident stops. *Linguistic Inquiry* 25: 119-143.
RUBACH, JERZY. 1997. Extrasyllabic consonants in Polish. Derivational Optimality Theory. *Derivations and Constraints in Phonology*, ed. by Iggy Roca, 551-581. Oxford: Oxford University Press.
RUBACH, JERZY. 2000a. Backness switch in Russian. *Phonology* 17: 39-64.
RUBACH, JERZY. 2000b. Glide and glottal stop insertion: A DOT analysis. *Linguistic Inquiry* 31: 271-317.
RUBACH, JERZY. 2003. Polish palatalization in Derivational Optimality Theory. *Lingua* 113: 197-237.
SABOL, JÁN. 1989. *Syntetická fonologická teória*. Bratislava: Jazykovedný ústav L'udovíta Štúra Slovenskej Akadémie Vied.
SAGEY, ELIZABETH C. 1986. *The Representation of Features and Felations in Non-linear Phonology*. Cambridge, MA: MIT dissertation
SWEET, HENRY. 1879. On Russian pronunciation. *Transactions of the Philological Society* 1877-79. 543-560.
SCHUSTER-ŠEWC, HEINZ. 1996. Grammar of the upper Sorbian language. *Phonology and Morphology.* Translated by Gary H. Toops. München - Newcastle: Lincom Europa.
TRAVNIČEK, FRANTIŠEK. 1948. *Mluvnice spisovné češtiny*. Praha: Melantrich.
TURSKA, HALINA. 1983. Język polski na Wileńszczyźnie. *Studia nad polszczyznąkresową*, ed. Janusz Rieger and Wiaczesław Werenicz, 15-24. Wrocław: Ossolineum.
ZUBRITSKAYA, EKATARINA L. 1995. *The Categorical and Variable Phonology of Russian*. Philadelphia, PA: University of Pennsylvania dissertation.

Jerzy Rubach
Linguistics Department
570 English Philosophy Building
The University of Iowa
Iowa City, IA 52242-1408 USA
e-mail: rubach@mail.uw.edu.

received: Octorber 28, 2003
accepted: January 9, 2004